U. S. DEPARTMENT

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BUREAU OF

SCOTT TURNER,

MINERAL RE

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Chief Economist, Division

PART I—M

IMPORTS

Imports since 1920 are shown in the following table:

Tantalum ores imported into the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	[1] 60	$54	1925	[2] 5,022	$1,347
1921	[1] 1,229	788	1926	[1] 350	149
	[2] 6,785	1,327	1927	[3] 15,119	20,012
1922			1928		
1923	[2] 5,600	3,031	1929	[3] 15,250	19,418
1924					

[1] Classified as "Ferro-alloys (tantalum)."
[2] Classified as "Steel-hardening ores (tantalum)."
[3] Classified as "Ores of ferro-alloying metals (tantalum)."

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DYSON, G. MALCOLM. The production and uses of tantalum. Chem. Age (London), vol. 20, March 2, 1929, pp. 18–19.

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"An alloy resistant to scaling at elevated temperature
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1711484, May 7, 1929. Chem. Abs., vol. 23, July 1
"A rust, heat, and acid resisting alloy suitable for cu
prises Fe together with Cr 7–25, Ta about 0.2–3.0 per ce
cent or less. Mn and Si also may be added in small prop

AUSTIN, MINER M., and BALKE, CLARENCE W. (to F
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ENGLE, EDGAR W., and AUSTIN, MINER M. (to Fansteel
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"Pens are made with nibs of Ta 90 and W 10 per cent

MARDEN, JOHN W., and RICH, MALCOLM N. (to Westingh
metals. U. S. Patent 1728941, September 24, 1929
November 10, 1929, p. 5150.

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heated with Ca and $CaCl_2$ in a sealed or evacuated contai
alkali metal."

REMY-STAHLWERKE STAHL SCHMIDT & Co. GES. Alloy
tools. British Patent 289990, February 28, 1927.
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"An alloy steel is specified containing W 17, Cr 5, V 1
cent, with or without Mo 2 per cent."

STAHLWERKE ROCHLING BUDERUS A.-G. and KROPF
material. German Patent 469433, December 19, 1
23, April 10, 1929, p. 1732.

"Ta powder, which may contain up to 10 per cent of
graphite in the proportions 3:2 with the use of a binder;
The mixture is molded under pressure, dried at 300–50
000–3,000°. The molded piece may be given a coat
ing. The products may be used as electrical-resistanc
crucibles, furnace linings, etc."

TITANIUM

DOMESTIC PRODUCTION

During 1929 the American Rutile Co. (a subs
Thermit Corporation) shipped ilmenite and rut
mine at Roseland, Nelson County, Va. The pro
minerals during the last 10 years, so far as data
Bureau of Mines for publication, is shown in
quantities are largely for shipments rather tha

Titanium minerals produced in the United States, 1920–1929

Year	Rutile concentrates			Ilmenite concentrates		
	Short tons	Percentage of TiO_2	Value	Short tons	Percentage of TiO_2	Value
1920	277	94–96	(1)	268	50	(1)
1921						
1922	310	95	(1)	5,181	52–54	(1)
1923	270	95	(1)	6,270	52	(1)
1924				4,769	52	[2] $76,300
1925	46	95	[2] $11,000	5,566	52	[2] 89,000
1926 [3]	30	95	[2] 7,500	4,813	52	[2] 77,000
1927	524	95	129,861	3,500	50	44,000
1928	(1)	(1)	(1)	(1)	(1)	(1)
1929	(1)	(1)	(1)	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.
[2] Arbitrary value.
[3] Figures for Florida only. Bureau of Mines not at liberty to publish figures for Virginia.

During 1928 the Vanadium Corporation of America acquired ilmenite properties on the border of Nelson and Amherst Counties, Va., and did considerable drilling during 1929. At the end of the year its subsidiary, the Southern Mineral Products Corporation, awarded a contract for designing and constructing a mining, milling, and chemical plant at its Virginia properties. The Vanadium Corporation has been engaged in developing a concentrating process for separating the ilmenite from the gangue, and according to common report is contemplating adding titanium pigments to its list of products. The Titanium Pigments Co. also did some drilling on its properties in the vicinity of Roseland, Va. A shaft has been sunk in the ilmenite deposit at Fort Edwards, N. Y. The Buckman & Pritchard operation near Jacksonville Beach, Fla., was discontinued. Some further work was done on the beach deposits in California, but the Bureau of Mines has no record of shipments being made.

GENERAL CONDITIONS

Domestic sales of titanium pigments were said to have been one-third larger in 1929 than in 1928. Titanium white is marketed in the form of the nearly pure oxide and also blended with blanc fixe and zinc oxide. A new product, titanated lithopone, was also marketed in 1929. The desirable properties of titanium pigments have been summarized by Hixson and Plechner,[5] as follows:

> Paints made with titanium pigments have shown no tendency to crack or peel, but have worn down evenly and uniformly, the surface finally becoming powdery ("chalking") and remaining in excellent condition for repainting. Since a pure titanium oxide paint is inclined to be too elastic the addition of zinc oxide as a hardener gives an even more durable paint. Owing to the fact that titanium oxide is a neutral pigment it has no action whatsoever on the vehicle, making a very slow-drying "tacky" paint. This condition is overcome by the addition of zinc oxide or driers. Since titanium oxide, like the similar oxide of silicon, is the most stable compound of the metal, the pigment is extremely resistant to attack by any of the destructive agencies to which it is likely to be exposed. That it will resist the attack of sulphuric acid, which is notoriously the chief destructive agent in the air of cities, that it is not fully oxidized and therefore is not attacked by sea air or salt water, make it an excellent pigment.

[5] Hixson, A. W., and Plechner, W. W., Titanium Offers New Possibilities as a Pigment: Chem. and Met. Eng., vol. 36, February, 1929, pp. 76–78.

Titanium pigments are manufactured in the
the Titanium Pigments Co., a subsidiary of the
with plants at St. Louis and Niagara Falls, and
Pigments Co., a subsidiary of the Commercial Sol
with a plant at Baltimore. These pigments are
ilmenite. Ilmenite is also used in the manufact
titanium, produced by the Titanium Alloys Man
carbide-free ferrotitanium, produced by the Metal
tion. Rutile is used chiefly in the ceramic industr
and in dinner ware, to add color and strength.

The United States probably consumes more titan
all the rest of the world; Europe, however, uses
as compared to the total amount of all kinds of p
due in part to restrictive legislation affecting the
paints. European sales are reported to have dou
plant of the Titan A./S. company at Fredrikstad
to produce titanium pigments, has been closed, b
been completed by the same interests at Lebe
near Cologne. The Titan concern (now affiliated
Lead Co.) is the largest European producer, but th
in Germany, a factory in England, and one in Ita
present no titanium industry, but a Canadian c
(Ltd.), has secured control of the Ivry ilmenite d
pose of utilizing material from them in the manu
white; however, no plant has been erected yet.

Partly as a result of a reduction in the price (
cents a pound in the case of the 15 per cent ferrocar
sales of titanium ferro-alloys increased in 1929.

IMPORTS

Ilmenite sand is imported extensively from Tra
from Senegal. From time to time shipments ha
from Brazil. The imports of ilmenite as recorded
Foreign and Domestic Commerce amounted to
valued at $104,887, in 1929, as compared with 1
at $79,640, in 1928. A study of the customhous
that in 1928 there was also imported 5,000 tons
a value of around $4 a ton, from these ilmenite-p
and entered by the importer and hence classified
tistics as "sand, other than glass sand." Muc
imported is from beach deposits in which it occu
monazite and zircon, and in former years undoubt
was included in the statistics for sand and othe
ilmenite are exempt from duty. A study of the
however, indicates that this situation is much in
even now some of the ilmenite imported probably
corded under its special category. In Quebec, fo
of massive ilmenite are worked at Ivry and at Bai
ore which contains up to 38 per cent TiO_2 is ship
States, but this movement does not appear in the
Rutile is imported from Norway, but only in sma
mineral is also associated with the ilmenite produ
near Baie St. Paul, in Quebec, and shipped to th
Co.'s works at West Lynn, Mass.

WORLD PRODUCTION

The world production of titanium minerals in 1928 and 1929, as gathered from Government reports and other available sources, is shown in the following table:

World production of titanium minerals, 1928 and 1929

Mineral and country	1928 Ore produced	1928 Content of TiO_2	1928 Value [1]	1929 Ore produced	1929 Content of TiO_2	1929 Value [1]
	Metric tons	*Per cent*		*Metric tons*	*Per cent*	
Ilmenite:						
Brazil [2]	1,498	(3)	(3)	6,361	(3)	$75,109
Canada (Quebec)	2,036	(3)	$6,728	2,493	(3)	7,304
India (Travancore)	25,713	(3)	202,226	(3)	(3)	(3)
Norway	7,948	42.6	61,915	(3)	(3)	(3)
Portugal	703	(3)	3,140	(3)	(3)	(3)
Senegal	2,110	[4] 50	6,623	[2] 7,240	(3)	24,289
United States	(5)	(5)	(5)	(5)	(5)	(5)
Rutile:						
Norway	[6] 59	90–93	18,414	(3)	(3)	(3)
United States	(5)	(5)	(5)	(5)	(5)	(5)

[1] Values as officially reported, converted to United States currency at the annual average rate of exchange as published by the Federal Reserve Board.
[2] Exports.
[3] Data not available.
[4] Estimated.
[5] Bureau of Mines not at liberty to publish figures.
[6] Concentrates.

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"Solutions obtained by the decomposition of ilmenite, etc., with sulphuric acid containing, e. g., 200 g. TiO_2 and 500 g. H_2SO_4 (free and combined) per liter, are introduced at 100–110° into about one-quarter of their volume of boiling water at a uniform rate during about 10 minutes, the mixture being well stirred during the addition and then boiled for 2–3 hours, to precipitate colloidal titanium hydroxide. The product may be dispersed as described in British Patent 247296. Compounds of the rare-earth metals may be similarly prepared."

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ous iron contents were prepared and burned.
cream color was obtained, but with increasing
to greenish gray. Conclusion: (1) Rutile is sa
ment of cream-colored vitreous floor-tile bodie
in bodies which are free from ball clay and lo
from TiO_2 or rutile is largely dependent upo
Fe_2O_3. (3) The use of TiO_2 as a coloring agent
bilities, and satisfactory colors can be secured
if TiO_2 is utilized instead of rutile. TiO_2 is ve
to crystallize on a clay body, and has an unce
gives variable color effects owing entirely to va
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dilute sulphuric acid, and worked up to give th

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MONK, REGINALD H. Titanium oxide. U. S. Patent 1695341, December 18, 1929. Chem. Abs., vol. 23, February 20, 1929, p. 939.

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TITANIUM PIGMENT CO. Recovery of titanium compounds. British Patent 288569, March 15, 1928. Chem. and Ind. (London), vol. 48, August 2, 1929, p. 597.

"Finely ground ilmenite is mixed with 72–92 per cent sulphuric acid and steam is injected into the lower part of the reaction vessel until the temperature reaches 120° and the mass thickens; a small quantity of water is then forced into the lower part of this thick pulp, followed by vigorous streams of air to keep the mass in agitation and to render it porous, and finally the cooled solid mass is treated with just sufficient water to dissolve the iron and titanium sulphates. The clear solution is agitated with scrap iron or zinc to reduce ferric to ferrous sulphates, and the titanium is recovered by hydrolysis in the usual way."

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calcined."

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that TiO_2 is more economical than lithopone in rub
costs and coloring power lithopone is the more e
vulcanizates containing lithopone age considerably b
vulcanizates containing TiO_2, particularly with p
Examination of TiO_2 from different sources shows
Ti. It is considered that lithopone is much preferabl
for rubber goods."

TUNGSTEN

UNITED STATES

Contrary to general expectations, the sales
the United States dropped in 1929 to only 8
trates carrying 60 per cent of tungsten trioxid
were 1,208 tons. However, due to the rise in
the decrease in value was relatively small—fr
$654,000 in 1929. Tungsten ore from domes
and sold in 1929 by 14 companies.
The tungsten production of the United St
years has been as follows:

LEAD [1]

By ELMER W. PEHRSON [2]

GENERAL SUMMARY

Salient figures of the lead industry in the United Sta

Production of refined primary lead:
From domestic ores..............short
From foreign ores and base bullion..............
Recovery of secondary lead:
As pig lead..............
In alloys..............
Total production of pig lead (primary and secondary)..............
Imports (general):
Lead in base bullion..............
Lead in ore..............
Exports:
Refined pig lead from domestic ores..............
Refined pig lead from foreign materials..............
Apparent consumption of refined primary lead..............
Estimated consumption of primary and secondary lead..............
Prices per pound of refined lead at New York:
Highest monthly average..............
Lowest monthly average..............
Average for year..............
Quotation at end of year..............
Mine production of recoverable lead..............short
Southeastern Missouri district..............per cent of
Utah..............
Coeur d'Alene region..............
Joplin (tri-State) region..............
All other..............
World smelter production of lead..............short
United States..............per cent of
Mexico..............
Australia..............
Spain..............
Canada..............
All other..............

[1] Exclusive of the output from Virginia, figures for which the Bureau of M

Conditions in the lead industry were generally out most of 1929. Domestic production and pric above the 1928 averages. The production of from domestic ores was 7 per cent more than tha to decreased imports of Mexican base bullior refined lead from foreign ores and base bullion d so that the total primary lead output from all per cent less than that in 1928. Production in th stimulated in March and April by the rapid incre from the threatened curtailment of supply b Mexico. This increase in production, together

[1] Work on manuscript completed November, 1930.

[2] The statistics in this report were prepared (unless otherwise indicated) on imports and exports were compiled from records of the Bureau of Fore J. A. Dorsey, both of the Bureau of Mines.

off in domestic deliveries in April, May, and June, caused a sharp increase in stock, which reacted unfavorably on prices. From April to August production and price had declined steadily, whereas stocks had increased steadily, but by October consumption and production had returned to the March level, prices had recovered somewhat, and stocks were down. This rally, however, was terminated by the collapse of the stock market, and in November and December production, consumption, and prices declined sharply.

The New York quotation for lead increased steadily from 6.65 cents on January 2 to a high for the year of 7.80 cents during the latter part of March. Thereafter it declined steadily to an average of 6.75 cents in August. In October the average had increased to 6.87 cents, but in November and December there were sharp declines and on December 31 the quotation was 6.25 cents per pound. The average for the year was 6.83 cents, as compared to 6.31 cents in 1928.

The recovery of secondary lead in pig lead and alloys in 1929 again broke all previous records; it was equivalent to 46 per cent of the primary lead produced from domestic ores.

The total consumption of lead in the United States in 1929, as estimated by the American Bureau of Metal Statistics, surpassed all previous records, amounting to 945,200 tons, or an increase of 2 per cent over 1928 and 12 per cent over 1927. Storage batteries ranked first among the consumers of lead in 1929, taking 22.2 per cent of the total; cable covering was second, with 21.8 per cent; white lead third, with 12.5 per cent; and building fourth, with 10.2 per cent. There were decreases of 5 and 4 per cent, respectively, in the quantities of lead used in storage batteries and in white lead but an increase of 14 per cent in that used for cable covering.

Mine production of lead showed a 3 per cent gain in 1929. This rate of increase was fairly general for all areas, production in the Western States having increased 4 per cent and that in the Mississippi Valley States 3 per cent. Utah, Idaho, New Mexico, and Missouri showed the largest tonnage increases, while Colorado was the only State among the 10 largest producers to show a decrease.

General imports of lead in base bullion decreased 35 per cent as a result of a 47 per cent decrease in shipments from Mexico. Imports from Peru increased 130 per cent. Receipts of lead in ore and matte increased 21 per cent owing to increased shipments from Mexico. Exports of refined pig lead declined from 116,269 tons in 1928 to 73,251 tons in 1929 as a result of the decreased shipments of base bullion from Mexico which is refined in the United States under bond and exported from warehouse.

The Lead Industries Association, an organization of American producers and consumers of lead, expanded its statistical service during the year to include periodic reports on sales of domestic lead, manufacturer's stocks of pig lead, and the production, sales, and stocks of antimonial lead, mixed metals, white lead, red lead, litharge, sublimed lead, and orange mineral. It also distributed the monthly reports on production, shipments, and stocks of pig lead compiled by the Lead Producers Reporting Association of England.

World smelter production of lead in 1929 amounted to 1,971,000 short tons, an increase of 6 per cent over 1928. Production outside the United States increased 6 per cent, and the output of all but two

of the 13 countries that produced 1 per cent or m
lead was greater in 1929 than in 1928. The United
Spain, Germany, Mexico, Russia, and Peru showe
nage increases.

The London price of lead in 1929 averaged £23.
or 5.04 cents per pound; this is 10 per cent above
while the 1929 New York quotation is 8 per cent
average.

The European lead cartel was reported to have
working agreement between leading Mexican, Can
Indian, and continental producers. No announce
fixing or production curtailment has been noted in
so it is presumed that the cartel was engaged chief
tion of statistics. Producers of lead in Mexico
(Burma), and Australia cooperated in selling their
a central London agency.

Development during 1929 at Mount Isa, in
Buchans, in Newfoundland, resulted in greatly incre
Among the new deposits that appear to be promisi
of lead are the Lake George mine in New South W
to have a possible reserve of 5,000,000 tons of ore c
cent of lead in addition to other metals, and the
deposit at Lawn Hills, Queensland. Several
actively developing lead deposits in Yugoslavia in
promising to date is the Stantrg mine, which has a
2,000,000 tons of ore containing 11.5 per cent of lea
zinc, and 3 ounces of silver. In Canada the reserv
mine, British Columbia, and the Mayo district, Yu
increased by development work in 1929. Extensive
zinc ores were reported in the Great Slave Lake a
Territories. No extensive discovery of lead ore w
United States in 1929.

PRODUCTION

GENERAL

Pig lead produced in the United States for dom
export is derived from three main sources—domesti
and base bullion, and secondary materials. The foll
the quantity of pig lead produced from each of th
1920 to 1929.

Pig lead produced in the United States, 1920–1929, i

Year	From domestic ores and base bullion	From foreign ores and base bullion
1920	476,849	52,808
1921	398,222	50,367
1922	468,746	63,916
1923	543,841	74,481
1924	566,407	124,086
1925	654,921	112,048
1926	680,685	118,256
1927	668,320	128,210
1928	626,202	154,869
1929	672,498	102,135

The total production of pig lead in the Unite
decreased 5,938 tons, or less than 1 per cent.

domestic ores and base bullion increased 7 per cent, whereas that from foreign ore and base bullion decreased 34 per cent. Production of pig lead from secondary materials increased slightly.

PRIMARY LEAD

REFINERY PRODUCTION

Pig lead is classified by the Bureau of Mines as primary or secondary, according to whether it is derived directly from the smelting of ores and from base bullion or is reclaimed from industrial lead scrap. Some plants that ordinarily smelt ore frequently add lead scrap to the charge, so that the resulting product is an inseparable mixture of lead from both sources and is all marketed as refined pig lead. Nevertheless, the smelter calculates the quantity of secondary lead so produced, thus enabling the Bureau of Mines to obtain a consecutive record of the amount of primary lead being supplied to the trade each year.

Primary lead may be produced from domestic ore or foreign ore and from base bullion. The smelting of lead-bearing ores from the Western States yields an impure pig lead (base bullion) that contains valuable amounts of silver and gold, in addition to objectionable impurities such as copper, arsenic, and antimony. This base bullion is given further treatment for the removal of the impurities and finally emerges for the market as refined pig lead. The smelting of lead-bearing ores from the Mississippi Valley and Southern States yields soft lead pure enough for marketing, but some of it is desilverized and is designated in this report as desilverized soft lead. Foreign ore is first smelted into base bullion and then refined for market. Foreign base bullion imported into the United States is also refined before marketing. All of these products for market are referred to as refined lead. The following table gives a summary of the refined primary lead produced in the United States from 1720 to 1929.

Refined primary lead produced in the United States, 1720–1929

Year	Short tons							Value	
	Desilverized lead [1] [2]	Desilverized soft lead	Soft lead [2]	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1720–1912	7,176,497	326,991	2,929,180	10,432,668	8,545,383	1,887,285		....	$924,600,000
1913	301,160	29,433	131,867	462,460	411,878	13,223	37,359	$0.044	40,696,000
1914	340,397	43,506	158,219	542,122	512,794	7,639	21,689	.039	42,286,000
1915	344,593	44,001	161,461	550,055	507,026	9,581	33,448	.047	51,705,000
1916	335,375	68,244	167,515	571,134	552,228	6,085	12,821	.069	78,817,000
1917	365,998	56,268	188,503	610,769	548,450	15,872	46,447	.086	105,052,000
1918	382,314	47,418	210,463	640,195	539,905	15,334	84,956	.071	90,908,000
1919	266,538	67,938	147,744	482,220	424,433	7,656	50,131	.053	51,115,000
1920	273,135	66,668	189,854	529,657	476,849	8,414	44,394	.080	84,745,000
1921	238,329	52,747	157,513	448,589	398,222	7,120	43,247	.045	40,373,000
1922	249,107	74,305	209,250	532,662	408,746	13,898	50,018	.055	58,593,000
1923	366,241	61,332	190,749	618,322	543,841	24,288	50,193	.070	86,565,000
1924	423,429	63,449	203,615	690,493	566,407	46,385	77,701	.080	110,479,000
1925	457,477	48,932	260,560	766,969	654,921	47,024	65,024	.087	133,453,000
1926	484,669	55,707	258,565	798,941	680,685	48,210	70,046	.080	127,831,000
1927	507,099	55,487	233,944	796,530	668,320	32,369	95,841	.063	100,363,000
1928	506,603	49,465	225,003	781,071	626,202	26,632	128,237	.058	90,604,000
1929	483,622	55,666	235,345	774,633	672,498	29,675	72,460	.063	97,604,000
	13,502,583	1,267,557	6,259,350	21,029,490	17,798,788	3,230,702		....	2,315,789,000

[1] The lead content of antimonial lead is excluded (see p. 238). [2] Desilverized soft lead is excluded.

The total production of refined primary lead in th
in 1929 was nearly 1 per cent less than that in 1928
cent less than the 1926 output, the maximum annual
The total value of the 1929 output was 8 per cent g
of 1928, due to an increase of one-half cent per poun
price of lead, but amounted to only 73 per cent of
the peak annual value up to the end of 1929.

Two outstanding features in the production of pri
United States in 1929 were the decreased output fr
bullion and the increased production from domestic
duction of refined lead from foreign base bullio
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Refined lead produced from foreign ores and base b
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Year	Short tons	Value	Year
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1922	408,746	51,562,000	1927
1923	543,841	76,138,000	1928
1924	566,407	90,626,000	1929

GEOGRAPHICAL SOURCE OF LEAD RAW MATERIA REFINED IN THE UNITED STATES

The following table shows the source of the ore
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from 1920 to 1929. A large part of the base bullio
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PRIMARY LEAD

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[1] The lead content of antimonial lead is excluded (see p. 238). [2] Desilverized soft lead is excluded.

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lead from domestic ores, as shown in the pr
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amounted to 17,062 tons.

Primary lead smelted or refined in the United States, 1920–1929, by sources, in short tons

Source of ore	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Domestic ore:										
Alaska	591	773	324	400	582	699	1,018	1,010	962	1,266
Arizona	5,987	3,313	7,218	8,828	9,372	10,281	10,646	7,918	8,144	8,153
California	2,260	614	3,018	5,168	2,305	4,148	4,044	1,232	637	1,459
Colorado	17,752	12,104	11,108	23,885	25,491	31,855	37,553	37,040	28,683	23,675
Idaho	117,191	99,707	91,487	127,797	123,709	123,363	132,564	150,618	141,748	147,595
Illinois [1]	948	271	750	1,288	1,080	474	357	222	398	777
Kansas [1]	8,421	10,939	10,900	20,207	12,895	15,001	20,884	[2] 25,463	[2] 27,014	[2] 26,104
Kentucky [1]	114	41	73	66	201	96	27	139	268	303
Missouri [1]	171,999	151,028	202,245	169,323	191,501	208,547	218,083	210,366	192,789	211,345
Montana	13,231	11,565	14,551	18,345	21,226	22,008	26,350	23,041	20,470	26,795
Nevada	8,650	3,553	4,264	8,044	8,070	10,978	11,379	8,680	6,823	13,256
New Mexico	1,123	384	1,230	1,638	2,263	3,782	4,383	8,377	8,469	12,249
Oklahoma [1]	68,494	46,902	67,436	59,602	56,017	78,487	70,004	[2] 47,857	[2] 46,692	[2] 45,653
Oregon			37	47		6	5	2	7	15
South Dakota	6	2	2		2	2	1	79	37	
Tennessee [1]	2,705		751	1,020	985	436	770	19		
Texas	1	1	5	40	27	31	102	275	437	559
Utah	64,006	51,872	63,130	104,678	119,318	166,844	151,127	155,199	151,724	157,085
Virginia [1]					1,582	2,179	1,714	2,214	4,944	(3)
Washington	2,460	325	478	2,008	2,057	2,802	2,262	442	537	447
Wisconsin [1]	3,841	1,079	1,323	601	1,973	2,889	2,052	2,067	1,812	1,729
Undistributed	201	101	75	691	15	2				5,624
Zinc residues	4,366	713	1,284	362	1,320	1,541	505	1,905	102	1,903
	494,347	395,287	481,689	554,036	582,000	686,451	695,830	684,165	642,697	685,992
Foreign ore:										
Africa	1,171			99	6		6	12		
Australia	450							2	2	5
Canada	1,186	2,877	3,604	3,032	4,633	10,676	5,385	4,138	10,123	9,499
Central America	22	6	14	18	30	6		18	3	
Europe	19	17	519	139	328	470	233	19	67	28
Mexico	2,729	1,912	7,260	18,867	33,328	81,107	32,693	22,844	14,839	16,807
South America	2,747	2,235	2,458	1,461	7,663	4,496	9,893	5,506	1,568	3,285
Other foreign	90	73	43	72	397	269			30	51
Foreign base bullion:										
Canada	1,919	1,599	2,900							[illegible]
Mexico	42,421	41,648	47,118	50,193	77,701	65,024	70,046	95,841	117,193	51,295
South America	54								11,044	21,165
	52,808	50,367	63,916	74,481	124,086	112,048	118,256	128,380	154,869	102,135
Grand total	547,155	445,654	545,605	628,517	706,086	798,499	814,086	812,545	797,566	788,127

[1] The lead produced by these States is nonargentiferous or soft lead. A small quantity of the lead produced from Colorado and New Mexico ores is also nonargentiferous.
[2] The smelter output of lead in Kansas and Oklahoma is separated on the basis of mine output as the Bureau of Mines has been unable to obtain an accurate separation of smelter output.
[3] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

The table shows that in 1929, 87 per cent of the primary lead smelted or refined in the United States was derived from domestic ores, 4 per cent from the smelting of foreign ores, and 9 per cent from the refining of foreign base bullion. There were substantial increases in lead production in 1929 in most of the important lead-producing States. Decreased production was recorded for Colorado, Kansas, Oklahoma, Washington, and Wisconsin. Foreign ore smelted in the United States in 1929 came largely from Mexico, Canada, and South America (chiefly Chile). Refined lead produced in the United States from Mexican base bullion decreased 56 per cent in 1929 owing to the completion of new refineries in Mexico which treated a larger part of the Mexican production of base bullion. There was an increase of 92 per cent in the production of refined lead from South American (chiefly Peruvian) base bullion.

SPECIFICATIONS FOR PIG LEAD

The American Society for Testing Materials classifies pig lead in three grades—corroding, chemical, and common. The requirements as to chemical composition are shown in the following table.

Allowable chemical composition of the various grades of pig le[...] American Society for Testing Materia[...]

	Corroding lead,[1] not over—	Chemica[l] lead [2]
	Per cent	*Per cen[t]*
Silver	0.0015	0.005–0.0[...]
Copper	.0015	.04– .0[...]
Copper and silver together	.0025	(3)
Arsenic	.0015	(3)
Antimony and tin together	.0095	(3)
Zinc	.0015	(3)
Iron	.002	(5)
Bismuth	.05	(4)
Lead, by difference	99.9300	(5)

[1] The maximum limits for bismuth, copper, and silver have been given, bu[t ...] delivery will contain the maximum of all three.
[2] Chemical lead is a designation that has been used for many years in the [...] silverized lead produced from southeastern Missouri ores.
[3] Not given.
[4] Less than 0.005 per cent.
[5] Not specified.

SOFT LEAD

A large part (43 per cent in 1929) of the leac
United States from domestic ores is derived from th
lead ores of the Mississippi River basin. The t
producing areas are the southeastern Missouri di
State district (Joplin) at the junction of Misso
Oklahoma. The former district produced about 6
latter 25 per cent of the total soft lead in ore minec
Eighty-one per cent of the soft pig lead prod
marketed without desilverizing, and 19 per cent
The former, which is known in the trade as chemic
to 4 ounces of silver to the ton and 0.04 to 0.08 pe
used chiefly in the manufacture of cable, pipe, a
verized soft lead is used largely in the manufact
where a very pure product is required.

A substantial quantity of high-grade lead conc
Mississippi Valley is used each year in the ma
pigments, principally basic lead sulphate (white s
leaded zinc oxide. In 1929 nearly 9,500 tons of soft
in this manner.

The following table summarizes the production
1922 to 1929:

Soft lead produced in the United States from domestic ores, 1[...]

Year	Soft pig lead			Soft lead recovered in pigments	T[...]
	Undesilverized	Desilverized	Total		
1922	209,250	74,305	283,555	18,892	
1923	190,749	61,332	252,081	18,612	
1924	203,615	63,449	267,064	15,338	
1925	260,560	48,932	309,492	17,547	
1926	258,565	55,707	314,272	13,685	
1927	233,944	55,487	289,431	13,136	
1928	225,003	49,465	274,468	10,465	
1929	235,345	55,666	291,011	9,429	

[1] Includes domestic refined lead, domestic lead in antimonial lead, and do[...]

ANTIMONIAL LEAD

Antimonial lead is an important by-product of the refining of base bullion. In 1929, 25,669 tons of primary antimonial lead was produced, which contained 22,617 tons of lead, a decrease of 22 per cent from the 1928 output of antimonial lead and equivalent to 5.3 per cent of the total refined lead produced from base bullion.

The decreased importation of base bullion from Mexico had a marked effect on the production of primary antimonial lead. In 1928 more than 15,000 tons was produced from the smelting and refining of foreign ores and base bullion, whereas in 1929 only 8,600 tons was derived from the same source. Foreign ores also yield a higher percentage of antimonial lead. The production of antimonial lead from foreign ores was equivalent to 9.8 per cent of the refined lead produced from those ores in 1928 and to 8.4 per cent in 1929, while the yield from domestic ores was 5.1 and 4.5 per cent, respectively.

The principal uses of antimonial lead are in the manufacture of storage batteries, bearing metal, and type metal. The consumption of antimonial lead in storage batteries decreased about 3 per cent in 1929. The following table shows the production of primary antimonial lead from 1920 to 1929:

By-product primary antimonial lead produced in the United States, 1920–1929

Year	Total lead refined from base bullion (short tons)	By-product antimonial lead (percentage of total)	Antimonial lead: From domestic ore (short tons)	From foreign ore (short tons)	Total: Short tons	Value	Antimony content: Short tons	Antimony content: Percentage	Lead content by difference (short tons)
1920	273,135	4.6	9,604	2,931	12,535	$1,963,255	2,033	16.2	10,502
1921	238,329	4.2	7,881	2,183	10,064	870,059	1,589	15.8	8,475
1922	249,107	3.2	7,068	1,007	8,075	844,993	1,441	17.8	6,634
1923	366,241	3.9	11,635	2,555	14,190	1,960,370	2,170	15.3	12,020
1924	423,429	4.9	13,593	7,194	20,787	3,376,713	2,763	13.3	18,024
1925	457,477	4.3	14,472	5,195	19,667	3,785,547	2,624	13.3	17,043
1926	484,669	4.6	18,909	3,615	22,524	3,910,714	2,693	12.0	19,831
1927	507,099	4.8	16,040	8,307	24,347	3,277,043	2,736	11.2	21,611
1928	506,603	6.5	17,930	15,128	33,058	3,978,318	3,432	10.4	29,626
1929	483,622	5.3	17,062	8,607	25,669	3,267,095	3,052	11.9	22,617
Average		4.8						12.9	

SECONDARY LEAD

Much of the lead consumed in the United States is used in the manufacture of articles from which there is a large return of secondary metal. This is particularly true of the storage-battery industry, which is the leading single consumer of lead and in which there is a large and rapid return of secondary metal. This industry is responsible for much of the increase in the ratio of secondary lead production to domestic primary lead production. In 1914 the secondary output was equivalent to only 12 per cent of the primary output from domestic ores; in 1929 the ratio was 46 per cent, a decrease from 49 per cent in 1928. Other important lead-consuming industries in which

there is a large return of secondary metal include c
building, bearing-metal manufacture, and type-m
Fifty-five per cent of the secondary lead output
ered in the form of alloys, principally alloys of l
mony, and 45 per cent was recovered as pig lead.
The following tables show the recovery of seco
ratio to the refined primary lead produced in the U
domestic ores. Further details of the secondary
be found in the Mineral Resources chapter on seco

Secondary lead recovered in the United States, 1922–19

Year	Pig lead	Lead alloy
1922	75,480	84,
1923	90,430	98,
1924	90,400	114,
1925	112,420	114,
1926	125,000	152,
1927	119,000	157,
1928	138,000	170,
1929	138,500	172,

Ratio of secondary lead recovered to refined primary lead p States from domestic ores, 1913–1929

Year	Refined primary le: Short tons	Avera price p poun (cent
1913	411,878	
1914	512,794	
1915	507,026	
1916	552,228	
1917	548,450	
1918	539,905	
1919	424,433	
1920	476,849	
1921	398,222	
1922	468,746	
1923	543,841	
1924	566,407	
1925	654,921	
1926	680,685	
1927	668,320	
1928	626,202	
1929	672,498	

PIGMENTS

Lead pigments manufactured in 1929 contain
lead derived from the sources shown in the follow
pig lead is used in the manufacture of white lead
sublimed lead, and orange mineral. In 1929 abo
the lead contained in lead pigments was derive
lead; white lead accounting for 48.3 per cent, lith
red lead 15.8 per cent, and sublimed lead and ora
cent. Sublimed lead and leaded zinc oxide are the
in which the lead content is derived from ores.

Further details of the production and value of lead pigments in the United States are given in the Mineral Resources chapter on lead and zinc pigments and salts.

Lead in pigments,[1] 1922–1929, by sources, in short tons

Year	Lead in pigments from—				
	Domestic ore	Foreign ore	Metal	Scrap	Total
1922	13,892		241,096	111	255,099
1923	13,612		236,541		250,153
1924	15,338	545	250,930		266,813
1925	17,547		256,064		273,611
1926	13,685		240,902	1,029	255,616
1927	13,136		242,713	1,246	257,095
1928	10,465		242,914	654	254,033
1929	9,429		248,657	2,427	260,513

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.

MINE PRODUCTION

BY STATES

The following table shows the mine production of recoverable lead by States from 1920 to 1929:

Mine production of recoverable lead, 1920–1929, by States, in short tons

State	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Alaska	875	759	377	410	631	789	778	1,008	1,019	1,316
Arizona	6,935	3,271	7,535	8,146	9,321	11,938	11,629	9,933	7,190	8,027
Arkansas	8	21	42	25	20	58	18	23	38	61
California	2,407	562	3,156	4,775	2,382	3,283	4,047	1,359	946	71[illegible]
Colorado	23,315	9,830	11,739	22,849	23,779	31,483	34,494	33,386	26,751	24,44[illegible]
Georgia	2		4							
Idaho	118,565	99,235	97,917	121,178	124,475	126,521	136,490	151,019	145,323	148,69[illegible]
Illinois	1,708	672	1,325	1,381	1,464	1,001	655	277	385	44[illegible]
Kansas	16,452	18,679	23,271	17,598	18,560	22,775	28,463	27,497	25,276	26,59[illegible]
Kentucky	120	69	92	53	175	152	58	139	39	28[illegible]
Massachusetts	14				(1)					
Missouri	161,812	180,085	178,412	169,743	189,929	211,566	207,012	198,760	195,393	198,46[illegible]
Montana	14,846	10,183	14,884	17,973	19,738	18,765	21,153	17,949	16,880	19,607
Nevada	10,100	3,594	4,695	9,078	10,030	12,238	11,184	7,892	7,874	9,84[illegible]
New Mexico	1,435	339	1,506	1,916	1,817	3,210	3,480	8,026	7,805	11,1[illegible]0
Oklahoma	64,080	41,552	62,856	66,904	71,358	79,946	69,704	51,680	43,687	46,51[illegible]
Oregon			38	14	(2)	3	6	3	7	10
Pennsylvania	7									
South Dakota	6	2						69	37	
Tennessee	1,880		732	1,250	937	448	800			
Texas			4	13		8	42	244	348	42[illegible]
Utah	66,898	44,594	67,606	101,724	116,955	153,335	147,635	151,285	145,915	149,877
Virginia					1,275	2,229	2,450	2,393	(3)	(3)
Washington	2,749	72	691	1,453	1,968	2,814	2,273	478	542	50[illegible]
Wisconsin	2,594	972	691	734	1,254	1,877	1,546	2,069	1,698	1,5[illegible]
	496,814	414,491	477,633	547,217	596,068	684,439	683,917	665,489	[4] 627,153	[4] 647,99[illegible]

[1] It is said that a few tons of lead ore was mined at the old Chipman mine in Massachusetts and w[illegible] treated at a small smelter owned by the mine operators.
[2] 513 pounds.
[3] Bureau of Mines not at liberty to publish figures.
[4] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at liberty to publi[illegible]

BY DISTRICTS

The following table gives the lead production in the principal lead-producing districts.

Mine production of recoverable lead in the principal lead-pr[illegible] United States, 1921–1929, in short tons

District	State	1921	1922	1923	1924	1925
Southeastern Missouri region.	Missouri	178,735	176,708	167,458	187,737	208,915
Coeur d'Alene region.	Idaho	94,543	91,216	114,426	118,327	120,856
Joplin region	Kansas, Missouri, Oklahoma.	61,581	87,771	86,787	92,110	105,372
Bingham	Utah	12,288	19,848	25,353	34,786	54,982
Tintic	do	18,158	23,040	38,900	40,674	45,889
Park City region	do	8,840	16,129	26,220	33,346	40,656
San Juan Mountains.	Colorado	5,323	5,332	13,157	13,148	17,092
Rush Valley	Utah	607	586	1,284	926	2,465
Butte	Montana	6,614	10,070	12,745	13,648	12,091
Barker	do	850	971	846	1,272	1,420
Willow Creek	New Mexico					
Leadville	Colorado	1,762	2,742	2,804	4,795	6,931
Central	New Mexico	2	176	656	592	1,182
Pioche	Nevada	666	932	2,697	2,152	2,806
Banner	Arizona	10	2,140	1,731	160	49
Jack Rabbit	Nevada	866	791	536	120	224
Tybo	do				1	3
Dome	Idaho	24			276	602
Upper Mississippi Valley.	Iowa, Northern Illinois, Wisconsin.	1,506	1,259	948	1,039	2,355
Warm Springs	Idaho	2,374	1,758	925	357	355
Cedar Plains	Montana	140	23	274	230	175
Bisbee (Warren)	Arizona	2,335	4,187	4,221	5,719	6,657
Pend d'Oreille	Idaho	1	239	304	67	113
Vulture	Arizona		3		4	26
Kentucky-Southern Illinois.	Kentucky-Illinois.	207	849	1,220	1,254	676
Aspen	Colorado	1,198	1,778	1,480	455	1,820
San Francisco	Utah	442	1,118	1,489	1,069	1,909
Inyo County	California	523	3,135	4,744	2,806	3,098
Yellow Pine	Nevada	93	158	786	3,855	2,644
Montana	Montana	749	775	912	1,241	1,427
Magdalena	New Mexico	30	462	753	818	1,217
Spruce Mountain	Nevada	458	237	261	508	647
Eureka	do	388	251	673	888	2,163
Summit County	Colorado	252	280	1,946	1,105	1,707
Bryant	Montana	83	158	968	1,743	1,150
Eagle County	Colorado	6	161	230	1,145	2,041
Texas	Idaho	971	2,168	2,417	2,197	1,714
Big and Little Cottonwood.	Utah	2,230	2,754	8,831	3,128	2,374
Northport	Washington	50	534	1,062	1,232	2,218
Troy	Montana	377	1,528	1,059	530	259
Ophir	Utah	480	2,921	3,443	1,414	2,945
Port Hill	Idaho	750	1,440	2,116	2,317	1,506
New Placers	New Mexico				3	125
Mammoth	Nevada	3	5	2	21	331
Bell	do		612	1,160		128
Embree	Tennessee		732	1,250	937	448
Austinville [1]	Virginia				1,275	782
Boulder [1]	Idaho				(2)	(2)
Oro Blanco [1]	Arizona				1	4

[1] Not listed according to rank. [2] Bureau of Mines not at liberty[illegible]

LEAD BALANCE SHEET OF THE UNIT[illegible]

Most of the lead ore mined in the United Stat[illegible] its lead content emerges in marketable form as p[illegible] lead and antimonial lead. Some of the ore is used i[illegible] of pigments and some may be exported, but for [illegible] amount exported has been negligible. The total [illegible] lead in the various products in which it is produ[illegible] compared in the following table with the estimates [illegible] in the ore mined. The table begins with 1907, the f[illegible] the mine production of the entire country was det[illegible] quantities compared were determined by independen[illegible] producers and consumers of lead-bearing ore, the t[illegible] on the accuracy of the figures.

Comparison of mine production of lead and primary domestic lead accounted for in lead products manufactured in the United States, 1907–1929, in short tons

Year	Mine production	Primary lead accounted for in— Refined lead	Antimonial lead	Pigments made from ore	Total	Primary excess (+) or mine excess (−)
1907–1918	5,653,706	5,249,081	124,168	121,750	[1] 5,503,330	−150,376
1919	429,589	424,433	8,339	11,179	[2] 443,954	+14,365
1920	496,814	476,849	8,032	15,212	500,093	+3,279
1921	414,491	398,222	6,675	9,989	414,886	+395
1922	477,633	468,746	5,810	13,892	488,448	+10,815
1923	547,217	543,841	9,794	13,612	567,247	+20,030
1924	596,068	566,407	11,741	15,338	593,486	−2,582
1925	684,439	654,921	12,500	17,547	684,968	+529
1926	683,917	680,685	16,620	13,685	710,990	+27,073
1927	665,489	668,320	14,044	13,136	695,500	+30,011
1928	[3] 627,153	626,202	15,825	10,465	652,492	+25,339
1929	[3] 647,995	672,498	14,751	9,429	696,678	+48,683
1919–1929	6,270,805	6,181,124	124,131	143,484	6,448,742	+177,937
1907–1929	11,924,511	11,430,205	248,299	265,240	11,952,072	+27,561

[1] Includes 8,325 tons of lead produced from domestic ores smelted outside the country.
[2] Includes 8 tons of lead produced from domestic ores smelted outside the country.
[3] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at liberty to publish.

The table shows substantial discrepancies for individual years, probably due largely to variations in mine and smelter stocks of ore, but in none of the last 11 years has the discrepancy exceeded 7 per cent of the total lead produced. From 1907 to 1918, inclusive, mine production exceeded the primary lead accounted for in lead products by 150,000 tons, or less than 3 per cent. From 1919 to 1929 there was an excess of nearly 178,000 tons, or less than 3 per cent, in favor of the lead contained in the lead products. For the total period of 23 years, 1907 to 1929, the primary lead content of lead products exceeded mine production by only 27,561 tons, or about one-fifth of 1 per cent.

LEAD SMELTERS AND REFINERIES

A list of lead smelters and refineries in the United States, Canada, and Mexico follows.

UNITED STATES

Arizona: Douglas—Phelps Dodge Corporation. (Smelter.)
California: Selby—Selby plant, American Smelting & Refining Co. (Smelter and refinery.)
Colorado:
  Durango—Durango plant, American Smelting & Refining Co. (Smelter.)
  Leadville—Arkansas Valley plant, American Smelting & Refining Co. (Smelter.)
Idaho: Bradley—Bunker Hill & Sullivan smelter. (Smelter and refinery.)
Illinois:
  Collinsville—St. Louis Smelting & Refining Works of National Lead Co. (Smelter and refinery.)
  Federal—Federal plant, American Smelting & Refining Co. (Smelter.)
Indiana:
  East Chicago—International Lead Refining Co.[3] (Refinery only.)
  East Chicago—U. S. S. Lead Refinery (Inc.)[4] (Refinery only. Betts electrolytic process.)
Kansas: Galena—Galena plant, Eagle-Picher Lead Co. (Smelter.)
Missouri:
  Granby—American Zinc, Lead & Smelting Co.[5] (Smelter.)
  Herculaneum—St. Joseph Lead Co. (Smelter and refinery.)
  Joplin—Eagle-Picher Lead Co. (Smelter.)
Montana: East Helena—East Helena plant, American Smelting & Refining Co. (Smelter.)

[3] Subsidiary of Anaconda Copper Mining Co.
[4] Subsidiary of the United States Smelting, Refining & Mining Co.
[5] Plant idle in 1929.

Nebraska: Omaha—Omaha plant, American Smelti
  and refinery.)
New Jersey:
  Newark—Balbach plant, U. S. Metals Refining
  Perth Amboy—Perth Amboy plant, America
    (Smelter and refinery.)
Oklahoma: St. Louis—Ontario smelter, Eagle-Piche
Pennsylvania: Carnegie—Pennsylvania Smelting C
Texas: El Paso—El Paso plant, American Smelting
Utah:
  International—International Smelting Co.[3] (S
  Midvale—United States Smelting, Refining &
  Murray—Murray plant, American Smelting &

CANADA

British Columbia: Trail—Consolidated Mining &
  (Ltd.). (Smelter and refinery. Betts electrolytic
Ontario: Galetta—Kingdon Mining, Smelting &
  (Smelter.)

MEXICO

Chihuahua: Chihuahua—American Smelting & Re
Coahuila: Torreon—American Metal Co. (Ltd.). (C
  (Smelter.)
Hidalgo: Zimapan—Cia. Min. y Fundidora de Zima
Nuevo Leon:
  Monterrey—American Metal Co. (Ltd.). (Cia
    (Smelter and refinery.)
  Monterrey—American Smelting & Refining Co
San Luis Potosi: San Luis Potosi—American Smel
  Minera Asarco.) (Smelter.)
Zacatecas: La Fé—American Metal Co. (Ltd.). (
  A.) (Smelter.)

TARIFF

The tariff act of 1930 became effective Ju
change in the lead schedules from the 1922 a
ticles or wares not especially provided for, i
chief value of lead, but not plated with plat
colored with gold lacquer, whether partly or
The import duty on articles coming under
increased from 40 per cent to 45 per cent ad
table gives the duties on the principal lead i

Import duties on lead commodities under th

Paragraph	Item
391	Lead-bearing ores, flue dust, and matte of all kinds. (Duty s to lead content of copper, gold, or silver ores, or copper ma tually recovered.)
392	Lead bullion or base bullion, lead in pigs and bars, lead dr lead, scrap lead, antimonial lead, antimonial scrap lead Babbitt metal, solder, all alloys or combinations of lead provided for.
	Lead sheets, pipe, glazier's lead, and lead wire
397	Articles or wares n. s. p. f., if composed wholly or in chief val not plated with platinum, gold, or silver, or colored with whether partly or wholly manufactured.
72	Lead pigments:
	Litharge
	Orange mineral
	Red lead
	White lead
	All pigments containing lead, dry or in pulp, or ground in oil or water, n. s. p. f.
46	Lead chemicals:
	Acetate, white
	Acetate, brown, gray, or yellow
	Nitrate, arsenate and resinate
	All other lead compounds, n. s. p. f.

[3] Subsidiary of Anaconda Copper Mining Co.

zinc concentrates and 6,335 tons of 74.47 per cent lead concentrates were produced. The lead concentrates contained 58.35 ounces of silver per ton. Operations were conducted at a loss, but profitable operations were expected to result from the completion of additional mill capacity and a lead smelter in 1930.

SPAIN

Spain produced nearly 143,000 metric tons of pig lead in 1929, an increase of 9 per cent over the 1928 output and equal to 8 per cent of the world total. Exports amounted to 99,600 tons, of which 2,400 tons was argentiferous lead. France took 33 per cent of the total, England 17 per cent, Russia 16 per cent, and Italy 13 per cent. The mine production of Spain in 1929 amounted to 180,890 tons of ore containing from 25 to 70 per cent of lead, as compared with 177,059 tons in 1928. Fifty-three per cent of the 1929 output came from the Province of Jaen, 18 per cent from Cordoba, 13 per cent from Murcia, and 5 per cent from Ciudad Real. The low price of lead prevailing during the latter part of 1929 and the early part of 1930 is reported to have resulted in the closing down of many of the smaller properties. Only the richest of the mines, or those where lead is found in large quantities and near the surface, are able to operate.

TUNISIA

Tunisia produced 18,850 metric tons of pig lead in 1929, as compared with 17,606 tons in 1928. Exports of pig lead in 1929 amounted to 18,296 tons, 88 per cent of which went to France. Production of lead ore was reported at 32,000 tons in 1929 and 34,000 tons in 1928.

YUGOSLAVIA

Developments in the lead industry of Yugoslavia in 1929 have been summarized by the Mining Journal [11] (London) as follows:

The country's output in lead ores advanced in 1929 to 26,250 tons, against 15,886 tons in the preceding year; the bulk of the production emanated from the Slovenian properties of the Central European Mines (Ltd.). This company treats imported parcels of ore, which swell the figures of the lead output from their smelter. Official returns appear to indicate that roughly some 9,460 tons of pig lead were produced in Yugoslavia during the year. Toward the close of the year lower metal prices began to adversely affect the production of lead ores by small producers. The foregoing figures solely refer to lead ores mined, smelted or sold, and do not take into account the considerable tonnage of lead-zinc ores which are being accumulated at surface on some of the Southern Serbia and Macedonia properties and await treatment. In July, 1929, the issue in London and oversubscription of 1,600,000 shares of Trepca Mines (Ltd.) attracted attention to this very promising enterprise, which has been hard at work since 1926 exploring and developing the Stantrg ore deposits near Kosovska Mitrovica. These deposits have now been sufficiently opened up for the estimate to be made that there are close upon three million tons of good-grade lead-zinc ore above the level of the lowest adit. Since last summer secondary development has been proceeding apace, and a very substantial tonnage is now blocked out; an aerial ropeway, a power plant, and a fine modern 500-ton mill are approaching completion. It is hoped that toward the autumn the producing stage will be reached, and even with to-day's depressed metal prices this concern should be able to give a very good account of itself. The company's concession and prospecting rights cover roughly 400 square miles, and there are indications of ancient mining operations in several localities, notably at Meljenica and

[11] Mining Journal (London): Vol. 170, July 26, 1930, p. 603.

Trepca Hill, where recent exploration has shown o
beneath the old surface and underground workings.
original prospectors of this concession located some fi
in the Government laboratories, showed values of ov
per ton, and it seems possible that systematic pro
reveal the source of this eroded material. To the sou
sion are the extensive areas held by Novo Brdo Min
amalgamated a few months ago with a sister concer
the merger being the normal outcome of a situation i
concession was completely surrounded by the big ho
Co. The joint capital is now £300,000 sterling, whi
continue the development of the lead-zinc ore bodies
to further examine the extensive tract of ancient wor
Novo Brdo areas. More recently Selection Trust
London two other companies to take over concess
Belasica Mines (Ltd.) and Kopaonik Mines (Ltd.),
£137,500 sterling. The concessions acquired are situ
Trepca areas and in the vicinity of Mount Kopaonik
cessions extending northward from this mountain tha
Penarroya Co., have been for some time past explo
workings known as the Plana Mine. The American
acquired a year or two ago the Srebrenitsa Concessio
again an extensive concession comprising an ancient c
which was also a scene of mining activity during t
however, the opening up of the property has not been p

IMPORTS

The United States imports much lead in va
in base bullion and ore. Some of it is enter
sumption; most of it, however, is entered for
and refined in bond, and is then reexported a
manufactured products.

GENERAL IMPORTS

The following table shows the general im
United States, by classes, including both i
consumption and imports for warehouse. Of t
in 1929, as shown in the table, 71. 6 per cen
27.0 per cent in ore, and 1.4 per cent in pigs,
Imports in base bullion decreased 35 per cent
and in pigs, bars, etc., increased 21 per cent and
tively. Total imports of lead decreased 25 p

Lead imported into the United States, 1920–1929, b

[General imports]

Year	Lead in ore	Lead in bulli
1920	29, 488, 816	96, 10
1921	14, 234, 039	71, 73
1922	24, 474, 481	124, 07
1923	66, 882, 850	161, 49
1924	95, 320, 168	155, 50
1925	88, 962, 502	141, 25
1926	116, 232, 669	156, 57
1927	81, 276, 126	236, 56
1928	51, 829, 530	256, 93
1929	62, 661, 871	166, 14

General imports of lead by countries are sh
Mexico supplied nearly 76 per cent of the
(principally Peru) 20 per cent, Canada 4 per

other countries only small amounts. Imports from Mexico and Canada decreased 36 per cent and 37 per cent, respectively, while imports from South America increased 131 per cent. The decrease from Mexico was due to a large decline in imports of base bullion, while the decrease from Canada was due to lower imports of lead in ore. The increased shipments of base bullion from Peru and lead ore from Chile accounted for the increase of lead imports from South America.

Lead imported into the United States, in ore, base bullion, and refined, 1920–1929, by sources, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total
1920	8, 199, 234	131, 816, 278	7, 086, 351	38, 766, 504	11, 163, 100	197, 029, 527
1921	8, 127, 158	106, 406, 238	2, 381, 365	30, 224, 701	1, 430, 949	148, 570, 411
1922	8, 663, 236	141. 216, 136	3, 803, 478	1, 454, 384	513, 335	155, 650, 569
1923	11, 399, 671	242, 352, 788	5, 300, 161	11, 004, 938	520, 635	270, 578, 193
1924	11, 022. 091	243, 161, 069	15, 820, 867	4, 857, 805	453, 432	275, 315, 264
1925	11, 646, 820	218, 873, 800	10, 621, 737	1, 594, 963	1, 521, 110	244, 258, 430
1926	12, 316, 740	254, 203, 852	24, 790, 075	3, 224, 504	572, 856	295, 108, 027
1927	6, 214, 867	300, 634, 815	14, 583, 513	1, 226, 049	118, 883	322, 778, 127
1928	14, 352, 967	275, 184, 287	20, 408, 574	56, 406	85, 915	310, 088, 149
1929	9, 023, 527	175, 872, 302	47, 052, 018	29, 441	141, 480	232, 118, 768

The following tables show the imports of lead in ore, matte, and base bullion, by countries.

Lead imported into the United States, in ore and matte, 1925–1929, by countries, in short tons

[General imports]

Country	1925	1926	1927	1928	1929
Mexico	32, 971	40, 239	30, 615	17, 055	23, 415
Canada	4, 978	5, 524	2, 558	7, 131	3, 953
Peru	1, 887	3, 042	3, 415	1, 170	1, 601
Chile	3, 216	7, 506	3, 877	504	2, 295
Other countries	1, 429	1, 115	173	55	67
	44, 481	58, 116	40, 638	25, 915	31, 331

Imports of lead in ore from Mexico increased 37 per cent in 1929, amounting to 75 per cent of the total. Imports from Chile and Peru increased considerably, while imports from Canada decreased 45 per cent.

Lead imported into the United States, in base bullion, 1925–1929, by countries, in short tons

[General imports]

Country	1925	1926	1927	1928	1929
Mexico	70, 505	77, 663	117, 938	119, 935	63, 458
Peru		435		8, 525	10, 605
Spain			336		
Other countries	122	187	10	8	8
	70, 627	78, 285	118, 284	128, 468	83, 071

Imports of base bullion from Mexico in 1929, although 47 per cent less than in 1928, amounted to 76 per cent of the total. The decrease was due to the completion of additional refinery capacity during the year, which permitted an increase in the quantity of

refined lead produced in Mexico. Imports fro[...]
per cent owing to increased production in that [...]
de Pasco Copper Corporation.

IMPORTS FOR CONSUMPTI[...]

Statistics on imports for consumption, as sho[...]
follow, include imports entered for immediate c[...]
drawals from warehouse for domestic consump[...]
lead imported is smelted and refined in bond an[...]
imported for consumption is considerably less [...]
In 1929 imports for consumption were equival[...]
per cent of the general imports of lead.

Lead remaining in warehouse in the United States, De[...] pounds

[Stated in the form in which the material was entered [...]

Year	Ore (lead content)	Base bullion (lead content)	Pigs, bars, and old	Year	Ore (lead con[...]
1920	32, 923, 299	69, 517, 026	2, 644, 576	1925	105, 8[...]
1921	13, 679, 465	24, 692, 350	693, 440	1926	114, 6[...]
1922	10, 470, 144	7, 076, 544		1927	99, 5[...]
1923	76, 031, 259	80, 806, 856	5, 234, 475	1928	97, 6[...]
1924	103, 474, 370	95, 007, 016	10, 090, 668	1929	120, 4[...]

[1] Includes lead in reclaimed scrap, as follows: 1925, 241,078 pounds; 1[...] pounds. Corresponding figures for earlier years and for 1928 and 1929 are [...]

Lead imported for consumption in the United States, [...]

Year	Lead in ore [1]		Lead in base bullion		Pigs, bars, and old [2]		[...]
	Pounds	Value	Pounds	Value	Pounds	Value	P[...]
1920	13, 700, 499	$908, 619	66, 816, 820	$3, 340, 600	68, 901, 959	$3, 887, 821	
1921	6, 842, 807	327, 046	56, 819, 980	1, 668, 410	61, 909, 094	1, 972, 716	
1922	23, 649. 851	812, 603	55, 859, 422	1, 815, 142	8, 566, 110	835, 924	
1923	22, 420, 046	1, 190, 414	11, 124, 151	626, 201	42, 925, 265	2, 510. 466	
1924	65, 147, 976	3, 145, 791	28, 796, 402	1, 542, 167	27, 362, 392	1, 850, 862	
1925	12, 706. 508	672, 112	24, 747, 605	1, 823, 566	15, 464, 205	1, 038, 350	
1926	58, 752, 911	3, 393. 039	13, 341, 038	972, 758	24, 365, 570	2, 191, 658	8[...]
1927	70, 200, 478	4, 203, 897	14. 629, 600	925, 328	9, 933, 679	635, 807	9[...]
1928	46, 511, 508	2, 626, 231	13. 397, 455	560, 983	20, 488, 373	808, 359	7[...]
1929	21, 645, 609	1, 160, 533	12, 395, 696	627, 455	20, 178. 922	1, 052, 087	8[...]

[1] Includes also lead in matte beginning Sept. 22, 1922.
[2] Includes also imports of antimonial lead, antimonial scrap lead, babb[...] with tariff of Sept. 22, 1922, except in 1925, 1926, 1927, 1928, and 1929, when [...]

Type metal [1] imported for consumption in the Unit[...]

Year	Type metal	
	Pounds	Val[...]
1920	29, 887, 353	$1, 34[...]
1921	38, 971, 851	1, 19[...]
1922	44, 895, 120	1, 12[...]
1923	(2)	43[...]
1924	(2)	10[...]
1925 [1]	6. 009, 161	46[...]
1926 [1]	8, 621, 175	91[...]
1927 [1]	878, 846	6[...]
1928 [1]	8, 990, 548	19[...]
1929 [1]	5, 440, 857	18[...]

[1] Classification for 1925 to 1929 is "Type metal and antimonial lead"; se[...]
[2] Figures not available.

EXPORTS

The chief lead export of the United States is refined pig lead derived from the treatment of foreign ores and base bullion. Exports decreased 37 per cent in 1929 owing primarily to a 35 per cent decrease in imports of base bullion. Europe took 69 per cent of the total, Asia 25 per cent, South America 5 per cent, and North America and Africa 1 per cent. In Europe United Kingdom, Germany, and Sweden were the largest importers, while in Asia and South America Japan and Brazil ranked first. United Kingdom took 32 per cent and Japan 22 per cent of the total United States exports.

Refined pig lead exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	132	$18,755	141	$24,662
Cuba	152	18,249	248	27,899
Mexico	79	10,815	83	16,696
Panama	19	2,655	52	6,981
Other	90	11,857	169	29,107
	472	62,431	693	105,345
South America:				
Argentina	1,243	129,705	599	57,848
Brazil	2,439	243,303	1,538	154,135
Chile	494	56,284	989	112,220
Colombia	87	11,906	93	13,481
Ecuador	18	2,392	33	4,465
Peru	78	7,308	88	8,693
Uruguay	384	35,540	448	43,248
Other	91	9,181	64	7,318
	4,834	495,619	3,852	401,405
Europe:				
Belgium	861	74,549	806	92,085
Denmark	3,673	321,700	4,322	419,031
France	4,628	397,123	2,202	205,009
Germany	23,552	2,063,281	9,745	945,460
Italy	336	29,440	103	9,700
Netherlands	5,088	445,294	1,522	149,812
Sweden	5,316	463,050	7,255	708,255
United Kingdom	43,428	3,817,353	23,732	2,295,228
Other	279	25,418	872	84,945
	87,161	7,637,208	50,649	4,909,535
Asia:				
China	2,131	190,306	813	78,439
Japan	21,216	1,927,144	16,416	1,594,706
Philippine Islands	210	22,118	111	14,417
Other	245	24,296	715	74,154
	23,802	2,163,864	18,055	1,761,716
Africa	(1)	57	2	215
Oceania, French	(1)	42	(1)	121
	116,269	10,359,221	73,251	7,178,837

[1] Less than 1 ton.

The following table shows the exports of lead from the United States from 1920 to 1929. Of the lead exported with benefit of drawback in 1929 miscellaneous lead manufactures (principally lead foil) accounted for 55.1 per cent, white lead in oil 25.1 per cent, red lead and litharge 9.9 per cent, babbitt 2.7 per cent, lead-covered cable 2.0 per cent, type metal 1.8 per cent, shot shells 1.6 per cent, and others 1.8 per cent.

Refined lead exported from the Unite

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)	Year
	Short tons	Value		
1920	20,093	$3,032,758	6,175	1925
1921	26,624	2,462,033	9,369	1926
1922	38,178	3,781,965	5,677	1927
1923	50,735	5,455,743	12,526	1928
1924	82,090	10,396,766	15,275	1929

CONSUMPTIO

REFINED PRIMARY PIG LEAD AVAI CONSUMPTIO

The manufacturing industry of the Uni four main forms; namely, refined prima monial lead, primary lead in the form The following table shows the refined for consumption from 1924 to 1929.

Refined primary pig lead available for consumptio in short tons

	1924	1925
Supply:		
Stock in bonded warehouse Jan. 1	2,617	5,04
Imports of pigs, bars, and old [1]	12,247	7,02
Production	690,493	766,96
	705,357	779,03
Withdrawn:		
Exports—		
Pig lead	82,090	103,51
In manufactures, with benefit of drawback	15,275	11,69
Stock in bonded warehouse Dec. 31	5,045	8,16
	102,410	123,38
Supply available for consumption	602,947	655,65

[1] Includes 622 tons of "old, reclaimed, and scrap" in 1925 a ures for other years not separately recorded.

The foregoing table is intended to in lead smelted directly from ore. There a crepancies which should be pointed out. produce from secondary materials som from the primary lead in the final pr reported above may therefore contain so are also some inaccuracies in the statisti warehouse transactions. Nevertheless, available, the table gives approximately lead available to American industry eac not consider fluctuations in producers' indicates the trend of consumption only i

CONSUMPTION BY USES

The quantity of lead in all forms consumed by American industry is estimated each year by the American Bureau of Metal Statistics. The following table is quoted in full from the 1929 yearbook of that bureau.

Lead consumed in the United States,[1] 1921–1929, in short tons

Purpose	1921	1922	1923	1924	1925	1926	1927	1928	1929
White lead [2]	136,000	156,000	130,000	150,000	131,000	120,000	126,000	123,000	118,000
Red lead and litharge [3]	23,500	30,000	46,000	34,000	42,000	36,000	38,000	31,000	30,000
Storage batteries [4]	87,000	130,000	143,000	170,000	180,000	190,000	175,000	220,000	210,000
Cable covering [4]	67,000	93,000	131,000	138,000	156,000	185,000	161,000	180,000	206,000
Building [5]	48,000	71,000	75,000	83,100	88,400	93,700	88,000	96,000	96,000
Automobiles [5]	4,600	7,200	10,400	10,700	12,800	16,700	12,000	17,000	18,000
Locomotives [6]	1,000	850	2,100	1,100	750	1,000	650	500	800
Railway cars [6]	1,800	2,500	6,000	4,500	4,450	3,800	2,700	2,000	3,500
Shipbuilding [4]	850	100	100	200	100	100	200	100	100
Ammunition [4]	20,500	38,000	40,000	27,000	31,500	32,000	34,000	39,000	41,100
Terneplate [4]	3,000	4,700	4,600	4,050	4,500	4,100	3,900	4,400	4,200
Foil [4]	23,800	26,800	33,300	35,000	32,500	35,000	30,000	35,000	30,000
Bearing metal [5]	21,000	26,000	28,000	32,000	34,000	36,000	31,000	32,000	33,000
Solder [7]	12,000	20,000	30,000	30,000	35,000	37,000	35,000	37,000	37,000
Type metal [7]	7,500	9,500	12,000	13,000	15,000	16,000	16,000	17,000	18,000
Calking [7]	20,000	20,000	25,000	26,500	30,000	32,000	30,000	32,000	31,500
Castings [7]	12,000	15,000	15,000	16,000	18,000	18,000	17,000	18,000	18,000
Other uses [8]	25,000	82,500	36,500	38,000	40,500	44,500	40,500	46,000	50,000
Total	520,550	683,150	768,000	812,150	856,500	900,900	840,950	930,600	945,200

[1] Source: American Bureau of Metal Statistics. These estimates are for the total consumption of lead, irrespective of whether its origin be primary or secondary. Antimonial lead is included and the manufacture of lead for export under drawback provisions is included.
[2] From data of sales reported by U. S. Bureau of Mines up to 1929. The 1929 figure has been determined by an improved method.
[3] Exclusive of oxides for storage batteries; based on data of sales reported by U. S. Bureau of Mines.
[4] Based on reports from a large proportion of manufacturers in each industry.
[5] Based upon estimates of manufacture and the quantity of lead used per unit of manufacture. Under the head of building is included the lead used in chemical construction.
[6] Based on the estimated consumption of lead for this purpose by the railways.
[7] Estimates of persons engaged in the trades.
[8] Conjectural.

According to the foregoing table the lead consumed in the United States in 1929 amounted to 945,200 tons, which surpassed all previous records. It exceeded 1928, the previous peak, by 2 per cent and 1927 by 12 per cent. In the following table the individual uses of lead have been arranged according to their percentage relation to the total lead consumed in 1929.

Percentage of total lead consumed in the United States, 1925–1929, by uses

Use	1925	1926	1927	1928	1929
Storage batteries	21.02	21.09	20.81	23.64	22.22
Cable coverings	18.21	20.53	19.15	19.34	21.79
White lead	15.29	13.32	14.98	13.22	12.48
Building	10.32	10.40	10.46	10.32	10.16
Ammunition	3.68	3.55	4.04	4.26	4.35
Solder	4.09	4.11	4.16	3.98	3.92
Bearing metal	3.97	4.00	3.69	3.44	3.49
Calking	3.50	3.55	3.57	3.44	3.33
Litharge and red lead	4.90	4.00	4.52	3.33	3.17
Foil	3.80	3.89	3.57	3.76	3.17
Castings	2.10	2.00	2.02	1.93	1.91
Type metal	1.75	1.78	1.90	1.83	1.91
Automobiles	1.49	1.85	1.43	1.83	1.91
Terneplate	.53	.45	.46	.47	.44
Railway cars	.52	.42	.32	.21	.37
Locomotives	.09	.11	.08	.05	.08
Shipbuilding	.01	.01	.02	.01	.01
Miscellaneous	4.78	4.94	4.82	4.94	5.29

For several years storage batteries have bee
of lead, having taken first place from white l
batteries are used chiefly in motor vehicles, y
23 per cent increase in the number of passenger
factured in 1929 there was a decrease of 5 pe
of lead used in storage batteries. The decreas
part to the larger percentage of light-weight
1929 which operate with the smaller-size st
American Bureau of Metal Statistics has esti
of automobile storage batteries at 16,000,000 i
in 1928. Exports of storage batteries have g
total of about 207,000 in 1925 to 353,000 in 1
per cent. The expansion of the automobile
trade has more than offset the decreased use
radios which resulted from the introduction o
The American Bureau of Metal Statistics has
170,000 radio storage batteries were manu
compared to 400,000 in 1928.

The second largest use of lead is as a protecti
wire cables used chiefly in telephone and und
lines. The quantity of lead so used in 1929
records, being 14 per cent greater than in 1928
than in 1926, the previous peak. This use ap
crease. General expansion of the use of electr
large electrification programs announced by so
panies and the development of the Boulder
power projects, will require large amounts
Increasing civic consciousness will undoubte
many of the present unsightly overhead telep
lines underground, as has been the custom in
many years. Research work now in progress t
and remedies of certain defects in lead-covered
its use in some industries should yield profitab
the market for lead-covered cable.

The manufacture of white lead is the third
one that appears to be on the decline. Prior
was the largest consumer of lead and in 1922 to
or 23 per cent of the total estimated lead consu
118,000 tons (12.5 per cent of the total) was s
use of white lead is due to the substitution in
pigments, principally lithopone and zinc oxide
use of nitrocellulose paints in which white le
count of its chemical instability in contact with

F. E. Wormser, secretary of the Lead Indu
summarized developments in the uses of lead

A lead-calcium alloy which is finding wide use as ca
been developed. The addition of a very small amou
an alloy of high-fatigue strength which is resistant to f
such as are often encountered in cables due to expans
Lead linings are now being extensively used in the
cipally because of developments which have produ
secrets of the various processes of manufacturers makin
usually carefully guarded, but the fact remains that

[1] Wormser, F. E., Lead: Metal Ind., vol. 28, January, 1930, p. 7.

proved. Could production costs be lowered, these products would find even a wider field of application. Large amounts of antimonial-lead sheet are used as tank linings in the chromium-plating industry, and it has been found that if these tanks are put into use immediately or if they are given anodic treatment at regular weekly intervals the life of the lining can be extended.

Lead-coated copper is finding growing favor for architectural purposes such as roofing, leaders, and gutters. It has the advantage of the strength and durability of copper plus the protection and durability of lead. Moreover, it furnishes a pleasing gray color, one which will not discolor, and is less expensive than antimonial or soft lead. This gives it a wide field of application on moderate-priced dwellings where lead is considered too expensive. Here it is interesting to note that results of tests on the corrosion of metals by city air, conducted in England and reported by J. Newton Friend, place antimonial lead at the top, followed by the highest grade of tin and then soft lead. Other metals, common tin, stainless steel, aluminum, copper, and so on, follow.

The Bureau of Standards is doing considerable research work on lead-bearing metals at the request of the Assistant Secretary of War with the idea of replacing tin-base bearings with lead base for the purpose of conserving tin. E. J. Hall, of the Hall-Scott Motor Car Co., reports that they have found that a bearing composed of 25 per cent lead and 75 per cent copper, having no lining or backing but a uniform structure throughout the shell, will give from 100,000 to 150,000 miles of intercity motor-coach service without attention.

The use of a baked red-lead priming coat under asphaltic or bituminous protective coatings on underground pipe lines has only received general attention in the last six months, although such a coat has been successfully used in isolated instances for several years. This red-lead coat has been entered in the tests of coating materials being conducted by the American Gas Association and the Bureau of Standards and should give a good account of itself judging by past performances. This may open another large market for red lead.

PRICES

The two major markets for lead in the United States are at New York and St. Louis, and a large part of the lead produced in the United States is sold at prices based on the quotations in these two 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, 0.35 cent a pound. The following tables show the average monthly quoted prices of lead at St. Louis, New York, and London for 1927, 1928, and 1929 and the average yearly prices from 1910 to 1929, inclusive.

Average monthly quoted prices of lead at St. Louis, New York, and London, 1927–1929, in cents per pound [1]

Month	1927			1928			1929		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	7.41	7.58	5.95	6.29	6.50	4.74	6.50	6.65	4.79
February	7.29	7.48	5.92	6.08	6.34	4.41	6.73	6.86	5.01
March	7.34	7.61	6.03	5.82	6.02	4.34	7.38	7.50	5.50
April	6.84	7.11	5.76	6.00	6.11	4.42	7.03	7.20	5.37
May	6.27	6.60	5.43	6.02	6.13	4.46	6.77	7.00	5.19
June	6.16	6.43	5.30	6.16	6.30	4.57	6.80	7.00	5.13
July	6.13	6.36	5.09	6.05	6.22	4.47	6.61	6.80	4.94
August	6.39	6.68	5.02	6.05	6.25	4.68	6.55	6.75	5.02
September	6.05	6.31	4.66	6.29	6.45	4.77	6.69	6.89	5.10
October	6.01	6.26	4.45	6.32	6.50	4.78	6.67	6.87	5.08
November	6.04	6.28	4.55	6.23	6.39	4.60	6.13	6.29	4.71
December	6.33	6.51	4.83	6.34	6.50	4.62	6.10	6.25	4.68

[1] St. Louis: Metal Statistics, 1930, p. 389. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in the American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market) prompt shipment from west.
London: Metal Statistics, 1930, p. 393. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.

Average yearly prices of lead at St. Louis, New York, a

Year	St. Louis [1] (per pound)	New York [2] (per pound)
	Cents	*Cents*
1910	4.33	4.4
1911	4.31	4.4
1912	4.38	4.4
1913	4.20	4.4
1914	3.74	3.8
1915	4.57	4.6
1916	6.80	6.8
1917	8.92	8.7
1918	7.25	7.4
1919	5.55	5.8
1920	7.93	8.0
1921	4.80	4.5
1922	5.52	5.7
1923	7.35	7.2
1924	8.10	8.0
1925	8.92	9.0
1926	8.25	8.4
1927	6.52	6.7
1928	6.14	6.3
1929	6.66	6.8

[1] Compiled from daily quotations in open market at St. Louis, as pu
p. 387.
[2] Average prices based on quotations of American Smelting & Refinin
tistics, 1930, p. 381.
[3] Prices of foreign lead in London, as published in Metal Statistics, 19
pound on basis of average exchange rates published in the reports of the
[4] Import duties on refined pig lead have been as follows: Aug. 6, 1909, to
Oct. 4, 1913, to Sept. 21, 1922—25 per centum ad valorem; average tarif
Sept. 22, 1922, to date (1929)—2⅛ cents per pound.

To facilitate the settlement of its buying an
lead the American Smelting & Refining Co., whic
of the United States lead production, at freque
an official contract price based on the New
following are the company's quotations for 50-
York, in 1928 and 1929, in cents per pound:

1928

Feb. 10	6.35
Feb. 20	6.25
Feb. 27	6.15
Mar. 1	6.00
Apr. 2	6.10
May 25	6.20
May 29	6.30
July 9	6.20
Aug. 23	6.30
Aug. 27	6.40
Sept. 17	6.50
Nov. 9	6.35
Dec. 3	6.50

1929

Jan. 2	6.65
Feb. 6	6.75
Feb. 11	
Feb. 19	
Feb. 27	
Mar. 6	
Mar. 19	
Mar. 20	
Apr. 4	
Apr. 8	
Apr. 10	
Apr. 15	
July 5	
July 10	
Sept. 5	
Oct. 29	
Oct. 31	
Nov. 6	
Nov. 7	

The gradual upward trend in the price of lea
tinued in the early part of 1929. The New Yo
ary 2 and the average for that month was 6.

sharp increase from 6.50 cents on December 31, 1928. During February there was a further increase to an average of 6.86 cents. The threatened curtailment of supplies from Mexico, due to the revolution, sent the price to 7.80 cents toward the latter part of March, a high for the year, but following the collapse of the revolution the price quickly declined to 7 cents by April 15. Meanwhile rising prices had stimulated production, and when domestic consumption declined sharply in May and June stocks increased rapidly and the price of lead decreased to an average of 6.75 cents in August. In September and October the price increased slightly as a result of increased demand, but in November and December the price dropped off sharply following the stock-market crash. The New York quotation was 6.25 cents on December 31, 1929.

The average New York price for 1929 was 6.83 cents—8 per cent over the 1927 average and 24 per cent under the record 1925 price. The New York market averaged 0.17 cent per pound over the St. Louis market in 1928, as compared with 0.17 cent in 1928 and 0.23 cent in 1927.

The average price, including domestic and foreign sales, received by lead producers in the United States in 1929, according to reports of producers to the Bureau of Mines, was 6.3 cents a pound; in 1928 it was 5.8 cents.

The London quotation reached the high monthly average in March (equivalent to 5.5 cents per pound), declined to approximately 5 cents during July, August, September, and October, then declined further to 4.68 cents in December. The yearly average was 10 per cent greater in 1929 than in 1928; it was 1.79 cents per pound under the New York price in 1929, as compared to 1.73 cents in 1928.

GOLD, SILVER, AND LEAD I

(MINE REPOR

By Chas. W. Hen

SUMMAR

Metal mining in South Dakota is conf
counties—Custer, Lawrence, and Penn
the Black Hills. The Homestake go
County, has been producing almost co
now the largest producing gold mine in
this mine to the company's mills amour
an increase of 20,986 tons over 1928, b
of gold-silver bullion bars amounted
$48,946.74 less than in 1928. The o
South Dakota in 1929 was a lode mine
nington County. The following table s
mines, tons of ore produced, and recover
Dakota from 1920 to 1929.

Mine production of gold, silver, and lead in So
recovered meta

Year	Mines producing			Ore (short tons)	Gold (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value
1920	3	4	7	1,356,189	226,224.23	$4,676,470
1921	3	6	9	1,725,685	319,524.95	6,605,167
1922	3	3	6	1,751,454	315,297.99	6,517,788
1923	5	-------	5	1,605,439	309,905.05	6,406,306
1924	4	-------	4	1,674,720	295,930.24	6,117,421
1925	3	-------	3	1,590,079	289,747.10	5,989,604
1926	2	2	4	1,415,785	279,528.93	5,778,376
1927	2	2	4	1,376,583	322,031.74	6,656,987
1928	5	4	9	1,422,233	317,378.04	6,560,805
1929	2	-------	2	1,463,159	316,836.85	6,549,599

For total production of gold and silver in South Dakota,
42, and Mineral Resources, 1922, pt. 1, p. 194.

Work on manuscript completed February, 1931.
For information on the geology of the metal resources of
vey Geol. Atlas, Central Black Hills Folio 219, 1925.

the deposits are situated in the Atlas Mountains, and it is estimated from top layers alone 20,000,000 tons of bauxite can be obtained. The mineral has a large alumina content, estimated at 70 per cent, and numerous water falls in the vicinity can furnish water power for the mining operations.

GOLD COAST

Bauxite, or aluminum hydrate, with certain impurities is found over portions of Gold Coast Colony and Ashanti, as a cap from a few feet to more than 50 feet in thickness on the summits of several mountains. The ores are of fairly high grade. The most important deposits are those of the Mount Ejuanema Kwahu district, estimated to have about 4,000,000 tons, and the Sefwi Bekwai district, having about 33,300,000 tons.[39] The Ejuanema deposit is 1½ miles in a direct line from Nkawkaw railway station, which is 111 miles from the port of Accra or 249 miles from the port of Sekondi, via Kumasi. The Sefwi Bekwai deposits are about 55 miles northwest of Dunkwa, a station on the Sekondi-Kumasi Railway 100 miles from Sekondi. Average analyses of 198 specimens from Mount Ejuanema and of 5[…] specimens from Mount Supirri, Sefwi, are reported as follows:

	Mount Ejuanema	Mount Supirri
SiO_2	0.87	1.88
Al_2O_3	60.06	55.77
Fe_2O_3	9.27	10.30
TiO_2	1.94	1.12
H_2O	26.80	30.69

During 1928 a large deposit of bauxite was discovered[40] 4 to 5 miles west of Kumasi, 18 miles northeast of Bibiani, at the end of a proposed Western Province Railway in the Yenahin district; the deposit is alleged to contain 180,000,000 tons of good ore. Bauxite deposits have been located in the Pusu Pusu River, Kibi district, in Akim, and small deposits at Atiwa Range, Sajumase.

Although the economic value of these Gold Coast deposits has not been demonstrated and the quantity of bauxite reported for the Yenahin district seems almost fantastic, it seems probable that the Gold Coast may be counted upon to provide reserves of substantial character for the future.

OCEANIA

AUSTRALIA

Bauxite deposits have been found 60 miles southwest of Gladstone, at Crows Nest near Toowoomba, and at Cooranga station in the Gaynah district, Queensland, and numerous high-iron bauxite deposits are known in New South Wales. Aluminous clays, alunite, and bauxitic clays have been found in other sections of Australia. Production has been small and has come chiefly from Victoria which produced 55[…] metric tons of bauxite in 1929, compared with 196 tons in 1928 and 936 tons in 1927.

[39] American Metal Market, Large Bauxite Deposits of Gold Coast: Dec. 9, 1927.
[40] Mining Journal, London, vol. 104, No. 4882, Mar. 10, 1929, p. 200.

LEAD AND ZINC PIGMEN[…]

By ELMER W. PE[…]

SUMMARY

Lead pigments accounted for 55.6 per […]
per cent of the total value of the lead and […]
tic producers in 1929, which amounted to […]
an increase of 2 per cent over 1928. […]
pigments sold increased 2 per cent in tot[…]
The quantity of lead pigments sold by […]
to 295,460 short tons, a decrease of nearl[…]
arge, red lead, and orange mineral incre[…]
of white lead in oil and white sublimed lea[…]
lead in oil were the lowest since 1918 and […]
per cent of the 1922 sales. Sales of dry […]
lead were practically unchanged in 1929.
The quantity of zinc pigments sold by […]
to 394,075 short tons, an increase of 2 p[…]
lithopone increased by 6,000 tons, or 3 p[…]
zinc oxide increased by 3,000 tons, or 12[…]
decreased slightly.
Sales of zinc chloride increased 2 per c[…]
Quoted prices of lead pigments in 1929 […]
tions in pig-lead quotations; the averag[…]
lead pigments sold by producers, as repor[…]
increased only 3 per cent, whereas the a[…]
lead increased 8 per cent. Quotations […]
changed throughout the year at levels es[…]
age price received by producers per to[…]
reported to the Bureau of Mines, decreas[…]
average quoted price for slab zinc increas[…]
Imports of lead pigments in 1929 were […]
pigments increased 3 per cent in quanti[…]
and amounted to 3 per cent of the tota[…]
producers. The total quantity of whi[…]
exported decreased 9 per cent, whereas th[…]
39 per cent.
Imports of zinc pigments in 1929 decre[…]
and 5 per cent in value and were equival[…]
3 per cent of the sales by domestic produ[…]
and zinc oxide decreased, whereas impo[…]
doubled. Exports of zinc pigments in 19[…]
quantity and 26 per cent in value and am[…]
per cent of the total domestic output.

[1] Work on manuscript completed December, 1930.
[2] The statistics in this report were prepared (unless otherwis[…]
on imports and exports were compiled from records of the Bure[…]
J. A. Dorsey, both of the Bureau of Mines.

An outstanding feature of the lead and zinc pigment industry during the last few years has been the severe competition between white lead and other pigments for the paint trade. The effect of this is indicated roughly in the comparative sales of the pigments concerned. Sales of white lead in oil decreased from 153,000 tons in 1922 to 105,000 tons in 1929. During the same period the combined sales of zinc oxide and lithopone increased from 212,000 to 367,000 tons. As three-fourths of the lithopone and about one-third of the zinc oxide produced in the United States are used in the manufacture of paints, these figures indicate the marked degree to which the zinc pigments have invaded the paint industry at the expense of white lead.

The rapid expansion in the use of nitrocellulose paints in recent years has not altered materially the quantity of pigments consumed. The average nitrocellulose paint contains considerably less pigment per gallon than oil paints, but a heavy pigment priming coat and more finishing coats are used to offset the low pigment content. White lead is seldom used in these paints owing to its chemical instability in contact with nitrocellulose products. As it is desirable to have a low pigment content in nitrocellulose paints there has been an increased use of high hiding-power pigments such as high-strength lithopone and titanium pigments.

PRODUCTION

In this chapter the pigments and salts sold are considered as representing the production, no account being taken of the stocks on hand at the beginning and end of the year. The amounts used by producers at their own plants are included under sales. The total value of the lead and zinc pigments sold by domestic producers was approximately $98,045,000 in 1929 as compared with $96,136,000 in 1928, the increase being shared about equally by the lead and the zinc pigments. The quantity of lead pigments was slightly less in 1929 than in 1928, but the average value per ton was 3 per cent more; the average quoted price for pig lead was 8 per cent higher than in 1928. There was a slight increase in the quantity of zinc pigments in 1929, but the average value per ton was 0.3 per cent less than in 1928; the average quoted price for slab zinc increased 8 per cent over 1928.

The following tables show the production of lead and zinc pigments and zinc salts as reported to the Bureau of Mines.

Lead pigments sold by domestic manufacturers in the United States, 1920–1929, in short tons

Year	White lead		Basic lead sulphate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1920	33,678	112,017	12,412	928	[1] 34,431	([1])	62,829
1921	26,738	143,545	11,568	463	21,805	381	41,009
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107
1924	42,622	144,872	14,572	1,088	36,813	331	74,724
1925	43,426	120,479	14,996	1,090	41,669	840	86,546
1926	37,968	111,845	12,271	1,236	42,550	813	82,540
1927	38,669	119,026	13,482	1,061	39,073	709	81,655
1928	42,049	111,923	16,002	1,234	40,497	459	85,570
1929	42,150	104,872	15,580	1,234	43,021	678	87,916

[1] Figures for red lead include orange mineral prior to 1921.

Lead pigments sold by domestic manufacturers in the

	1928		
	Short tons	Value (at plant, ex-sive of containe	
		Total	Ave
Basic lead sulphate or sublimed lead:			
White	16,002	$2,211,470	$
Blue	1,234	175,508	
Red lead	40,497	6,816,876	
Orange mineral	459	112,521	
Litharge	85,570	12,872,730	
White lead:			
Dry	42,049	6,683,115	
In oil	111,923	24,553,989	

Zinc pigments and salts sold by domestic manufacture 1929, in short tons

Year	Zinc oxide	Leaded zinc oxide
1920	99,444	30,460
1921	74,329	16,103
1922	128,465	19,613
1923	126,987	23,504
1924	131,470	26,729
1925	151,354	31,750
1926	146,923	23,859
1927	151,246	26,064
1928	160,904	24,223
1929	160,611	27,149

[1] Figures cover production, not sales.
[2] Figures published in earlier reports of this series have been revise liberty to publish the revised figures.
[3] Bureau of Mines not at liberty to publish figures.

Zinc pigments and salts sold by domestic manufacture and 1929

	1928		
	Short tons	Value (at plant, exclu-sive of container)	
		Total	Averag
Zinc oxide [1]	160,904	$20,685,442	$12
Leaded zinc oxide [1]	24,223	2,945,823	12
Lithopone	200,468	19,073,914	9
Zinc chloride, 50° Baumé	38,837	1,706,222	4
Zinc sulphate	([3])	([3])	([3])

[1] Zinc oxide containing 5 per cent or more of lead is classed as lead
[2] Figures published in the report of this series for 1928 have been not at liberty to publish the revised figures.
[3] Bureau of Mines not at liberty to publish figures.

Statistics for lead arsenate, lead acetate, zinc stearate, and other lead and zinc salts and compounds are collected biennially by the Bureau of the Census for odd years. The following tables show the production (exclusive of pigments, zinc chloride, and zinc sulphate) during the past few years, as compiled by that bureau.

Lead acetate, lead arsenate, and other lead salts (exclusive of lead pigments) produced in the United States, 1919, 1921, 1923, 1925, 1927, and 1929

Year	Lead acetate			Lead arsenate		Other salts
	Total production	Produced for sale				
	Short tons	Short tons	Value	Produced for sale (short tons)	Value	Value
1919	2,566	2,092	$552,435	5,733	$2,090,341	$335,906
1921	1,408	372	90,305	4,615	1,629,446	120,327
1923	2,753	016	160,183	5,378	2,220,431	388,868
1925	3,432	1,251	359,686	5,969	1,777,552	192,995
1927	(1)	1,508	395,122	[2] 10,764	[2] 3,100,257	254,809
1929	(1)	1,042	255,753	[2] 14,952	[2] 3,304,351	186,735

[1] Not given.
[2] The statistics for 1927 and 1929 are not comparable with those for preceding years as the figures prior to 1927 do not include data for the production reported by establishments engaged primarily in the manufacture of patent and proprietary medicines and compounds.

Zinc stearate and other salts and compounds of zinc (exclusive of zinc pigments, zinc chloride, and zinc sulphate) produced in the United States, 1923, 1925, 1927, and 1929

Year	Zinc stearate		Other salts and compounds, value
	Short tons	Value	
1923	227	$107,319	$410,913
1925	393	169,051	420,944
1927	391	164,927	376,666
1929	727	320,203	(1)

[1] Not given.

SOURCE

The following table gives the quantity and source of the lead and zinc contained in the pigments and salts produced in the United States in 1928 and 1929. It shows that in 1929, 95 per cent of the lead in lead pigments was derived from pig lead, 4 per cent from ore, and 1 per cent from secondary material. For zinc pigments and salts, the proportions were 68 per cent from ore, 19 per cent from metal, and 13 per cent from secondary material. The zinc in zinc salts is derived largely from secondary material.

Metal content of lead pigments and zinc pigments and sa
manufacturers, 1928 and 1929, by sources, i

Source	1928	
	Lead in pigments [1]	Zi pig and
Domestic ore	10,465	
Metal	242,914	
Secondary material [2]	654	
	254,033	

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide. The
and lead arsenate is not available, as no canvass of their production is
Moreover, these salts are derived from pig lead, and their metal conte
statistical account in the figures covering lead production.
[2] Zinc ashes, skimmings, drosses, and old metal.

PREPARATION AND USE

WHITE LEAD

White lead is the basic carbonate of lead ar
most important of the white pigments used in
erties of white lead that contribute to its usefu
very great hiding power and the facility with wh
can be worked with a brush. Owing to its rela
and the fact that white-lead paints are blackene
taining sulphur, the use of less-expensive zinc ox
paint pigments has increased during recent yea
retarded expansion of the white-lead industry.

The largest part of the white lead manufac
States is produced by the "stack" or old Du
perforated disks of high-grade metallic lead, ca
inches in diameter, are placed in small clay pots
well in the bottom containing dilute acetic ac
arranged in tiers within a large room. Each
boards and a layer of spent tanbark. The lea
basic carbonate by the action of acetic acid va
CO_2 and the heat necessary to vaporize the acet
by the fermentation of the tanbark. The proc
four months for completion. The corroded lead
crushed, screened, and ground in water, and th
to form dry white lead or ground with oil wit
the oil pigment. In the United States about
product is ground in oil.

Some white lead is also made by the Carter pro
lytic process. In the former metallic lead is fin
of steam and is then treated with dilute acetic aci
in slowly rotating wooden cylinders. The pro
about 12 days.

In the electrolytic process a lead anode and
used, each of which has an independent conti
electrolyte kept separate by a porous diaphrag
are solutions of sodium acetate containing sodi
anolyte contains the exact amount of carbona
cipitate the basic lead carbonate, whereas the

relatively large amount of carbonate. During electrolysis the lead dissolves at the anode surface and is immediately precipitated as the basic carbonate in suspension in the anolyte. At the same time CO_3 is generated at the cathode, passes through the diaphragm, and replaces the CO_3 precipitated with the lead, thus maintaining the anolyte at a constant concentration. The catholyte passes through a carbon dioxide absorption tower where it is restored to its original strength. The basic lead carbonate is filtered from the anolyte, washed, dried, pulverized, and barreled.

During 1929 it was announced[3] that a new process had been developed for producing white lead and other lead pigments directly from galena ore, in which the ore is first treated with nitric acid. The resultant solution is then purified by a secret process which yields an extremely pure solution of lead from which pigments of high purity can be produced. White lead is precipitated from this solution by the addition of sodium carbonate (soda ash or sal soda), chrome yellow by the addition of sodium bichromate, and basic lead sulphate by the addition of sodium sulphate. The precipitates are very finely divided and are collected in filter presses, washed, dried, and ground. The process involves the regeneration of nitric acid and the recovery of by-products, including zinc oxide, silica, and elemental sulphur. The General Reduction & Chemical Co. was contemplating the erection of three plants, each to cost $1,500,000.

The principal use of white lead is in the manufacture of paint. It is the only important white pigment that is used unmixed with other pigments in oil paints; it is also used in varying proportions in many mixed pigments. Dry white lead is used in paints, as a constituent of the glaze used in the finer grades of pottery, and to some extent in the manufacture of rubber.

The following table shows the sales of white lead (dry and in oil) to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of white lead (dry and in oil) sales in 1929, by industries

Industry	Short tons	Per cent of total
Paint	136,526	92.8
Ceramics	4,246	2.9
Other	6,259	4.3
	147,031	100.0

The United States produces an exportable surplus of about 6,000 tons of white lead annually, most of which is manufactured in bond from foreign lead.

BASIC LEAD SULPHATE

Basic lead sulphate is also known as sublimed lead and is marketed in two forms, "white" and "blue." The white variety is usually made by vaporizing powdered galena at a high temperature in the presence of air, which oxidizes it to the basic sulphate. The resultant fume is collected in bags, and owing to the zinc content of the ore used it usually contains about 5 per cent of zinc oxide. This product is usually not as white as basic carbonate white lead, but has a more

[3] Oil, Paint and Drug Reporter, vol. 125, June 3, 1929, p. 29.

stable color in the presence of sulphur gases.
also made directly from pig lead. The molten
an atomizing nozzle into a heated furnace, an
oxygen and sulphur dioxide are introduced.
oxidized, and converted into basic lead sulph
quantity proportionate to the oxygen and sul
into the furnace. The resultant fume is collect
It is claimed that this product is the whitest o
that it has a promising future in the manufact
where it is used with lead oxides to produce
battery plates. In 1929 the development o
basic lead sulphate directly from ore, using
sulphate, was reported (see discussion unde
White sublimed lead is used chiefly in the m
paints and mixed pigments. Smaller amount
facture of storage batteries and rubber.

The blue variety is generally a by-product
lead and is collected from the fumes leaving
Its color is due to small amounts of carbon and
made from blue lead are especially useful as
metallic surfaces. Some blue lead is also use
rubber.

The following table shows the sales of basic
industries in 1929, as reported to the Bur
producers.

Distribution of basic lead sulphate sales in 19

Industry
Paints
Storage batteries
Rubber
Other

LITHARGE

Litharge is the monoxide of lead and is pro
of molten lead at a moderate temperature in a
The oxide forms on the surface of the molten
into iron pots. The texture and color of the
its use in the various industries, are controlle
the furnace and the method of cooling. The
in the manufacture of storage-battery plates
are usually made of straight litharge, whereas
a mixture of red lead and litharge. The next
is in the oil-refining industry, where it is used t
sulphur compounds from gasoline. Litharge
cure accelerator in the manufacture of mecha
rubber clothing. It is also used in the manuf
color pigment, insecticides, pottery, enamel w
drier in the manufacture of varnish and lino
The following table shows the sales of lithar
in 1929, as reported to the Bureau of Mines b

Distribution of litharge sales in 1929, by industries

Industry	Short tons	Per cent of total	Industry	Short tons	Per cent of total
Storage batteries	37,160	42.2	Varnish	3,124	[illegible]
Oil refining	13,615	15.5	Linoleum	322	[illegible]
Ceramics	8,663	9.8	Other	10,269	11[illegible]
Chrome pigments	8,112	9.2			
Rubber	6,651	7.6		87,916	100.[illegible]

RED LEAD

Red lead is the tetroxide of lead and is made by heating powdered litharge at a moderate temperature in a "coloring oven." The marketed product varies in composition, averaging about 85 per cent pure red lead and 15 per cent litharge; the latter is unchanged in the process of manufacture. The principal use of red lead is in the manufacture of storage batteries where, mixed with litharge, it usually forms the positive plate of the battery. It is an important pigment in paints used as a protective coating on metal surfaces and accounts for the familiar orange color seen on practically all steel construction. During 1929 the American Gas Association and the Bureau of Standards began tests for protective coatings on underground pipe lines. The tests were to include the use of a baked red-lead priming coat under asphaltic or bituminous protective coatings. Red lead is the most important of the lead compounds used in the production of flint and optical glass. It is also used in potter's glaze and in enamel ware and as a drier in the manufacture of varnish.

The following table shows the sales of red lead to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of red lead sales in 1929, by industries

Industry	Short tons	Per cent of total
Storage batteries	25,689	59.7
Paints	11,855	27.6
Ceramics	903	2.1
Other	4,574	10.6
	43,021	100.0

ORANGE MINERAL

Orange mineral is a form of red lead; it has the same chemical composition but differs in physical properties and has a lower specific gravity and lighter color. It is usually made by roasting white lead by a process that requires great care and skill. Consequently, the price is higher than that for any of the other lead pigments. Orange mineral is used chiefly in the manufacture of an artificial vermilion color pigment known as eosin lake; it is also used in the production of printer's inks and enamels.

The following table shows the sales of orange mineral to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of orange mineral sales in 1929, b

Industry
Color pigments
Ink manufacture
Other

ZINC OXIDE

Zinc oxide, the monoxide of zinc, is made in t
two processes—the French and the American.
lic zinc is heated in a current of air, and the res
collected in long chambers. The product is gra
fineness and is labeled "white seal," "green s
The white-seal variety is the finest and whitest
gravity is much lower than those of the coarse
chiefly in high-grade enamel paints. Green seal
intermediate and heavy grades, respectively.

American process zinc oxide is made by heati
ore and anthracite to produce a metallic zinc va
treated with air to form the oxide. The oxide
bag houses. As lead is usually present in the or
contains some lead compounds. It is usually
French oxide but in other respects is very sim
process of making zinc oxide predominates in th

Zinc oxide has been used as a paint pigment
for several centuries, but the increase in produ
States during the twentieth century has been
growth of the rubber industry. In an estima
1926,[4] the use of zinc oxide in the various ind
follows:

	Per cent	
Rubber	53	Ceramics
Paints and enamels	38	Miscellaneous.
Oilcloth and linoleum	5	
Exports	4	

Zinc oxide is used in the manufacture of rubbe
ficial properties it imparts to the rubber. It
strength and the resistance to abrasion and te
aging qualities by counteracting the tendency of
riorate under action of light and heat. All of
essential in making automobile tires, tubes, a
represent about 75 per cent of the entire rubbe

Zinc oxide is seldom used alone as a paint p
a hard, smooth surface which on aging tends t
leaving an unsatisfactory surface for repaint
stable color and costs less than white lead, has
and covering properties, and is durable. The
make zinc oxide a useful constituent of mixed
finds a large usage. It is generally mixed w
lead, and inert pigments.

[4] Chemical and Metallurgical Engineering, vol. 33, January, 1926, p. 5

Zinc oxide is also used in the manufacture of oilcloth and linoleum, pottery glazes and glass, celluloid, druggists' supplies, printer's inks, and leather finishes, and for many other purposes.

The use of zinc oxide as a lubricant was reported [5] in 1929. A mixture of zinc oxide and oil in equal parts is said to prevent corrosion of bearings and to improve the bearing surface by depositing thereon a thin film of zinc.

Exports of zinc oxide in 1929 amounted to 11 per cent of the total production.

LEADED ZINC OXIDE

Leaded zinc oxide is made by a method similar to the American process of making zinc oxide. The ore used contains lead in varying proportions, and the finished product may contain from 5 to 35 per cent of basic lead sulphate. The properties of this pigment are similar to those of zinc oxide and basic lead sulphate. It has fair hiding power, but is not so white as American process zinc oxide. Leaded zinc oxide is used chiefly in the manufacture of paint.

LITHOPONE

Lithopone is the newest of the important white pigments, and its introduction into the United States dates back to the close of the nineteenth century. It contains about 70 per cent of barium sulphate and about 30 per cent of zinc sulphide. The latter, a powerful pigment, is responsible for the useful pigment qualities of lithopone. The process of manufacture consists in mixing proper proportions of solutions of barium sulphide and zinc sulphate. The resultant precipitate is heated to a red heat and plunged into cold water, after which it is ground, dried, and powdered.

The use of high-strength lithopone, containing above 30 per cent of zinc sulphide, has been increasing in recent years. This product can be made directly or by mixing zinc sulphide with ordinary lithopone. The increase in imports of zinc sulphide from less than 4 short tons in 1926 to more than 315 tons in 1929 has probably been due to the increased manufacture of high-strength lithopone. This pigment is said to possess very high hiding power and nonsettling properties which make it particularly suitable for the manufacture of shelf goods.

The use of lithopone in the United States has increased rapidly and has spread to many industries. Its chief use is in paint manufacture, in which it is favored on acount of its low cost and many good qualities. Formerly the use of lithopone was confined to interior paint, as the pigment would discolor in sunlight. In recent years, however, the refining process has been changed, and it is claimed that lithopone with a stable color suitable for exterior paints is now being produced. It is generally mixed with other pigments, notably zinc oxide.

A large quantity of lithopone is used in the manufacture of oilcloth and linoleum, artificial leather finishes, window shades, and printer's inks.

Imports of lithopone into the United States in 1929 amounted to 8,400 short tons, and exports amounted to 4,600 tons.

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[5] Chemistry and Industry, vol. 48, Nov. 22, 1929, p. 1136.

White lead—Continued.	
National Lead Co.	Brooklyn, N. Y.
Do	Port Richmond, N. Y.
Do	Cincinnati, Ohio.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.
Wetherill & Bro	Philadelphia, Pa.
Basic lead sulphate, or sublimed lead:	
Eagle-Picher Lead Co	Galena, Kans.
Do	Joplin, Mo.
St. Louis Smelting & Refining Works of National Lead Co	Collinsville, Ill.
Red lead, orange mineral, and litharge:	
Eagle-Picher Lead Co	East St. Louis, Ill.
Do	Joplin, Mo.
Do	Newark, N. J.
Do	Cincinnati, Ohio.
Evans-Wallower Lead Co	Charleston, W. Va.
Franklin Lead Oxide Co	Franklin, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
Grasselli Chemical Co	East Chicago, Ind.
Do	Newark, N. J.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Metals Refining Co	Hammond, Ind.
National Lead Co. of California	Melrose, Calif.
National Lead Co	Chicago, Ill.
Do	St. Louis, Mo.
Do	Brooklyn, N. Y.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Wetherill & Bro	Philadelphia, Pa.
Zinc oxide and leaded zinc oxide:	
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Eagle-Picher Lead Co	Hillsboro, Ill.
Empire Zinc Co	Canon City, Colo.
Grasselli Chemical Co	East Chicago, Ind.
International Lead Refining Co. (French process)	East Chicago, Ind.
Do	Akron, Ohio.
Mineral Point Zinc Co	Mineral Point, Wis.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Do. (French process)	Freemansburg, Pa.
Ozark Smelting & Mining Co	Coffeyville, Kans.
River Smelting & Refining Co	Florence, Colo.
Lithopone:	
Chemical & Pigment Co. (Inc.)	Oakland, Calif.
Do	Collinsville, Ill.
Do	St. Helena, Md.
Eagle-Picher Lead Co	Argo, Ill.
Grasselli Chemical Co	Grasselli, N. J.
Do	Newark, N. J.
Do	Philadelphia, Pa.
Krebs Pigment & Chemical Co	Newport, Del.
Mineral Point Zinc Co	Depue, Ill.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc salts:	
American Smelting & Refining Co	Selby, Calif.
Do	Durango, Colo.
Do	Omaha, Nebr.
Do	Perth Amboy, N. J.
Arkansas Preservative Co	North Little Rock, Ark.
Charles Cooper & Co	Newark, N. J.
General Chemical Co	Chicago, Ill.

Zinc salts—Continued.	
Grasselli Chemical Co	E
Do	C
Do	W
Charles Lennig & Co. (Inc.)	P
Merrimac Chemical Co	E
Monsanto Chemical Works	M
Ozark Smelting & Mining Co	C

TARIFF

The tariff act of 1930 became effective Ju
changes in the schedules on lead and zinc pig
increase from 1½ cents to 3 cents per pound
increase from 1¾ cents per pound to 1¾ cent
cent ad valorem on lithopone containing by
more of zinc sulphide. The rates on lead and
provided in the 1930 act are shown in the fol

Import duties on lead and zinc pigments and salts

Paragraph	Item
72	Lead pigments:
	Litharge
	Orange mineral
	Red lead
	White lead
	All pigments containing lead, dry or in pulp, or ground mixed with oil or water, not specially provided for
46	Lead chemicals:
	Acetate, white
	Acetate, brown, gray, or yellow
	Nitrate, arsenate, and resinate
	All other lead compounds, n. s. p. f.
77	Zinc pigments:
	Zinc oxide and leaded zinc oxide containing not more t per cent of lead—
	Dry powder
	Ground in or mixed with oil or water
	Lithopone, and other combinations or mixtures of zinc su and barium sulphate containing by weight—
	Less than 30 per cent of zinc sulphide
	30 per cent or more of zinc sulphide
93	Zinc chemicals:
	Zinc chloride
	Zinc sulphate
	Zinc sulphide

IMPORTS AND EXPO

LEAD PIGMENTS

Imports of lead pigments into the Uni
unimportant. Exports of the white lead p
cent in 1929 and amounted to 4 per cent o
put of white lead; United Kingdom took 5
1929, compared with 66 per cent in 1928.
lead, litharge, and orange mineral increased
amounted to 2 per cent of the total dome
three pigments.

Basic carbonate white lead, red lead, litharge, and orange mineral imported for consumption in the United States, 1920–1929

Year	Basic carbonate white lead		Red lead		Litharge		Orange mineral	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	159,977	$19,449	23,076	$1,789	21,002	$2,647	52,094	$5,352
1921	124,176	12,598	12,236	689	100	7	77,937	7,830
1922	222,465	21,335	1,405	94	1,770	162	111,419	9,729
1923	336,892	31,386	3,600	220	22,525	1,314	116,293	9,031
1924	141,156	13,478	1,874	155	1,838	193	99,341	8,047
1925	213,028	21,535	3,452	268	2,417	330	58,522	6,278
1926	297,567	31,690	9,591	817	122	13	58,104	5,143
1927	330,421	29,901	51,688	4,403	1,182	133	44,866	3,816
1928	166,236	15,889	24,676	1,510	2,100	153	62,409	5,227
1929	196,478	19,086	10,197	745	3,763	270	52,122	3,889

White lead and red lead exported from the United States, 1920–1929

Year	White lead [1]		Red lead [2]	
	Short tons	Value	Short tons	Value
1920	14,901	$3,195,101	1,532	$365,575
1921	5,161	993,130	548	115,500
1922	4,598	710,765	1,683	294,183
1923	[1] 5,172	836,261	[2] 1,840	372,828
1924	[1] 5,055	853,444	[2] 940	210,598
1925	[1] 6,832	1,293,108	802	183,591
1926	[1] 6,239	1,119,350	775	175,273
1927	[1] 6,047	947,226	[2] 1,429	271,376
1928	[1] 6,476	952,316	[2] 2,084	364,995
1929	[1] 5,908	921,509	[2] 2,890	503,243

[1] Exports of white lead and basic lead sulphate or sublimed lead not classified separately after 1922; the figures for 1923–1929 may include an unknown quantity of basic lead sulphate or sublimed lead.
[2] Exports of red lead and litharge not classified separately for 1923–1924 and 1927–1929; the figures for those years may include an unknown quantity of litharge; the figures for 1928 and 1929 include also an unknown quantity of orange mineral. Figures for other years are for red lead only.

White lead [1] exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	58	$9,285	122	$19,807
Cuba	80	14,750	58	10,207
Mexico	149	32,040	127	28,776
Panama	284	57,022	568	117,561
Other	84	17,517	65	13,588
	655	131,214	940	189,939
South America:				
Brazil	45	7,043	12	2,231
Colombia	13	2,599	18	4,206
Uruguay	41	5,857	32	5,089
Venezuela	7	1,566	19	4,213
Other	402	59,370	415	68,061
	508	76,435	496	83,800

[1] Exports of white lead and basic lead sulphate or sublimed lead not classified separately after 1922; the figures may include an unknown quantity of basic lead sulphate or sublimed lead.

White lead exported from the United States, 1928 and 1

Destination	192
	Short tons
Europe:	
Netherlands	657
United Kingdom	4,274
Other	64
	4,995
Asia:	
Philippine Islands	214
Other	99
	313
Africa	1
Oceania, including Australia	4
	6,476

ZINC PIGMENTS AND SA

Imports of lithopone, the principal zinc pig
United States, decreased 15 per cent in 1929
4 per cent of the domestic output. Imports
5 per cent in 1929 and were equivalent to les
domestic production. There has been a large
of zinc sulphide imported into the United Sta
years. This product is used principally in th
strength lithopone. Belgium supplied 60 pe
imported in 1929, Netherlands 82 per cent of
many 97 per cent of the zinc sulphide. The z
chiefly to Canada (44 per cent) and the U
cent). Canada also took 87 per cent of th
1929.

Zinc oxide, lithopone, zinc sulphide (white), zinc c imported for consumption in the United S

Year	Zinc oxid	
	Dry	
	Short tons	Value
1920	1,431	$289,890
1921	1,286	145,071
1922	2,712	861,599
1923	1,036	169,415
1924	1,703	229,620
1925	1,274	205,582
1926	1,127	198,897
1927	1,899	220,427
1928	1,348	208,557
1929	1,267	203,080

Zinc oxide, lithopone, zinc sulphide (white), zinc chloride, and zinc sulphate imported for consumption in the United States, 1920–1929—Contd.

Year	Zinc sulphide[1]		Zinc chloride		Zinc sulphate	
	Pounds[1]	Value	Short tons	Value	Short tons	Value
1920	45, 482	$15, 027	565	$76, 495	50	$3, 038
1921	93, 537	8, 330	2, 199	213, 995	17	820
1922	27, 159	8, 453	1, 374	87, 509	17	1, 064
1923	11, 844	5, 403	551	44, 164	20	3, 466
1924	9, 678	5, 727	319	28, 911	13	1, 265
1925	14, 604	5, 589	469	50, 712	17	1, 368
1926	7, 800	4, 125	508	51, 605	66	4, 590
1927	132, 223	22, 984	470	40, 069	205	9, 390
1928	338, 030	47, 235	502	47, 185	683	28, 866
1929	630, 565	84, 260	638	50, 324	909	32, 127

[1] Zinc sulphide is stated in pounds rather than tons because of its high value and smaller quantities.

Zinc oxide and lithopone exported from the United States, 1920–1929

Year	Zinc oxide		Lithopone	
	Short tons	Value	Short tons	Value
1920	11, 164	$2, 151, 544	(1)	(1)
1921	2, 511	426, 253	(1)	(1)
1922	3, 977	593, 128	1, 616	$169, 982
1923	5, 024	743, 577	1, 485	176, 624
1924	3, 927	805, 630	923	104, 783
1925	10, 855	1, 503, 561	1, 287	132, 771
1926	14, 601	1, 917, 420	1, 941	200, 412
1927	14, 494	1, 821, 786	2, 110	222, 585
1928	14, 799	1, 849, 889	3, 326	337, 565
1929	17, 638	2, 301, 643	4, 556	463, 235

[1] Not classified separately prior to 1922.

Zinc oxide exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	6, 404	$882, 180	7, 702	$1, 062, 618
Cuba	135	20, 288	117	17, 508
Mexico	102	19, 112	73	13, 448
Panama	94	17, 291	87	15, 486
Other	30	5, 657	18	4, 483
	6, 765	944, 528	7, 997	1, 113, 543
South America:				
Brazil	8	1, 663	5	1, 129
Other	120	22, 011	64	13, 730
	128	23, 674	69	14, 859
Europe:				
France	(1)	93	452	50, 836
Italy	247	29, 270	69	11, 361
United Kingdom	4, 315	491, 658	6, 360	762, 010
Other	1, 859	186, 144	1, 144	125, 964
	6, 421	707, 165	8, 025	950, 171
Asia:				
Philippine Islands	93	11, 111	88	12, 264
Other	1, 130	129, 375	819	110, 415
	1, 223	140, 486	907	122, 679
Africa	4	724	3	594
Oceania, including Australia	258	33, 312	637	99, 797
	14, 799	1, 849, 889	17, 638	2, 301, 643

[1] Less than 1 ton.

PRICES AND VALUE

The total value and the average price receiv
sales of lead and zinc pigments and salts are gi
of this chapter. The range of market quotati
Oil, Paint and Drug Reporter is shown in the

Range of quotations on lead pigments and zinc pigmen 1927–1929, in cents a pound

Product	192
Basic lead sulphate, or sublimed lead, dry, in casks	7.75–
White lead, or basic lead carbonate:	
Dry, in casks	8.50–
In oil, carload lots	10.78–
Litharge, American, commercial, powdered, casks	8.75–
Red lead, dry, in casks	9.75–
Orange mineral, American, casks	11.75–
Lead acetate, brown, broken, barrels	12.00–
Lead arsenate, powdered, drums	13.50–
Zinc oxide:	
American process, lead-free, bags, car lots	
American process, leaded, barrels, car lots	6.75–
French process, red seal, bags, car lots	
French process, green seal, bags, car lots	
French process, white seal, barrels, car lots	
Lithopone, American, bags, car lots	
Zinc chloride:	
Solution,[1] drums	2.75–
Fused	
Zinc sulphate, barrels	8.00–

[1] At works.

The quotations for lead pigments are usu
25-point fluctuations in the price of pig lead
price trend of lead pigments in 1929 was upwa
downward thereafter in sympathy with the
Quotations on zinc pigments, however, were
year at levels established in 1927, notwith
increase in the price of zinc up to October, 19
by a sharp decrease in November and Decem
strength lithopone, containing 50 per cent
reduced to 7½ cents per pound in December
cuts for titanium pigments.

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