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required to supply the domestic demand first and to export only quantities over and above such requirements. In the past, large quantities of crude copper have been shipped to the United States for refining, but completion of this plant should seriously reduce or eliminate this movement. In 1937, 14,600 metric tons of unrefined copper were imported into the United States from Yugoslavia compared with 17,300 tons in 1936. According to one report the company plans to produce sulphur as a byproduct of its operations to avoid damage to surrounding agricultural lands.

LEAD [1]

By E. W. Pehrson and H. M.

SUMMARY OUTLIN

During the first 9 months of 1937 the l progress, but much of this gain was wiped industrial activity during the closing quarte less 1937 as a whole represented substantial Production and consumption exceeded 1936 and were the highest since 1930. Stocks sh decline, and the average price of lead was Wages surpassed those paid in 1929, and prod year.

Salient statistics of the lead industry in the United 1933–37, in short tons

	1925-29 (average)	1933	
Production of refined primary lead:			
From domestic ores	660, 525	249, 713	2
From foreign ores and base bullion	123, 104	13, 963	
	783, 629	263, 676	3
Recovery of secondary lead:			
As pig lead	126, 600	131, 800	1
In alloys	153. 400	92, 700	
	280, 000	224, 500	2
Total production of pig lead (primary and secondary)	910, 229	395, 476	4
Imports: [2]			
Lead in base bullion	95, 747	1, 587	
Lead in ore	40, 000	5, 958	
Exports of refined pig lead	98, 048	22, 835	
Refined primary lead available for consumption	690, 916	[3] 240, 950	3
Estimated consumption of primary and secondary lead	900, 250	449, 500	4
Prices:			
New York:			
Average for year cents per pound	7. 47	3. 87	
Quotation at end of year ...do	6. 25	4. 15	
London average ...do	5. 87	2. 21	
Mine production of recoverable lead	664, 230	272, 677	2
World smelter production of lead	1, 850, 000	1, 274, 000	1, 4

[1] Data include lead imported for immediate consumption plus mat
[2] Revised figures.
[3] Subject to revision.

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

Unfortunately, however, toward the end of 1937 it became evident that the peak of another cycle of prosperity had been passed and that the industry was facing another depression of unknown proportions. Other disturbing factors, from the viewpoint of the producer, were the reduction in the Government price for domestic silver and the announcement that the import duties on lead and lead products would be considered in trade-treaty negotiations with the United Kingdom and Canada scheduled for the spring of 1938. The latter opened the way for a possible reduction of 50 percent in the protection now afforded the lead industry by the tariff. Figure 1 shows trends in the lead industry of the United States since 1900.

A feature of the lead industry in 1937 was the violent fluctuation in price. From January 1 to March 10 the New York quotation

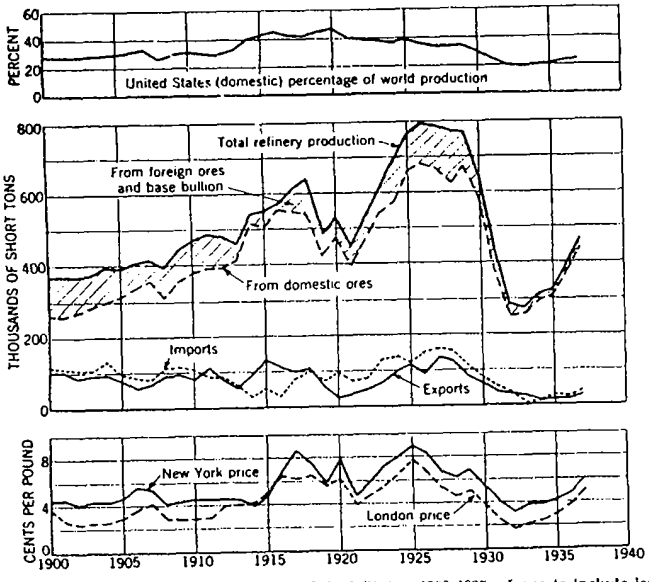

FIGURE 1.—Trends in the lead industry in the United States, 1900-1937. Imports include lead in ore, base bullion, and refined lead; exports include refined lead.

rose from 6.03 to 7.78 cents as a result of the speculative market in London, where at times prices actually exceeded those prevailing on the domestic market. About the middle of March speculative support abroad was withdrawn, and both markets moved downward abruptly. In a single day the New York price dropped 0.90 cent per pound. The domestic market finally was stabilized at 6.00 cents early in April, where it remained until the first part of August. A last flurry upward to 6.50 cents was short-lived, as the recession in the last quarter brought on a decline that carried the quotation down to 4.75 cents on December 31, 1937. London prices experienced an even greater decline—from a high of 7.92 cents in March to 3.45 cents at the close of the year. Normal differentials between New York and London thus were restored the latter part of 1937. Domestic stocks of lead dropped steadily from January to September and then rose

rapidly, as domestic shipments to consumers
the last quarter.

Outside the United States production
exceeded all previous records. Compared
abroad increased 11 percent in 1937 but in th
34 percent. Foreign consumption likewise
20 percent while the United States used a
less. However, increases in production and
were larger in the United States than in th
of the important foreign lead-producing c
outputs except Spain, where civil war has c
Larger production of secondary lead in the Un
by the high prices early in 1937, was an impo
prices on the London Metal Exchange.

Proposed trade agreements with the United
On November 17, 1937, the Secretary of St
announcement of the Government's intenti
agreement with the United Kingdom. A f
January 8, 1938, stated that Newfoundland
Empire also would be included in the negotiat
scheduled for consideration included litharg
lead, and other miscellaneous commoditie
issued January 24, 1938, included lead-bear
mattes of all kinds. The closing date for sub
application for public hearing was Februar
hearings began March 14, 1938.

Similar announcements with respect to Ca
vember 18, 1937, and on January 29, 1938.
be considered in the Canadian negotiations w
as lead bullion or base bullion, lead in pigs
claimed lead, scrap lead, and alloys or co
specially provided for. The closing date for
application for public hearings was March
began April 4, 1938.

Tariff history.—There has been a tariff on
and it has ranged from a low of 15 percent a
cents per pound. The Tariff Act of 1897 e
cents per pound on pig lead and lead in bas
rate was changed to 25 percent ad valorem,
placed at 2½ cents per pound, where it has
duty on lead imported in the form of ore was
1897 to 1913, 0.75 cent from 1914 to 1922, a
1923 to date.

Effectiveness of tariff.—The effectiveness of
from figure 2, which compares the difference
foreign prices for lead with the import duty
except during periods when domestic lead w
the United States, the tariff has been instr
domestic prices considerably above those pr
The sharp reduction in the differential b
indicates an upward trend in London prices r
the New York market. The European rise w
military preparations in anticipation of the W
edly the cut in tariff provided by the act of 1

pated to some extent. By the time the new duty had become effective the disparity between London and New York prices largely had been eliminated.

Owing to disturbed conditions during and immediately after the war, it is difficult to appraise accurately the net effect of the reduction in import duty during this period. Since 1924 the differential between New York and London has resumed pre-war proportions.

Seldom has the domestic price realized the full protection provided by the tariff. From 1900 to 1937 the annual differential between New York and London has averaged 1.25 cents per pound, whereas the tariff on pig lead averaged 1.89 cents. This may be ascribed to three factors:

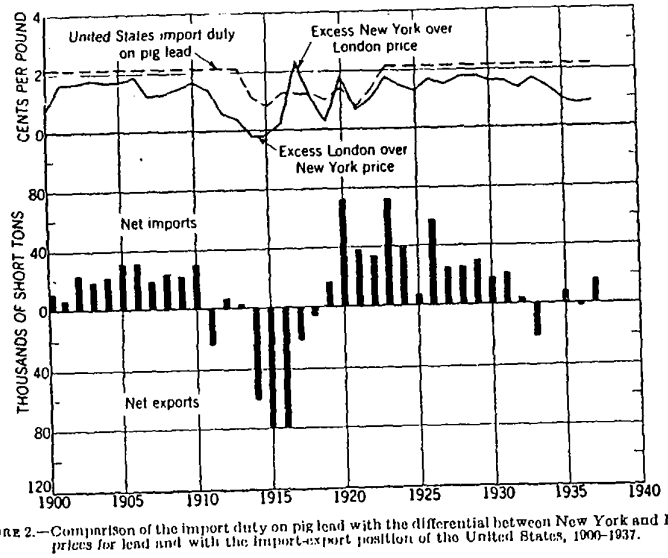

FIGURE 2.—Comparison of the import duty on pig lead with the differential between New York and London prices for lead and with the import-export position of the United States, 1900–1937.

1. The tariff was not effective during periods when the United States was a net exporter of lead, as from 1914 to 1916.
2. Competitive conditions in the domestic industry.
3. Influence of lower duties on lead imported in the form of ore, of which substantial quantities have been smelted in the United States.

From 1900 to 1937 net imports of lead have comprised 2.6 percent of the total consumed in the United States. It is evident, therefore, that despite the higher domestic price, the tariff has not excluded foreign lead from the domestic market.

Grade of ores mined in the principal lead-producing regions of the world.—The accompanying table compares the dollar yield of ores mined in the principal lead-producing regions of the world. The data were compiled on the basis of the metal recovered per ton of ore treated in the latest year for which representative data were available. The metal yield was converted into dollar yield at the following average world prices in 1936: Gold, $35 per ounce; silver, 45 cents per ounce; copper, 9.465 cents per pound; lead, 3.91 cents per pound; and zinc, 3.31 cents per pound. The same prices were applied to the

United States in order that the average values p
parable to those in other regions of the world.

*Average value per short ton of ores mined in the principal le
world, based on 1936 world prices*

Region or mine	Value of	
	Gold and silver	C in
United States:		
Southeastern Missouri	$0.02	
Idaho	1.59	
Utah	5.41	
Tri-State region		
Montana	3.77	
Arizona	5.48	
Nevada	4.30	
New Mexico	1.87	
Average United States	1.92	
Australia, Broken Hill	2.30	
Canada, Sullivan mine	1.04	
India, Bawdwin mine	5.53	
Mexico:		
Chihuahua	3.47	
Durango	0.12	
Coahuila	3.61	
Zacatecas	6.46	
Average Mexico	4.43	
Newfoundland, Buchans mine	1.43	
Yugoslavia, Trepca mines	1.22	

[1] Gold $35 per ounce; silver 45 cents per ounce; copper 9.465 cents per po
and zinc 3.31 cents per pound.

The data show that the grade of ore mined fo
States varies greatly for different regions but th
is much below the ore from other parts of the
Newfoundland, Mexico, and Canada. A signi
extremely low grade ore mined in the Southe
Tri-State regions. These two districts contribut
total United States output in 1937. The weigh
ores mined in districts that contributed about 95 p
States lead output was $8.23 per ton compared wi
$19.10 in Newfoundland, and $13.38 at the Su
the principal source of Canadian lead). The tabl
percent of the United States output was derived
little or no precious metals, whereas in neighborin
silver yield ranges from $1.43 to $6.46 per ton.

Variations in grade of ore do not necessarily
variations in costs of production. Thus in the So
district, where the extensive deposits permit
mechanized operations, production costs comp
those in smaller mines where the ore may be
valuable per ton. Nevertheless it may be assume
in a world market with foreign producers of high
those in Canada, Newfoundland, and Mexico, ma
tors would be handicapped severely because of
grade of ore.

DOMESTIC PRODUCTION

Refined pig lead produced in the United States is derived from three main sources—domestic ore, foreign ore and base bullion, and secondary materials. The following table lists the production from each of these sources from 1933 to 1937.

Total pig lead produced in the United States, 1933–37, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1933	240,713	13,963	131,800	395,476
1934	299,841	11,395	121,500	435,736
1935	310,505	14,055	156,800	481,360
1936	387,698	11,458	137,500	536,656
1937	443,142	24,175	154,500	621,817

PRIMARY LEAD

Refinery production.—Production of refined primary lead in 1937 increased 17 percent but was 40 percent below the 1925–29 average. The production of lead derived from domestic ores increased about 14 percent in 1937. Production from foreign ores and base bullion increased 111 percent but was equivalent to only 24 percent of the 1929 output; it represented only 5 percent of the total output of refined primary lead.

Refined primary lead produced in the United States, 1933–37

Year	Production (short tons)				Sources (short tons)			Value	
	Desilverized lead [1] [2]	Soft lead [3]		Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
		Desilverized	Undesilverized						
1933	165,791	12,307	85,578	263,676	249,713	7,677	6,286	$0.037	$19,512,000
1934	186,468	22,744	102,024	311,236	299,841	10,241	1,154	.037	23,031,000
1935	192,544	35,233	96,783	324,560	310,505	13,659	396	.040	25,965,000
1936	239,944	47,462	111,750	399,156	387,698	11,401	57	.040	36,722,000
1937	272,051	55,317	139,949	467,317	443,142	23,393	782	.059	55,143,000

[1] The lead content of antimonial lead is excluded.
[2] Desilverized soft lead is excluded.
[3] Includes lead derived from Missouri ores and other nonargentiferous ores.

Source of primary lead.—Of the total refined lead produced in 1937, 95 percent was derived from domestic ores and 5 percent from foreign ores and base bullion. Production from foreign ores increased 105 percent in 1937. In 1928 more than 128,000 tons of foreign bullion were refined in the United States, but in recent years this trade has been reduced to very small proportions, although there was a small increase in 1937. Details of the sources of lead derived from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1933–37,

Source	1933	1934	
Domestic ore	249,713	299,841	
Foreign ore:			
Australia		115	
Canada	3,472	2,514	
Europe	2,000	45	
Mexico	257	1,011	
South America	1,348	4,028	
Other foreign		2,528	
	7,077	10,241	
Foreign base bullion:			
Mexico	6,021	703	
South America	265	451	
	6,286	1,154	
Total foreign	13,903	11,395	
Grand total	263,676	311,236	3

Antimonial lead.—Antimonial lead or hard lea
byproduct of the refining of base bullion, but the an
this source is only a small part of the country's
The major part is derived from the smelting of anti
and some is produced by mixing metallic antim
soft lead.

Several lead-smelting plants operate on scrap ma
Production data from such plants are summarized
Secondary Metals in this volume. A large quan
scrap also is treated at primary smelters and refin
duction of antimonial lead at those plants is showr
follows.

Antimonial lead produced at primary lead refinerie

Year	Production (short tons)				Antimony content		Lead co
	From domestic ore	From foreign ore	From scrap	Total	Short tons	Percent	From domestic ore
1933	(1)	(1)	(1)	17,805	1,720	9.7	4,158
1934	(1)	(1)	(1)	16,607	2,263	13.6	5,901
1935	(1)	(1)	(1)	16,384	1,729	10.6	4,685
1936	(1)	(1)	(1)	23,230	2,162	9.3	7,442
1937	(1)	(1)	(1)	27,624	2,579	9.4	7,833

[1] Segregation discontinued.

SECONDARY LEAD

Recovery of secondary lead increased 5 percent
of battery scrap for smelting and refining increased
and stocks of scrap were considerably lower at the
As the output of domestic refined primary lead was
the ratio of secondary to primary lead production
1937. If lead consumption continues to increase, f
this ratio may be expected, as additional supplies

have to come largely from the mines. Additional details on secondary lead production in 1937 are given in the chapter on Secondary Metals in this volume.

Secondary lead recovered in the United States, 1933–37

[Compiled by J. P. Dunlop]

Year	Pig lead (short tons)			Lead in alloys (short tons)	Total recovered lead		
	At primary plants	At secondary plants	Total		Short tons	Value	Ratio to domestic refined primary lead (percent)
1933	41,632	90,168	131,800	92,700	224,500	$16,613,000	86
1934	33,557	90,943	124,500	83,900	208,400	15,421,600	70
1935	44,748	112,052	156,800	113,600	270,400	21,632,000	87
1936	34,556	102,944	137,500	125,400	262,900	24,186,800	68
1937	20,980	124,514	154,500	120,600	275,100	32,461,800	62

LEAD PIGMENTS

Lead pigments manufactured in 1937 contained 222,451 tons of lead, an increase of 1 percent over 1936. Of the 1937 total, 204,961 tons were derived from refined pig lead; white lead comprising 44 percent, litharge 39 percent, red lead 16 percent, and sublimed lead and orange mineral 1 percent. Sublimed lead and leaded zinc oxide are the principal pigments in which the lead content is derived from ores.

Lead in pigments,[1] 1933–37, by sources, in short tons

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Domestic ore[2]	Metal	Scrap	Total		Domestic ore[2]	Metal	Scrap	Total
1933	6,875	143,027	56	149,958	1936	15,062	204,997	37	220,096
1934	7,538	157,294	379	165,211	1937	17,363	204,961	127	222,451
1935	12,109	185,151	144	197,404					

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

MINE PRODUCTION

Production of lead from domestic mines increased 25 percent in 1937 and was the largest recorded since 1930. All three of the major producing regions shared in the larger volume of output, with percentage increases as follows: Southeastern Missouri 41 percent, Coeur d'Alene 11, and Utah 28. Production in the Joplin region increased 29 percent. Southeastern Missouri contributed 33 percent of the 1937 total, Coeur d'Alene 21 percent, Utah 19 percent, and Joplin 11 percent. Most of the more important minor producing States made increases in 1937. Nevada's output was affected adversely by approaching exhaustion of the Tybo mine, and the power shortage in Montana caused a slight decline in production in that State. Further details of production by mines, districts, and States can be found in the various State reports.

Mine production of recoverable lead in the United Stat 1933–37, in short tons

State	1925–29 average	1933	1934
Western States and Alaska:			
Alaska	982	1,157	747
Arizona	9,743	1,721	3,430
California	2,070	381	412
Colorado	30,112	2,402	4,218
Idaho	141,610	74,303	71,324
Montana	18,871	6,582	10,005
Nevada	9,807	2,303	10,991
New Mexico	6,730	11,043	9,365
Oregon	6	5	21
South Dakota	21		
Texas	213	3	360
Utah	149,509	58,688	58,077
Washington	1,323	840	291
Wyoming			1
	370,997	159,488	169,251
Central States:			
Arkansas	38	10	40
Illinois	552	240	40
Kansas	26,121	6,089	6,805
Kentucky	135	176	104
Missouri	202,240	84,080	90,493
Oklahoma	58,300	18,038	16,747
Wisconsin	1,745	540	234
	289,137	110,073	114,463
Eastern States:			
New York	4,000	3,116	3,625
Tennessee			
Virginia			
North Carolina			
	4,000	3,116	3,625
	664,230	272,677	287,339

[1] Subject to revision.

Mine production of recoverable lead in the principal lead-pr United States, 1933–37, in short tons

District	State	1933	193
Southeastern Missouri region	Missouri	83,970	89,5
Coeur d'Alene region	Idaho	73,920	70,3
Joplin region	Kansas, Missouri, Oklahoma.	25,137	24,4
Bingham	Utah	33,030	32,42
Park City region	do	11,557	12,36
Tintic	do	6,433	5,71
Rush Valley	do	5,916	5,59
Butte	Montana	4,155	5,39
Eagle	Colorado	996	1,65
Ploche	Montana	1,521	2,50
Oro Blanco	Nevada	1,026	4,64
Warm Springs	Arizona		1,67
Willow Creek	Idaho	21	
Ophir	New Mexico	7,075	6,143
Metalino	Utah	87	1,340
Tybo	Washington	722	237
Central	Nevada	107	4,285
Leadville	New Mexico	3,408	2,846
Cataract	Colorado	505	524
Banner	Montana	46	259
Flint Creek	Arizona	385	77
Bisbee (Warren)	Montana	59	400
Smelter	Arizona	(3)	64
Upper Mississippi Valley	Montana	424	676
	Iowa, northern Illinois, Wisconsin.	540	234
Tombstone	Arizona	872	1,200
Austinville[2]	Virginia	(3)	(3)
St. Lawrence County[2]	New York	(3)	(3)

[1] Data not yet available.
[2] Bureau of Mines not at liberty to publish figures.
[3] Not listed according to rank.

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 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, 1933–37, in short tons

	1933	1934	1935	1936	1937
Refined pig lead	191,624	223,593	215,595	165,159	119,837
Antimonial lead	11,437	10,437	6,711	6,697	9,294
	203,061	234,030	222,306	171,856	129,131
Lead in base bullion:					
At smelters and refineries	12,780	6,045	15,072	9,187	10,959
In transit to refineries	2,191	1,528	1,800	1,070	2,219
In process at refineries	10,403	11,567	16,233	14,100	14,413
	25,380	19,140	33,165	24,357	27,591
Lead in ore and matte and in process at smelters	67,263	60,699	58,562	50,098	52,081
	295,704	313,869	314,033	246,311	208,803

Considerable further progress was made during the first 9 months of 1937 in liquidating the large stocks of refined lead accumulated from 1929 to 1934, but in the last 3 months of the year the downward trend was reversed as shipments to consumers fell off abruptly. Inventories of refined metal reached a low of 90,742 tons at the end of September. Although the quantity of metal on hand at the end of 1937 was excessive, it includes metal sold and awaiting delivery. Early in 1937 the speculative demand for metal was exceptionally high, and the large stocks on hand at the beginning of the year aided in preventing a run-away price situation. Unfilled orders apparently declined during 1937, because at the close of the year consumers were reported to be "underbought to an unusual extent." [2]

Virtually no published data are available on stocks held outside of the United States. The British Metal Corporation, in its annual review of the lead industry issued in January 1938, states that "the very tight lead position which existed in the first quarter of 1937 was alleviated as output overtook consumption in the second half of the year. Stocks have grown a little but they are not large."

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1933 to 1937. The computation does not take into account variations in producers' stocks, and as these have changed considerably during the past 5 years the quantities given do not indicate the true trend in the actual consumption of new lead. The supply available for consumption in 1937 was 18 percent greater than in 1936 but was equivalent to only 65 percent of the

[2] Cornell, Irvin H., Lead in 1937: Metals, Vol. 8, No. 7, January 1938, p. 13.

1925–29 average. As total consump
in 1937, it is evident that more of the
by primary than by secondary metal.

Refined primary pig lead available for consu
in short t

Supply:	
Imports	
Production	26
	26
Withdrawn:	
Exports [1]	2
Supply available for consumption	[2] 24

[1] Includes small quantities of foreign lead reexported.
[2] Revised figures.

Consumption by uses.—Owing to th
secondary lead from lead-consuming in
of pig lead greatly exceeds the supply
lowing table gives the American Bure
of the total consumption of lead by in

Lead consumed in the United State

Purpose	19
White lead	59,
Red lead and litharge	38,
Storage batteries	147,
Cable covering	31,
Building	26,
Automobiles	5,
Railway equipment	
Shipbuilding	
Ammunition	
Terneplate	32,
Foil	2,
Bearing metal	22,
Solder	11,
Type metal	16,
Calking	11,
Castings	12,
Other uses	5,
	30,
	449,

[1] Source: American Bureau of Metal Statistics. These es
irrespective of whether its origin be primary or secondary.

The total industrial use of lead increa
still 30 percent below the 1929 reco
chapter of this series, recovery of lead
lows has lagged behind general industri
the low rate of consumption in the util
51-percent increase in the use of lead in
cent rise in building indicate substanti
these outlets for lead were still 58 and 5
1929 levels. All other major uses in

metal, were either increased or maintained at 1936 levels. The use of foil was affected adversely by the high prices early in the year, which prompted the use of substitutes, particularly aluminum.

Recent developments in the uses of lead include a new process for making white lead. According to United States Patent 2106555, the addition of small quantities of alkali metals to pig lead greatly accelerates the reaction between lead and the corroding reagent. The sodium compounds formed are removed from the basic lead carbonate by washing. Lead titanate appears to be making progress as a paint pigment, although there still appears to be some uncertainty as to its ultimate field of use. Oil- and gas-filled cables are supplanting overhead high-tension lines in England. Higher first costs are offset by lower maintenance costs and removal of hazards to aviation. In the oil-filled cables each wire is lead-sheathed, and the entire cable is encased in lead. The use of tellurium lead in chemical plants is expanding because of its exceptional resistance to corrosion and moderate strength.

To assist the consumer in obtaining lead products of standard quality, the Lead Industries Association on January 1, 1937, adopted a seal of approval. The seal is available to manufacturers whose products meet the standards set up by the association for lead pipe, lead traps, and bends.

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 on 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, normally 0.35 cent a pound.

The New York quotation for lead in 1937 averaged 6.01 cents per pound, an increase of 28 percent over the 1936 average of 4.71 cents and 12 percent below the 1929 average of 6.83 cents. At the beginning of the year the price stood at 6.03 cents, and the market was in the midst of a speculative boom, which began in the fall of 1936 following the announcement of the British rearmament program. Domestic demand for metal was exceptionally good, and shipments to consumers increased from 46,000 tons in January to 63,000 in March. Prices reached a peak of 7.78 cents on March 10. Up to this time advances in the domestic quotation were dictated by the London market. Quotations on the London Metal Exchange at times exceeded New York prices, and large exports of domestic metal were averted only by successive increases in domestic prices. On March 12 the London market broke sharply. Domestic quotations likewise moved to lower levels at an exceedingly rapid rate, the quotation reaching 6.00 cents on April 7—a level maintained until August 4. Meanwhile domestic shipments had dropped to 43,000 tons in June, but as production had failed to show much improvement, stocks declined steadily. Following a pick-up in sales during July, the quotation advanced to 6.50 cents on August 11, where it held until September 15. Thereafter it fell steadily to 4.75 cents at the end of the year, as the recession in industrial activity gained momentum in the closing quarter.

Average monthly and yearly quoted prices of lead at St. L 1935–37, in cents per pound

Month	1935			1936	
	St. Louis	New York	London	St. Louis	New York
January	3.54	3.69	2.25	4.35	4.5
February	3.38	3.53	2.22	4.37	4.5
March	3.43	3.58	2.35	4.45	4.6
April	3.54	3.69	2.64	4.45	4.6
May	3.81	3.96	3.02	4.45	4.6
June	3.87	4.02	3.03	4.45	4.6
July	3.97	4.12	3.20	4.45	4.6
August	4.10	4.25	3.50	4.45	4.6
September	4.26	4.41	3.58	4.45	4.6
October	4.36	4.51	3.99	4.49	4.6
November	4.35	4.50	3.94	4.96	5.1
December	4.35	4.50	3.70	5.40	5.5
Average	3.91	4.06	[2] 3.12	4.56	4.7

[1] St. Louis: Metal Statistics, 1938, p. 411. Average daily quotatio Louis (open market), as reported daily in the American Metal Mark New York: American Metal Market, daily issues. Pig lead, New ment from West.
London: Metal Statistics, 1938, p. 415. Average price of foreign lea in Metal Statistics, converted to cents per pound at average exchange Board.
[2] London quotations in pounds sterling per long ton, as follows: £23.3250.

The London quotation ranged from a high (U. S. exchange basis) on March 11 to a low of 31, 1937. On December 31, 1936, the price v ing the collapse on the London market in Marc prices was more severe than in the United Sta March 1937 were the same in London as in Ne ber New York exceeded London by 1.32 cents age differential for the year was 0.86 cent con 1936, and 1.79 cents in 1929. The 1937 aver the highest since 1926 in London and 1929 i

FOREIGN TRADE[3]

The foreign trade of the United States in imports of ore and base bullion, which are sme and the export of this lead either as refined l products. Since 1927, however, this trade only 40,806 short tons of lead in ore, base b scrap lead were imported compared with 161,3 of refined lead decreased from 125,267 to 20 same period lead exported in manufactures wi declined from 12,004 to 8,679 tons.

Imports.—Total imports of lead in ore and r for immediate consumption and entries for w percent in 1937 owning to larger shipments fro Peru. No ore was received from Newfound of base bullion, which had virtually ceased percent, and imports of refined lead, which for

[3] Figures on imports and exports compiled by M. B. Price, of the I Bureau of Foreign and Domestic Commerce.

a few hundred tons, increased to 4,903 tons in 1937, including 2,345 tons from Peru and 1,769 from Australia. Total imports of lead increased 73 percent but were only 35 percent of the 1929 total.

Total lead imported into the United States, 1933–37, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1933	5,958	1,587	109	7,654
1934	10,611	2,450	283	13,344
1935	20,025	2,602	1,322	24,039
1936	20,713	312	2,590	23,615
1937	34,103	1,800	4,903	40,806

[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, 1933–37, by countries, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1933	1,629	2,154		1,485	2,368	18	7,654
1934	1,160	3,270	3,357	5,455	67	35	13,344
1935	236	9,786	6,837	6,643	512	25	24,039
1936	1,692	10,501	3,955	6,861	341	265	23,615
1937	5,749	17,068		13,220	535	4,225	40,806

[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, 1933–37, by countries, in short tons [1]

Country	1933	1934	1935	1936	1937
In ore and matte:					
Canada	1,629	902	58	1,419	5,211
Chile	651	1,443	1,102	574	474
Mexico	862	1,283	7,986	10,462	15,970
Newfoundland		3,357	6,818	3,955	
Peru	522	3,645	3,716	4,007	10,132
Sweden	2,292				
Other countries	2	81	345	206	2,316
	5,958	10,611	20,025	20,713	34,103
In base bullion:					
Mexico	1,281	1,987	1,746	30	1,067
Peru	306	463	784	52	239
Other countries			162	221	494
	1,587	2,450	2,692	312	1,800

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

Lead remaining in warehouses in the United States, Dec. 31, 1933–37, in short tons

[Stated in the form in which the material was entered for warehouse]

Year	Lead in ore and matte	Lead in base bullion [1]	Year	Lead in ore and matte	Lead in base bullion [1]
1933	21,540	1,058	1936	33,401	1,930
1934	15,709	606	1937	57,509	2,022
1935	22,598	2,173			

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

Lead imported for consumption in the Unite

Yea	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs, ba ol	
	Short tons	Value	Short tons	Value	Short tons	
1933	19,239	$1,154,093	300	$31,700	45	
1934	10,760	558,568	2,220	117,720	1 285	
1935	8,273	258,954	1,164	66,559	1,590	
1936	5,836	225,548	763	45,340	2,321	
1937	9,903	760,323	1,828	189,408	4,183	

[1] Reclaimed scrap, etc. No imports of pigs, bars, etc., record

Miscellaneous products containing lead importe States, 1933–37

Year	Babbitt metal, solder, white m and other combinations con ing lead		
	Gross weight (short tons)	Lead content (short tons)	Val
1933	349	51	$30
1934	700	102	71
1935	128	24	44
1936	331	67	112
1937	618	178	213

Exports.—Exports of refined lead rose Germany and the United Kingdom showi a decrease. Data are not available indica lead exported in 1937 was of domestic bonded warehouse inventories with imp that several thousand tons of domestic m abroad.

Refined lead exported from the Unite

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year
	Short tons	Value		
1933	22,835	$834,589	6,508	1936
1934	5,909	305,994	7,472	1937
1935	6,982	472,017	8,995	

[1] Includes small quantities of foreign lead reexported.

Refined pig lead[1] *exported from the United States, 1933–37, by destinations, in short tons*

Destination	1933	1934	1935	1936	1937
COUNTRY					
Argentina	113	(2)		3	8
Brazil	320	475	338	795	652
Canada	6	21	45	45	7
Germany	5		11	2	568
Japan	21,230	4,454	5,324	8,629	7,330
Mexico	5	21	33	8,049	8,122
Netherlands		4	188		
Philippine Islands	360	169	217	223	569
United Kingdom		30	8	123	2,220
Uruguay	140	221	112		
Other countries	641	508	701	444	619
	22,835	5,909	6,982	18,313	20,091
CONTINENT					
North America	41	107	157	8,282	8,337
South America	730	1,070	668	1,021	784
Europe	5	40	212	133	2,919
Asia	22,053	4,684	5,945	8,865	7,989
Africa and Oceania		2	(2)	12	32
	22,835	5,909	6,982	18,313	20,091

[1] Includes small quantities of foreign lead reexported.
[2] Less than 1 ton.

TECHNOLOGY

Mining.—The use of mechanical loading in the southeastern Missouri lead district is probably more highly developed than in any other area where underground mining is practiced. Heretofore power shovels have been used exclusively, but since November 1936 scrapers have been adopted for certain types of work, such as loading ore shot down in pillar-robbing operations. In some instances a floor of commercial ore 6 to 12 feet thick has been left between the pillars. This ore is removed by benching and loaded into cars by scrapers. Apparently the use of scrapers was dictated primarily by the lower first cost of scraper equipment compared with that of power shovels. Many rich pillars are removed entirely, and roof support is provided by large concrete towers.[4] In the Tri-State region mechanical loading made little progress until recently. Scraper loaders are now being used in some mines in conjunction with belt conveyors. According to Clarke,[5] multiple rope haulage has been used advantageously in the Tri-State district where physical conditions precluded the use of animals or locomotives.

Approximately 5,000 feet of the 22,000-foot tunnel being driven to provide drainage and haulage for several mines in the Bingham district, Utah, was completed at the end of 1937, when the tunnel was progressing approximately 20 feet per day. Lambly[6] has described mining and milling methods at the Pend Oreille mine in Washington. Rock-drill practice and comparative costs of conventional and detachable bits at several mines have been presented in Bureau of Mines Information Circulars 6936 and 6951. The Bureau's Information Circular 6978, by J. Kruttschmitt and V. I. Mann, describes mining methods and costs at Mount Isa, Australia.

[4] Chellson, H. C., More Lead from Southeast Missouri: Eng. and Min. Jour., Vol. 138, No. 6, June 1937, p. 283.
[5] Clarke, S. S., Multiple Rope Haulage in the Tri-State District: Min. Cong. Jour., Vol. 24, No. 2, February 1938, p. 18.
[6] Lambly, C. A. R., Mining and Milling at Pend Oreille: Min. Cong. Jour., Vol. 24, No. 3, March 1938, p. 12.

Milling.—The increased demand for lead in
primarily on production schedules. Althou
ments were reported in mechanical equipment
apparently no important advance was made in
nology during the year. The new 750-ton flo
van Mining Co. was put into operation in A
treats ore from the company Star mine in th
The old Hercules mill, which was used former
returned to the owners.

Smelting.—Oldright[7] records several mino
smelting in 1937. The capacity of sintering
creased, costs have been reduced, and operati
by increasing the width of the pallets from 42 t
Pallets 10 feet wide are under consideration
Blast-furnace capacity has been increased gre
the trend continued in 1937. Enriched ore, c
terials, better sintering, and speedier smelti
higher temperatures have been the principal
the increase in capacity. The recovery of by
lines practiced at Trail, B. C., and East Hele
sidered at Port Pirie. The continuous process
to be highly successful at Port Pirie but as yet
elsewhere. The new plant at Northfleet,
Mount Isa bullion by the Parkes process as
was described in the April 1937 Bulletin of th
and Metallurgy. The Bureau of Mines is in
of removing bismuth from lead products.

WORLD ASPECTS OF LEAD IN

International cooperation.—No new develo
along this line during 1937.

World production.—World smelter producti
percent in 1937 and was equivalent to 96 perce
of 1929. Production increased 17 percent ov
States and 15 percent elsewhere. Compared
States output declined 34 percent and that of
creased 12 percent in 1937. The 10 principal
centage of the total output each contributed
States 25, Australia 14, Mexico 13, Canada 11
6, India 5, U. S. S. R. 3, Italy 2, and France 2.
made substantial increases in output in 1937 o
the United States, Mexico, and India produced
in 1929. Among the minor producers there
Peru and Tunisia, but there were exceptional d
United Kingdom. The British Empire pr
metric tons of smelted lead in 1937, an increase
Since the 5-year period 1925–29, the Empire
has advanced from 22 to 30 percent, although th
declined from 42 to 25 percent.

[7] Oldright, G. L., Some Advance at the Lead Smelters: Eng. and M
1938, p. 71.

LEAD AND ZINC PIGMENTS A

By H. M. MEYER and A. V

SUMMARY OUTLI

The lead and zinc pigments industry du
provement of industry in general over its
greater total values of sales for both classes
however, the total quantity of neither cl
tion in the principal uses for pigments—
matic tires, and storage batteries—held
early months of the year; some of them
through the third quarter, but all declined
low rate of consumption in the final qua
into the early months of 1938.

Salient statistics of the lead and zinc pigments indus
(average) and 1933–3

	1926–29 (average)	1933	1
Production (sales) of principal pigments:			
White lead (dry and in oil) short tons	154,483	72,082	7
Litharge do	84,845	61,193	6
Red lead do	41,362	21,988	2
Zinc oxide do	154,208	98,542	8
Leaded zinc oxide do	26,609	22,868	2
Lithopone do	177,745	140,831	14
Value of products:			
All lead pigments	$60,092,000	$20,819,000	$24,0
All zinc pigments	41,314,000	24,143,000	24,1
Total	101,406,000	44,962,000	48,1
Value per ton received by producers:			
White lead (dry)	178	112	
Litharge	176	101	
Red lead	193	120	
Zinc oxide	133	105	
Leaded zinc oxide	124	88	
Lithopone	98	83	
Foreign trade:			
Lead pigments:			
Value of exports	1,346,000	327,000	4
Value of imports	30,000	2,000	
Zinc pigments:			
Value of exports	2,150,000	230,000	3
Value of imports	931,000	567,000	3
Export balance	2,535,000	[1] 12,000	4

[1] Import balance.

Lead pigments again made a better showing than zinc pigments for, whereas they fell 9 percent in quantity compared with only 5 percent for zinc pigments, their total value gained 4 percent compared with 1 percent. The total value of lead pigments, however, has declined more sharply in relation to the 1925–29 average, lead having dropped 41 percent and zinc 32 percent. Prices for lead pigments generally followed the average price for pig lead, rising early in the year and declining as the year progressed to close the year at their lowest levels. Price increases in the various grades of lead-free zinc oxide, anticipating a higher slab zinc price, rose in June ahead of the price for metal and held at the higher level throughout the rest of the year. The increased popularity of leaded zinc oxide containing a higher lead content continued in 1937 with sales only slightly below the record level attained in 1936. Lithopone was the only pigment covered by this report that failed to increase in price in 1937, probably due to its continued competitive position in regard to titanium pigments.

PRODUCTION

In this report, 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 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 lead and zinc pigments sold by domestic producers in 1937 was approximately $63,714,000 compared with $62,068,000 in 1936. Thus it was 3 percent more than in 1936, despite declines of 9 percent in the total quantity of lead pigments and of 5 percent in zinc pigments, combined with a drop in the average value of lithopone sold. The higher total values are obviously explained by higher average values for other lead and zinc pigments than lithopone, all of which increased in 1937. The increases in average values of the important pigments, as reported by the producers, ranged from 11 to 23 percent, lagging behind the gains of 28 percent in the average quoted price of pig lead at New York and of 33 percent in zinc at St. Louis.

Lead pigments.—Sales of all lead pigments except basic lead sulphate were lower in 1937 than in 1936, the declines ranging from 3 percent each for litharge and red lead to 17 percent for white lead (dry and in oil). The increase in sales of basic lead sulphate totaled only 2 percent, but it would have been considerably larger if the quantity of this pigment used in the manufacture of leaded zinc oxide were not excluded to avoid duplication in reporting lead tonnages. The use of basic lead sulphate in the manufacture of leaded zinc oxide has expanded sharply in recent years. Litharge sales were only 1 percent below the average for 1925–29, red lead was 18 percent less, and white lead (dry and in oil) 36 percent less.

Lead pigments sold by domestic manufacturers in

Pigment	1936		
	Short tons	Value (at plant clusive of conta	
		Total	Av
Basic lead sulphate or sublimed lead:			
White	7,531	$863,268	
Blue	891	102,565	
Red lead	34,800	4,057,322	
Orange mineral	248	48,196	
Litharge	86,246	9,966,563	
White lead:			
Dry	34,775	4,307,337	
In oil [1]	83,632	14,200,617	

[1] Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturers in
short tons

Year	White lead		Basic lead su or sublime
	Dry	In oil	White
1933	24,628	48,354	7,320
1934	22,569	50,105	6,399
1935	27,972	68,859	7,572
1936	34,775	83,632	7,531
1937	32,061	65,552	7,514

Zinc pigments and salts.—Sales of all zinc
the drop in leaded zinc oxide being so small
pigment at relatively the peak rate of 193
the total value of zinc pigments made a mo
increased average values for zinc oxide and
of zinc oxide were 10 percent below the tot
below the average for 1925–29, whereas s
were relatively the same as in 1936 but 52
average for 1925–29. Sales of lithopone f
were 13 percent below the average for 1925
reported by producers were 14 percent hig
percent higher for leaded zinc oxide.

Large amounts of basic lead sulphate
leaded zinc oxide. Such quantities are incl
zinc oxide total and, to avoid duplication, a
sulphate.

Complete data covering zinc chloride pro
not available owing to the refusal of one la
accurate report.

Both quantity and value of zinc sulphate
than in 1936.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1936–37

Pigment or salt	1936			1937		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	126,800	$11,370,323	$90	114,652	$11,777,131	$103
Leaded zinc oxide [1]	40,512	3,508,073	87	40,343	4,190,952	104
Lithopone	158,319	12,976,754	82	154,771	12,069,790	78
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulphate	8,687	388,081	45	10,521	589,017	56

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.
[2] Figures not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1933–37, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulphate
1933	98,542	22,868	140,831	32,187	5,698
1934	87,088	20,506	145,565	10,614	6,783
1935	99,607	29,970	150,488	(1)	7,108
1936	126,800	40,512	158,319	(1)	8,687
1937	114,652	40,343	154,771	(1)	10,521

[1] Figures not available.

CONSUMPTION BY INDUSTRIES

White lead.—About 95 percent of the white lead made is used in the manufacture of paint. The quantity consumed for this purpose was 17 percent below that so used in 1936 and 31 percent below that in 1929.

Distribution of white lead (dry and in oil) sales, 1933–37, by industries, in short tons

Industry	1933	1934	1935	1936	1937
Paint	68,368	75,008	91,297	113,363	93,580
Ceramics	1,617	1,434	1,834	2,053	2,506
Other	2,997	2,292	3,700	2,301	2,127
	72,982	78,734	96,831	118,407	98,213

Basic lead sulphate.—The outstanding use of basic lead sulphate is in the manufacture of paint, and 96 percent of the quantity reported for 1937 was used for that purpose. This product was the only lead pigment that increased in total quantity in 1937. The increase was larger than is apparent from the statistics in the following table because basic lead sulphate used in the manufacture of leaded zinc oxide is excluded therefrom. The use of this pigment in making leaded zinc oxide has advanced rapidly in the past few years, and nearly 5,000 tons were reported to have been so used in 1937. To avoid duplication in reporting pigments production, the Bureau of Mines attempts to measure the output of final products only, and for statistical purposes basic lead sulphate is considered in this instance as an intermediate product.

Distribution of basic lead sulphate sales, 1933–37,

Industry	1933
Paints	7,072
Rubber	161
Storage batteries	99
Other	613
	7,945

Litharge.—Litharge is used principally in batteries, but consumption for this purpose portion to the output of batteries, owing to battery makers to substitute a black oxide they manufacture themselves. This substi made in 1923, and by 1929 a total of 33,0 tonnage declined after 1929, but reached when 42,000 tons were made. The black ox in Bureau of Mines totals for litharge. Us facture of insecticides has made rapid stric 1937 established a new high record. Its use 8 percent of the total in 1930 to 18 percent 1937. Chrome pigments was the only oth quired a larger tonnage in 1937 than in 1 totals the decline in the use of litharge for was the most drastic.

Distribution of litharge sales, 1933–37, by i

Industry	1933
Storage batteries	27,327
Insecticides	11,126
Chrome pigments	3,973
Oil refining	6,070
Ceramics	5,438
Varnish	610
Rubber	2,875
Linoleum	106
Other	3,668
	61,193

Red lead.—The principal uses of red lead storage batteries and paints. The amount teries was relatively the same in 1937 as in declined 11 percent. Paints made a bett 1929, however, having dropped 12 percent 21 percent.

Distribution of red lead sales, 1933–37, by i

Industry	1933
Storage batteries	12,949
Paints	7,182
Ceramics	715
Other	1,142
	21,988

Orange mineral.—Sales of orange mineral in 1937 were 17 percent less than in 1936 and 70 percent below their 1929 tonnage. This pigment is used chiefly in making ink and color pigments, and the tonnage involved is quite small.

Distribution of orange mineral sales, 1933–37, by industries, in short tons

Industry	1933	1934	1935	1936	1937
Ink manufacture	18	24	85	71	76
Color pigments	90	68	125	77	61
Other	117	142	42	100	79
	231	234	252	248	200

Zinc oxide.—Sales of zinc oxide in 1937 dropped 10 percent from those in 1936 despite an increase of 26 percent in the quantity consumed in the manufacture of floor coverings and textiles. All other uses declined, rubber dropping only 8 percent compared with larger percentage losses in other applications. Of the production for 1937, 69 percent was made by the American process and 31 percent by the French process compared with 58 and 42 percent, respectively, in 1936. The higher ratio of American- to French-process zinc oxide was caused largely, no doubt, by the tight situation as to supplies of zinc metal during the year. The proportion of French-process oxide made from scrap zinc increased from 22 percent in 1936 to 25 percent in 1937. A fair-sized tonnage of zinc oxide is used in the manufacture of leaded zinc oxide. This tonnage is not included as zinc oxide but is shown in the total for leaded zinc oxide.

Distribution of zinc oxide sales, 1933–37, by industries, in short tons

Industry	1933	1934	1935	1936	1937
Rubber	53,869	50,145	57,734	72,885	67,061
Paints	29,218	23,741	25,289	33,149	27,987
Floor coverings and textiles	4,087	4,781	7,179	7,178	9,019
Ceramics	2,030	2,003	4,028	6,102	5,216
Other	8,729	5,458	5,467	7,486	5,369
	98,542	87,088	99,697	120,800	114,652

Leaded zinc oxide.—The manufacture of paints uses virtually all the leaded zinc oxide made, 98 or more percent being employed regularly for this purpose. Total sales of leaded zinc oxide made a new high record in 1936, and activity in 1937 was at virtually the record level. This record rate of operation reflects the present trend toward higher content of lead in exterior paints. The total for 1937 includes about 5,000 tons of basic lead sulphate used to increase the lead content of this product, which tonnage is excluded from basic lead sulphate totals to avoid duplication in reporting metal tonnages.

Distribution of leaded zinc oxide sales, 1933–37, by industries, in short tons

Industry	1933	1934	1935	1936	1937
Paints	22,488	20,376	29,632	40,156	39,584
Rubber	46	28	36	32	97
Other	334	102	308	324	662
	22,868	20,506	29,976	40,512	40,343

Lithopone.—Sales of lithopone declined 2 percent in 1937 from those in 1936. A 5-percent drop was also shown in the average value

reported by producers, the only decreas
the important pigments. Lithopone st
basis of regular lithopone content of
normal lithopone sold as such. Prior to
basis of standard grade plus high-stren
the increased use of high-strength litho
importance of paint as a consumer of
1929 in relation to floor coverings and t
total sales in 1929 compared with 18 pe
textiles and 79 compared with 13 percen
for floor coverings and textiles in the fol
in linoleum and felt-base floor coverings
and textiles (oilcloth, shade cloth, art
uses" in 1937 included 2,145 tons used
printing ink.

Lithopone is employed extensively i
field is now subject to intense competiti

Distribution of lithopone sales, 1933–37,

Industry	1933
Paints, etc	106,9
Floor coverings and textiles	18,4
Rubber	5,0
Other	10,2
	140,8

The use of ordinary-strength litho
titanated lithopone, which usually contai
increased sharply since the output of th
as much lithopone was used in this w
Bureau of Mines was able to obtain m
titanated lithopone recently and has re
The new figures are considerably highe
already published. The revised totals
table, and the figures given are included
foregoing table.

Lithopone used in the manufacture of titanat
1929–37 [1]

Year	Short tons	
1929	1,900	1934
1930	1,400	1935
1931	4,600	1936
1932	5,100	1937
1933	7,000	

[1] Revised figures, except for 1937.

Zinc sulphide.—Production of this p
plants in 1937; but owing to the fact tha
a large part of the total, the Bureau o
representative statistics. Most of the
regular lithopone to make high-strength

Zinc chloride.—The Bureau of Mines
production because of the refusal of o
supply reliable data.

Complete data on sales of zinc chloride are not available, but returns from producers representing two-thirds or more of the output indicate the following distribution of sales by uses in 1937:

	Percent		Percent
Soldering flux	29	Oil refining	1
Wood preserving	24	Others	14
Dry-cell batteries	21		
Vulcanized fiber	11		100

Zinc sulphate.—Sales of zinc sulphate have been trending upward since 1932, and they established a new all-time high record in 1937. Efforts since 1934 to obtain complete data covering distribution of sales of zinc sulphate have been disappointing owing to large sales to jobbers, the ultimate destinations of which producers are unable to give. Of the total sales in 1937 (10,521 tons), 3,778 tons were reported as sold to the rayon industry, 2,235 for insecticides and fungicide control, 419 to electro-galvanizers, 418 for glue manufacture, 186 to paint and varnish manufacturers, and 130 tons to printers and dyers of textiles; 3,305 tons were undistributed. A break-down of the latter figure would undoubtedly indicate increased tonnages for the various uses indicated.

RAW MATERIALS USED IN THE 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 processes. In 1937, 92 percent of the lead in lead pigments was derived from pig lead and 8 percent from ore. Only a few tons were derived from secondary material. The proportions for zinc pigments in 1937 were 68 percent from ore, 17 percent from slab zinc, and 15 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1936–37, by sources, in short tons

Source	1936		1937	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Domestic ore	15,062	94,013	17,363	100,517
Metal	204,997	32,763	204,061	24,594
Secondary material [2]	37	22,834	127	21,526
	220,096	150,510	222,451	146,637

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

In the following tables the source of the metal used in the manufacture of each pigment and salt is given. Pig lead is used exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulphate. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulphate, and basic lead sulphate. A substantial proportion of the zinc in lithopone and zinc chloride made in the United States is derived from secondary material.

There has been a large increase in the quant
in the manufacture of zinc oxide since 193
placed slab zinc in the manufacture of the

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

Pigment	1936			Total
	Lead in pigments produced from—			Total lead in pigments
	Domestic ore	Pig lead	Secondary material	
White lead		89,779		89,77
Red lead		31,517		31,51
Litharge		81,883		81,88
Orange mineral		249		24
Basic lead sulphate	4,699	1,569		6,26
Leaded zinc oxide	10,363		37	10,40
	15,062	204,997	37	220,09

Zinc content of zinc pigments and salts produced by d
by sources, in short to

Pigment or salt	1936			Total
	Zinc in pigments and salts produced from—			Total zinc in pigments and sal
	Domestic ore	Slab zinc	Secondary material	
Zinc oxide	56,046	32,625	9,201	98,77
Leaded zinc oxide	19,065	138	183	19,38
Lithopone	18,902		13,460	32,36
Zinc sulphide	(1)		(1)	(1)
Zinc chloride	(1)	(1)	(1)	(1)
Zinc sulphate	1,078		1,224	2,30

[1] Figures not available.

PRICES

The total values for lead and zinc pigme
by producers are given in the tables in the
The average values received for importan
from 11 to 23 percent; those for zinc oxide
14 and 20 percent higher while the value o
cent. The value for zinc sulphate gained
range of market quotations, as reported b
Reporter, appears in the following table. T
followed that for pig lead, trending upward
year, then downward until August and S
higher temporarily, and dropping in the fi
at the end of the year were below those at it
tight situation with regard to domestic supp
as a result of which an increase in price w
prices advanced in June, somewhat ahead
did not soften with metal prices as the ye
of domestic and foreign metal became plent
grades showed a smaller increase than tho
and did not close the year at their best leve

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1934–37, in cents per pound

Product	1934	1935	1936	1937
Basic lead sulphate, or sublimed lead, less than carlots, barrels	6.25	6.25	6.25–6.75	6.50–9.25
White lead, or basic lead carbonate, dry, carlots, barrels	6.25–6.50	6.50	6.50–7.25	6.75–9.25
Litharge, commercial, powdered, barrels	6.00–6.75	6.00–7.00	6.00–8.50	6.25–10.75
Red lead, dry, 95 percent or less, less than carlots, barrels	7.00–7.75	7.00–8.00	7.50–9.50	7.75–11.75
Orange mineral, American, small lots, barrels:				
Ex-white lead	10.75–11.50	9.50–11.00	10.50–11.25	10.25–14.25
Ex-red lead	9.50–10.25	9.00–10.50	10.50–11.25	
Zinc oxide:				
American process, lead-free, bags, car lots	5.75–6.50	5.00–6.50	5.00–5.25	5.25–7.50
American process, 5 to 35 percent lead, barrels, carlots	5.75–6.50	5.13–6.50	5.13–5.38	5.38–6.88
French process, red seal, bags, carlots	8.38	5.50–8.38	5.50–5.75	5.75–7.50
French process, green seal, bags, carlots	9.38	6.00–9.38	6.00–6.25	6.25–8.00
French process, white seal, barrels, carlots	10.63	6.50–10.63	6.50–6.75	7.00–8.75
Lithopone, domestic, 5-ton lots, bags	4.50	4.50	4.25–4.50	4.25–4.63
Zinc sulphide, less than carlots, bags, barrels	10.50–13.25	10.50–11.75	9.25–11.75	9.25–9.50
Zinc chloride, works:				
Solution, tanks	2.00	2.00	2.00	2.00–2.25
Fused, drums	4.25–5.75	4.50–5.75	4.25–5.75	4.25–5.75
Zinc sulphate, crystals, barrels	2.65–4.50	2.65–2.80	2.65–3.05	2.80–4.05

FOREIGN TRADE [1]

Imports of lead and zinc pigments and salts increased 17 percent in value in 1937, and exports increased 25 percent. The excess value of exports over imports rose from $579,000 in 1936 to $765,000 in 1937 but was far below the average of $2,535,000 for 1925–29.

The following table shows the values of various pigments and salts imported and exported for 1936–37.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1936–37

	1936		1937	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$5,443	$265,685	$6,077	$207,381
Red lead	201	113,897	285	158,923
Litharge	51	166,093	31	220,134
Orange mineral	911	(1)	928	(1)
Other lead pigments	5,292	(1)	9,406	(1)
	11,898	545,675	17,327	586,438
Zinc pigments:				
Zinc oxide	92,112	190,045	97,686	378,332
Lithopone	273,571	229,942	302,417	231,622
Zinc sulphide	9,190	(1)	13,856	(1)
	374,873	419,987	413,959	609,954
Lead and zinc salts:				
Lead arsenate		64,215	42	91,377
Other lead compounds	25,980	(1)	36,615	(1)
Zinc chloride	33,368	(1)	44,191	(1)
Zinc sulphate	17,252	(1)	29,966	(1)
	76,600	64,215	110,814	91,377
Grand total	463,371	1,029,877	542,100	1,287,769

[1] Figures not available.

Lead pigments and salts.—Imports of these commodities are of negligible proportions. The most important item is the group of lead compounds, which include lead acetate, lead nitrate, and others, but only 213 tons of this class entered the country in 1937.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lead pigments and salts imported for consumptio in short tons

Year	Basic carbonate white lead	Red lead
1933	3	1
1934	15	
1935	6	1
1936	32	2
1937	34	1

[1] Less than 1 ton.

[2] Includes also—1933: Lead pigments n. s. p. f., $665 (11,984 po (200 pounds), sublimed lead (basic sulphate) $39 (210 pounds); pounds); 1936: Lead pigments, n. s. p. f., $19 (33 pounds), subli and suboxide of lead, n. s. p. f., $5,264 (39,010 pounds); 1937: Lead limed lead (basic sulphate), $2 (10 pounds), and suboxide of lead,

The principal exports are white lead, l arsenate. The total amount of these ex cause a drop in exports of white lead was small gains in exports of the other items. caused an increase in total value of lead Exports of white lead, red lead, and lit 2 percent of domestic production of these

Lead pigments and salts exported from the Unit

Year	White lead	Red l
1933	1,048	
1934	1,561	
1935	2,337	
1936	1,862	
1937	1,236	

[1] Includes an unknown quantity of orange mineral.

White lead, red lead, and litharge exported from t 1934–37, in short t

Destination	White lead		
	1934	1935	1936
Countries:			
Argentina	69	98	126
Canada	91	56	74
Netherlands	463	827	387
Netherland West Indies	10	3	3
Panama	201	205	453
Philippine Islands	130	190	170
United Kingdom	47	93	13
Others	550	865	636
	1,561	2,337	1,862
Continents:			
North America	475	441	754
South America	177	202	218
Europe	590	1,242	707
Asia	147	285	174
Africa	167	166	9
Oceania	5	1	(1)

[1] Less than 1 ton.

Zinc pigments and salts.—Imports of all zinc pigments and salts except zinc oxide gained in 1937. The decline in zinc oxide, although small, held imports of this pigment at slightly less than the low rate established in 1936. Imports of lithopone represented less than 4 percent of domestic sales of this product, although they held the highest ratio of imports to sales of the pigment group covered here.

Zinc pigments and salts imported for consumption in the United States, 1933–37, in short tons

Year	Zinc oxide		Lithopone	Zinc sulphide	Zinc chloride	Zinc sulphate	Total value
	Dry	In oil					
1933	2,359	182	5,596	27	431	193	$600,474
1934	1,204	64	3,927	12	382	140	404,256
1935	1,932	59	4,608	16	504	135	508,476
1936	694	96	4,781	30	520	385	425,493
1937	680	95	5,601	113	667	593	488,110

Exports of zinc oxide made a substantial gain in 1937—from 1,330 tons in 1936 to 2,953 tons—while exports of lithopone remained at substantially the 1936 level. Canada is the principal country of destination of exports of both zinc oxide and lithopone. Increased exports of zinc oxide to Canada and Asia were chiefly responsible for the larger shipments of this product.

Zinc pigments and salts [1] exported from the United States, 1933–37, in short tons

Year	Zinc oxide	Lithopone	Total value	Year	Zinc oxide	Lithopone	Total value
1933	722	1,180	$230,024	1936	1,330	2,538	$419,987
1934	1,155	2,401	305,189	1937	2,953	2,671	609,954
1935	1,140	2,372	302,308				

[1] Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, by destinations, 1934–37, in short tons

Destination	Zinc oxide				Lithopone			
	1934	1935	1936	1937	1934	1935	1936	1937
Countries:								
Argentina	36	35	55	48	33	74	35	63
Canada	439	453	704	1,583	1,803	1,652	1,812	1,740
Cuba	87	115	80	207	185	198	186	258
France	12	15	13	111	1	2	3	1
United Kingdom	68	56	80	29	104	138	199	199
Others	513	466	398	976	275	308	303	410
	1,155	1,140	1,330	2,953	2,401	2,372	2,538	2,671
Continents:								
North America	788	724	882	1,972	2,046	1,969	2,104	2,184
South America	65	78	130	149	115	118	57	90
Europe	110	94	99	148	125	140	218	217
Asia	63	132	52	467	6	16	25	24
Africa	13	5	6	57	------	3	4	1
Oceania	110	107	161	160	109	126	130	165

GOLD, SILVER, COPPER, A

(MINE REPO

By CHAS. W. HE

SUMMARY O

The total gross value of recovered from Alaska ores and gravels in 1937 17 percent over 1936. This advance better milling facilities at lode mines a equipment in the recovery of placer g tion of the Government prices for gol prices for the base metals. During normal and not subject to labor strike

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

The value of metal production herei at the following prices.

Prices of gold, silver, copper, le

Year	Gold [1]	
	Per fine ounce	
1933	$25.56	
1934	34.95	
1935	35.00	
1936	35.00	
1937	35.00	

[1] 1933-34: Yearly average weighted Government price; 19 Act of Jan. 31, 1934. Treasury legal coinage value of gold f ($20.671835) per fine ounce.

[2] 1933: Average New York price for bar silver; 1934: Treasu Yearly average weighted Treasury buying price for newly n

[3] Yearly average weighted price of all grades of primary m

[4] $0.64646464.

The following tables show the mir copper, and lead in Alaska in 1934–193 put of gold and silver in 1937, by type

the tungsten filament of powerful incandescent lamps such as are used in motion picture projection and photography, is claimed to eliminate the sudden surge of current when these high-watt bulbs are snapped off or on, thereby prolonging their life.

SELENIUM

Selenium supplies are scanty only when copper refining is curtailed, and notwithstanding great activity in glassmaking during the last 2 years no shortage has threatened. Probably the chief use of selenium is for decolorizing glass, replacing manganese dioxide first as a wartime substitute and subsequently because it had inherent advantages over manganese, which so long had almost a monopoly of the term "glassmakers' soap." The manufacture of red signal glasses has accounted for a considerable tonnage, and the vogue for multiple tail lights on automobiles boosted demand notably. For this reason experiments with molded plastics for tail-light lenses are watched with some concern by selenium producers. Mixtures of selenium with varying proportions of cadmium sulphide afford a complete series of excellent pigments ranging from yellow to red and are increasingly important in pottery glazes. Alone or mixed with sulphur, selenium is employed in the rubber industry as a secondary vulcanizing agent for tire-carcass stocks, belt frictions, oil-resisting stocks, wire insulation, clothing, electricians' gloves, motor mounts, nontarnishing ("sulphurless") articles, etc. Flameproofing, photovoltaic cells, and sundry other minor applications in the aggregate use a sizable quantity of selenium, but the steel industry may be the most promising outlet for further growth in demand. Already selenium is used in copper alloys and stainless steel to make them more machinable but vastly greater amounts might be used if it were employed generally in ordinary free-cutting steels, replacing bessemer screw stock. In copper alloys, selenium improves machinability without hot-shortness; and in copper, selenium does not cause cold-shortness, has comparatively little effect on tensile strength, and reduces ductility only slightly.[13]

Selenium is marketed chiefly as a black to steel-gray amorphous powder, but cakes and sticks are also obtainable. Ferroselenium, sodium selenite, selenious acid, and selenium dioxide are other market products. Prices throughout 1937 remained nominally unchanged at $1.75 to $2 a pound for the standard 99.5-percent black, powdered variety. The London quotation was 7s.

Domestic sales in 1937 rose to 282,598 pounds from 226,402 pounds in 1936. Production, by four companies (three plants), was 435,821 pounds in 1937 and 352,480 pounds in 1936. Imports in 1937, mainly now from Canada, were 92,523 pounds valued at $161,382 or $1.74 a pound.

TELLURIUM

Fairly large quantities of tellurium could be recovered from residues of lead and copper refineries, but commercial demand, nonexistent until a few years ago, continues to develop slowly. Expansion of

[13] Smith, C. S., Copper Alloys Containing Sulphur, Selenium, and Tellurium: Am. Inst. Min. and Met. Eng. Tech. Pub. 870, December 1937, 10 pp.

consumption probably will depend largely on the
Tellurium, like selenium, imparts free-cutting propert
plain carbon steels. Wider use of tellurium lead is
in the United States and abroad, but the amount
quired to harden, toughen, and increase the corrosi
lead is so small (0.02 to 0.085 percent) that 50 to 75 t
annually would treat all the lead used in the United S
cal plants and suffice for general building constructio
lurium lead now costs only a fraction of a cent a p
ordinary lead and, according to the manufacturer, is
for lining tanks and for pipes and coils in plants ha
and sulphurous acids, hot chromo solutions, copper su
chlorine gas, hydrochloric acid fumes, and hydroflu
potential domestic market could be more than doub
lead comes into general use for lead cable coverings
used in rubber hose and cable coverings and greatl
toughness and abrasion resistance of rubber. It is n
accelerator as selenium and so must be added in s
quantities but is recommended for low-sulphur con
superior to selenium where heat resistance is a facto
of tellurium is used at electrolytic zinc plants to facilit
of cobalt by the Tainton process, but, as crude te
slimes seem to be equally effective, purchases of the
purpose have dropped. Tellurium has some minor u
research may develop others, but, although generally
in electrolytic residues, tellurium continues to be
completely than its companion byproduct, selenium.

Tellurium-vapor arc lamps give a continuous instea
trum ordinarily found in metallic vapor lamps. Owi
of construction and operation the tellurium lamp is n
tory curiosity at present but will receive attentio
illuminant in the future.[14]

Tellurium is usually marketed as slabs and stick
purity, but for use in compounding rubber it is furnishe
derbilt & Co. (230 Park Ave., New York, N. Y.) in the
gray powder ("Telloy"), extra-fine grinding being nec
latex. The New York quotation (Engineering and
Metal and Mineral Markets) has continued nominally
several years at $2 a pound. London trade journals q
at 7s. a pound. Tellurium dioxide is also available,
been made to make a ferro-alloy.

Four American companies reported production in
plants, the domestic output being 51,409 pounds,
57,956 pounds in 1936. Sales were 23,365 pounds in
pounds in 1936. Foreign producing countries are t
selenium. Canada produced 51,622 pounds valued
1937, compared with 35,591 pounds valued at $62,997 i

TITANIUM

Commercial uses for titanium in recent years hav
advance independent of the course of general business

[14] Marden, J. W., Beese, N. C., and Meister, G., Measurement of Light From a
Jour. Franklin Inst., vol. 225, no. 1, January 1938, pp. 45–52.
[14] Hess, F. L., Rare Metals and Minerals: Min. and Met.

mates that in 1937 the world produced 225,000 tons of ilmenite. This ore would yield 100,000 tons of titanium pigment, 75,000 tons of which would normally be made in the United States, where further quantities of ilmenite are used in making ferrocarbontitanium and other alloys and compounds. World production of rutile has grown to around 3,000 tons annually and is used principally in welding rod coatings. The Soviet Government is reported to be actively mining sphene in the Kola Peninsula, probably for making pigments. Efforts several years ago to find a market for Canadian sphene were not successful.

Ilmenite for making white pigments has come mostly from two places on the southwestern shores of India, the beaches at Manavalakurichi and Quilon in Travancore having supplied more than 700,000 tons so far. These same sources are expected to continue to produce on a large scale for years to come; but there is some question whether the rate of production at these points can be indefinitely expanded, and interest is developing in other beaches around the point of British India and in Ceylon. A Travancore company is said to have acquired an exclusive lease on Ceylon ilmenite deposits in 1937. Black sands of Australia, Africa, Brazil, and other countries are also likely to be worked, and the nelsonite resources near Piney River and Roseland, Va., may be expected to come into greater utilization. Other domestic localities may undergo development.

Byproduct titanium has also made its appearance. The waste "amang," at least a quarter million tons of which have accumulated in the Malay Peninsula, is being shipped to Europe and Japan in steadily increasing quantities. Much of the black sand that has to be separated from cassiterite at placer tin mines consists of ilmenite. In Netherland India the Billiton Mining Co. is reported to be recovering ilmenite at its separation plant on the island of Billiton, and similar operations are conducted in the Belgian Congo; in fact, a Kilo-Moto subsidiary has recovered white pigment from titanium-tin concentrates mined in the northern part of the Belgian Congo. In Hungary, titanium compounds (chloride) are said to be extracted from bauxite residues.[16] Imports of ilmenite from Norway indicate that Germany's output of titanium pigments in 1937 exceeded that of the previous year, and Italy, now producing 1,500 tons a year, may have an exportable surplus of titanium pigment when production of southern Abyssinia ores is expanded. Methods for making titanium oxide are continually being improved. After overcoming a variety of difficulties the chemical plant at Piney River, using ilmenite locally produced from nelsonite, has succeeded in making a consistently good product and has begun to increase production. Chemical impurities have received much of the blame for the erratic behavior of ilmenite from different mines in the delicate operations of pigment making, but the petrographers and practical millmen have found that ilmenite concentrates do not always represent a single mineral. By means of a commercial machine, fractions of different magnetic susceptibility can be separated with different ratios of iron to titanium. A good deal of so-called ilmenite ($FeO.TiO_2$) is really arizonite ($Fe_2O_3.3TiO_2$), and there is a further possibility that mixtures of either or both of these minerals with magnetite occur so intimately intermingled that they cannot be freed by any commercially feasible degree of fine grinding.

[16] Chem. Age, vol. 36, no. 934, May 22, 1937, p. 467.

Domestic production statistics cannot be p
closing operations of individual companies.
Corporation doubled the capacity of its new con
Va. Ilmenite is produced by the same comp
Southern Mineral Products Co., Piney River,
ments of good-grade rutile (or brookite) concen
1937 by the Titanium Corporation (Box 1565,
Springs County, Ark. Krebs Pigment Divisi
has taken lease and option on a considerable
Los Angeles County, Calif. Magnetometer su
and diamond drilling was scheduled to begin
Imports of rutile increased to still another all-
tons valued at $67,643) compared with 510 ton
1936. Brazil continued to furnish all but a ne
total. Ilmenite imports also made a new record
long tons valued at $771,140, compared with
$697,822 in 1936 and 119,922 tons valued at
1937 British India supplied all but 2,000 to
England; imports from Norway were suspended

ZIRCONIUM

Progress in technology and utilization of zi
pounds during the last 7 or 8 years is reviewe
A seemingly simple method for dissociating zi
French report;[18] by this method zircon is melte
and then cooled rapidly, the dissociated zi
tallizing in the silica, which remains vitreous.

From Australia comes word that Zircon-I
operations at Byron Bay, New South Wales, a
due to marketing difficulties. Discoveries of z
reported,[19] an extensive deposit already being e
tuzi River and another important occurrence
miles northwest of Eshowe. In the U. S. S.
have been devised for obtaining the element fr
zirconium-silicate), large quantities of which
thrown away in the nepheline-syenite tailings
on the Kola Peninsula.

Further increase was recorded in imports
the United States, which rose to 17,868,139 pou
compared with 11,565,340 pounds valued at
1937 Australia supplied 14,913,380 pounds v
remainder being divided almost equally betwe
India. Ferrozirconium and zirconium ferrosili
Norway) increased to 230,449 pounds valued a
22,400 pounds of zirconium silicon valued at

[17] Fast, J. D., Zirconium: Fcote-Prints (Philadelphia), vol. 10, no. 2,
[18] George, H., and Lambert, R., Dissociation of Zircon: Compt. rend.,
vol. 31, no. 9, May 10, 1937, p. 2909.
[19] Min. Jour., London, July 24, 1937, p. 682.