U. S. DEPARTM
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O. E
Chief Economist,

PART

national Nickel but have pointed to a more than proportional increase in precio
metal resources, and it is these disclosures which have led to a tenfold increase
the platinum metal refining capacity of the Acton works. Although crudes a
concentrates from the Onverwacht Mine have hitherto been refined at Act
this source has now been exhausted, and we fear that no part of the huge capac
of Acton is provided for the handling of South African platinum products.
production there will be, in a sense, automatic, and will cost so very little,
outlook for other producing countries is far from cheerful. Such a developm
could scarcely have been foreseen three or four years ago, when South Af
settled down seriously to the attainment of platinum production, but it is, to
the least, more unfortunate that by-product platinum promises to becom
dominant factor in the world's markets, in respect of both output and price

Powell, [18] however, takes a more optimistic view, stating that m
of the difficulties associated with the recovery of the platinum meta
from the norite deposits in South Africa have been successfully ov
come; that the platinum industry in South Africa is now firmly esta
lished, in spite of the closing of some mines; that there is every pr
pect of further expansion in the near future as improved methods
treating the ore are introduced; and that in the future Canada, an
South Africa are likely to dominate the market for platinum.

[18] Powell, A. R., The Precious Metals During 1929-30: Met. Ind. (London), vol. 38, Jan. 16, 193
70-71.

LEAD AND ZINC PIGMENT

By ELMER W. PEHRS

CONTENTS

SUMMARY

The total value of lead and zinc pigme
ers amounted to approximately $69,25
th $98,045,000 in 1929, a decrease of 2
ments decreased 33 per cent in value
per cent of the total value, whereas
lined 24 per cent and amounted to 47 p
The quantity of lead pigments sold by p
219,542 short tons, a decrease of 75,918
The lead pigments shared in this decrea
decreased 35,280 tons or 34 per cent an
ce 1905. Sales of dry white lead decr
Other lead pigments showing large
compared with the preceding year w
38 tons or 17 per cent; red lead, 10,08
ic lead sulphate, 5,287 tons or 31 p
neral decreased 47 per cent; however,
a fraction of 1 per cent of the total pr
The quantity of zinc pigments sold by p
300,486 short tons, a decrease of 93,589
ithopone decreased 42,250 tons or 20 pe
469 tons or 26 per cent; and those of le
36 per cent.
Sales of zinc chloride and zinc sulphate
respectively, as compared with 1929
The marked decline in the pigment ind
curtailment in the manufacture of p
tion brought about by the general busine
ods of unemployment some paint-pigm

rk on manuscript completed July, 1931.
tistics in this report prepared (unless otherwise indicated
ports compiled from records of the Bureau of Foreign an
the Bureau of Mines.

joyed substantial increases in sales as many idle workers painted eir homes while unemployed. In 1921 the sales of white lead in increased 28 per cent over those in 1920. At the beginning of 1930 similar increase was expected, but the record now shows that in is respect 1930 was an exceptional year.

Market quotations for lead pigments declined about 1 cent per und during 1930 as a result of the steady decline in the price of pig ad. The average price of lead pigments per ton, received in 1930 by oducers reporting to the Bureau of Mines, was only 10 per cent low the 1929 average, whereas the average quoted price of pig lead in 1930 was 19 per cent below that in 1929. Quotations on zinc oxide and leaded zinc oxide were maintained at the levels of the three preceding years although the price of slab zinc (St. Louis) was 30 per cent lower in 1930 than in 1929. The quoted price of lithopone, which had remained unchanged for several years, dropped sharply during December, 1930, following a cut in the price of titanium pigment.

Imports of lead pigments in 1930 were negligible. Exports of lead pigments increased 21 per cent in quantity and 6 per cent in value and amounted to 5 per cent of the total quantity sold by domestic producers. The total quantity of white lead and sublimed lead exported increased 11 per cent, whereas that of the red oxides increased 43 per cent. The latter increase was due largely to increased exports to Netherland West Indies and the United Kingdom.

Imports of zinc pigments in 1930 decreased 18 per cent in quantity and 25 per cent in value and were equivalent in quantity to 3 per cent of the sales by domestic producers. Imports of lithopone decreased 17 per cent in 1930; they accounted for 85 per cent of the total quantity of zinc pigments imported. Imports of zinc sulphide, which increased rapidly from 1926 to 1929, declined 75 per cent in 1930. Exports of zinc pigments in 1930 declined 35 per cent in quantity and 34 per cent in value and amounted in quantity to less than 5 per cent of the total sales by domestic producers.

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 70,000 tons in 1930. During the same period the combined sales of zinc oxide and lithopone increased from 212,000 to 283,000 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 report the pigments and salts sold are considered ng the production, no account being taken of the stock he beginning and end of the year. The amounts used t their own plants are included under sales.

The total value of the lead and zinc pigments sold roducers was approximately $69,253,000 in 1930, as co 98,045,000 in 1929, a decrease of 29 per cent. Lead 1930 decreased 33 per cent in total value and 26 per cen hereas zinc pigments sold decreased 24 per cent in bo uantity as compared with 1929. The average value p igments sold in 1930, as reported by producers, dec per cent, whereas the average New York quotation eclined 19 per cent in 1930 as compared with 1929. eclined only 1 per cent in value per ton in 1930, as co 30 per cent decrease in the St. Louis quotation for sla

The following tables show the sales of lead and zinc nc salts from 1921 to 1930, as reported to the Bureau

Lead pigments sold by domestic manufacturers in the United State in short tons

Year	White lead		Basic lead sulphate or sublimed lead		Red lead
	Dry	In oil	White	Blue	
...	26,738	143,545	11,568	463	21,805
...	41,598	153,393	13,705	972	30,500
...	37,786	125,087	11,949	800	38,037
...	42,622	144,872	14,572	1,088	36,813
...	43,426	120,479	14,996	1,090	41,669
...	37,968	111,845	12,271	1,236	42,550
...	38,069	119,026	13,482	1,061	39,073
...	42,049	111,923	10,002	1,234	40,497
...	42,159	104,872	15,580	1,234	43,021
...	32,548	69,592	10,308	1,219	32,941

ad pigments sold by domestic manufacturers in the United States,

	1929			1930	
	Short tons	Value (at plant, exclusive of container)		Short tons	Va
		Total	Average		
ead sulphate or sublimed lead:					
hite	15,580	$2,274,917	$146	10,308	$1
ide	1,234	195,849	159	1,219	
ad	43,021	7,586,543	176	32,941	6
mineral	078	166,039	243	356	
	87,916	13,807,087	157	72,578	9
ead:					
	42,159	6,821,200	162	32,548	4
	104,872	23,679,875	226	69,592	15

Zinc pigments and salts sold by domestic manufacturers in the United States, 1921 [illegible] 1930, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° Baumé)	Zinc sulphate
[illegible]21	74,329	16,103	55,016	59,457	3,29[illegible]
[illegible]22	128,405	19,613	83,360	41,627	5,07[illegible]
[illegible]23	120,087	23,504	98,100	42,431	5,87[illegible]
[illegible]24	131,470	20,720	100,400	51,054	4,67[illegible]
[illegible]25	151,354	31,760	145,019	45,619	[1] 5,69[illegible]
[illegible]26	146,923	23,869	159,931	[1] 47,206	[1] 6,61[illegible]
[illegible]27	151,246	26,004	176,994	[1] 40,141	[1] 6,41[illegible]
[illegible]28	160,004	24,223	200,408	[1] 45,669	[1] 4,72[illegible]
[illegible]29	160,611	27,149	206,315	[1] 43,189	7,45[illegible]
[illegible]30	119,142	17,270	164,065	29,043	6,24[illegible]

[1] Revised figures.

Zinc pigments and salts sold by domestic manufacturers in the United States, 192[illegible] and 1930

	1929			1930		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide[1]	160,611	$20,516,246	$128	119,142	$14,896,883	$[illegible]
Leaded zinc oxide[1]	27,149	3,224,544	119	17,279	2,072,197	
Lithopone	206,315	19,773,864	96	164,065	15,897,683	
Zinc chloride, 50° B	[2] 43,189	[2] 1,864,431	[2] 43	29,043	1,247,385	
Zinc sulphate	7,454	333,837	45	6,249	276,728	

[1] Zinc oxide containing 5 per cent or more of lead is classed as leaded zinc oxide.
[2] Revised figures.

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

Lead acetate, lead arsenate, and other lead salts (exclusive of lead pigments) pr[illegible] duced in the United States, 1919, 1921, 1923, 1925, 1927, and 1929

Year	Lead acetate			Lead arsenate		Other [illegible]
	Total production	Produced for sale				
	Short tons	Short tons	Value	Produced for sale (short tons)	Value	Value
1919	2,500	2,092	$552,435	5,733	$2,090,341	$33[illegible]
1921	1,408	372	90,305	4,015	1,029,440	12[illegible]
1923	2,753	616	160,133	5,378	2,229,431	38[illegible]
1925	3,432	1,251	359,686	5,969	1,777,552	19[illegible]
1927	(1)	1,508	305,122	[2] 10,764	[2] 3,190,257	25[illegible]
1929	(1)	1,042	255,753	[2] 14,952	[2] 3,304,351	18[illegible]

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

Zinc stearate and other salts and compounds of zinc (exclusive o[illegible] zinc chloride, and zinc sulphate) produced in the United Sta[illegible] 1927, and 1929

Year	Zinc stearate	
	Short tons	[illegible]
[illegible]22	227	[illegible]
[illegible]25	393	
[illegible]27	391	
[illegible]29	727	

[1] Not given.

SOURCE

Lead pigments and zinc pigments and salts are manu[illegible] variety of materials, including ore, refined metal, and [illegible] condary materials such as scrap and waste materials [illegible] industrial processes.

The following table gives the quantity and source [illegible] contained in the lead pigments and in the zinc pigme[illegible] produced in the United States in 1929 and 1930. It [illegible] 930, 96.3 per cent of the lead in lead pigments was der[illegible] ad, 3.4 per cent from ore, and 0.3 per cent from secon[illegible] or zinc pigments and salts the proportions were 67.9 [illegible] e, 17.6 per cent from slab zinc, and 14.5 per cent fr[illegible] terial.

[illegible]al content of lead pigments and zinc pigments and salts prod[illegible] manufacturers, 1929 and 1930, by sources, in short to[illegible]

Source	1929		[illegible]
	Lead in pigments[1]	Zinc in pigments and salts	[illegible] pig
[illegible]mestic ore	9,429	[2] 138,104	
[illegible]tal	248,657	30,620	
[illegible]ondary material[1]	2,427	[2] 26,795	
	260,513	[2] 204,519	

[illegible]ncludes also lead recovered in zinc oxide and leaded zinc oxide. The metal co[illegible] [illegible]ead arsenate is not available, as no canvass of their production is made by t[illegible] [illegible]over, these salts are derived from pig lead, and their metal content has alre[illegible] [illegible]ctical account in the figures covering lead production.
[illegible]Revised figures.
[illegible]rd ashes, skimmings, drosses, and old metal.

[illegible]n the following tables the source of the metal used [illegible] [illegible]ture of each pigment and salt is given. Pig lead is use[illegible] [illegible]er directly or indirectly, in the manufacture of white [illegible] [illegible]lead, and orange mineral and, to a large extent, in the [illegible] [illegible]asic lead sulphate. Zinc oxide is the only pigment [illegible] [illegible]is used in considerable amounts. Ore is used in the [illegible] [illegible]nc oxide, leaded zinc oxide, lithopone, zinc sulphate, [illegible] [illegible]phate. Considerable secondary lead is used in the m[illegible] [illegible]lead sulphate, and a substantial proportion of the [illegible] [illegible]and zinc chloride made in the United States is [illegible] [illegible]ondary material.

Lead content of lead and zinc pigments produced by domestic manufacturers, 192[illegible] and 1930, by sources, in short tons

Pigment	1929				1930			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pig[illegible]
	Domestic ore	Pig lead	Secondary material		Domestic ore	Pig lead	Secondary material	
White lead	-------	120,040	-------	120,040	-------	87,329	-------	87,3[illegible]
Red lead	-------	39,375	-------	39,375	-------	30,493	-------	30,49[illegible]
Litharge	-------	82,670	-------	82,670	-------	67,510	-------	67,51[illegible]
Orange mineral	-------	702	-------	702	-------	222	-------	22[illegible]
Basic lead sulphate	4,213	5,804	1,682	11,759	1,963	4,628	636	7,21[illegible]
Leaded zinc oxide	5,078	-------	745	5,823	4,093	-------	53	4,74[illegible]
Zinc oxide	138	-------	-------	138	40	-------	-------	[illegible]
	9,429	248,657	2,427	260,513	6,686	190,182	689	197,5[illegible]

Zinc content of zinc pigments and salts produced by domestic manufacturers, 192[illegible] and 1930, by sources, in short tons

Pigment or salt	1929				1930			
	Zinc in pigments and salts produced from—			Total zinc in pigments and salts	Zinc in pigments and salts produced from—			Total zinc in pig[illegible] ments and salts
	Domestic ore	Slab zinc	Secondary material		Domestic ore	Slab zinc	Secondary material	
Zinc oxide	97,263	39,600	72	136,935	71,324	27,085	149	98,[illegible]
Leaded zinc oxide	11,177	-------	3,087	14,264	11,428	-------	100	11,[illegible]
Lithopone	[1] 28,707	15	12,871	[1] 41,593	[1] 20,540	-------	14,070	[1] 35,[illegible]
Zinc chloride	-------	5	9,871	9,876	-------	5	6,532	6,[illegible]
Zinc sulphate	957	-------	894	1,851	1,263	-------	784	2,[illegible]
	[2] 138,104	39,620	[2] 26,705	[2] 204,519	104,561	27,090	22,304	153,[illegible]

[1] Includes zinc content of a small quantity of zinc sulphide produced.
[2] Revised figures.

PREPARATION AND USES

WHITE LEAD

White lead is the basic carbonate of lead and is the oldest a[illegible] most important of the white pigments used in oil paint. The pro[illegible] erties of white lead that contribute to its usefulness in paint are[illegible] very great hiding power and the facility with which white-lead pai[illegible] can be worked with a brush. Owing to its relatively high first co[illegible] and the fact that white-lead paints are blackened by compounds co[illegible] taining sulphur, the use of less-expensive zinc oxide and lithopone[illegible] paint pigments has increased during recent years and has seriou[illegible] retarded expansion of the white-lead industry.

The largest part of the white lead manufactured in the Uni[illegible] States is produced, by the "stack" or old Dutch process, wher[illegible] perforated disks of high-grade metallic lead, called "buckles," ab[illegible] 6 inches in diameter, are placed in small clay pots, each of which[illegible] a well in the bottom containing dilute acetic acid. These pots[illegible] arranged in tiers within a large room. Each tier is covered wi[illegible]

boards and a layer of spent tanbark. The lead is co[illegible] basic carbonate by the action of acetic acid vapor and C[illegible] and the heat necessary to vaporize the acetic acid [illegible] by the fermentation of the tanbark. The process req[illegible] four months for completion. The corroded lead buckl[illegible] crushed, screened, and ground in water, and the pulp [illegible] to form dry white lead or ground with oil without d[illegible] the oil pigment.

Some white lead is also made by the Carter process a[illegible] lytic process. In the former, metallic lead is finely di[illegible] of steam and is then treated with dilute acetic acid and [illegible] in slowly rotating wooden cylinders. The process is [illegible] about 12 days. In the electrolytic process a lead anod[illegible] cathode are used, each of which has an independent c[illegible] culation of electrolyte kept separate by a porous diap[illegible] electrolytes are solutions of sodium acetate containing so[illegible] te. The anolyte contains the exact amount of carbon[illegible] to precipitate the basic lead carbonate, whereas the c[illegible] tains a relatively large amount of carbonate. During e[illegible] lead dissolves at the anode surface and is immediately p[illegible] the basic carbonate in suspension in the anolyte. At [illegible] CO_3 is generated at the cathode, passes through the di[illegible] places the CO_3 precipitated with the lead, thus ma[illegible] nolyte at a constant concentration. The catholyte p[illegible] carbon dioxide absorption tower where it is restored [illegible] strength. The basic lead carbonate is filtered from[illegible] washed, dried, pulverized, and barreled.

The principal use of white lead is in the manufacture [illegible] the only important white pigment that is used unmix[illegible] pigments in oil paints; it is also used in varying propor[illegible] mixed pigments. White lead is furnished to the paint[illegible] pigment, as "paste in oil" containing about 8 per cent [illegible] "semipaste in oil" containing 12 to 15 per cent linse[illegible] three-fourths of the white lead produced in the Uni[illegible] ground in oil. Dry white lead is also used as a constituen[illegible] ed in the finer grades of pottery, and some is used [illegible] ture of rubber.

The following table shows the sales of white lead (dry [illegible] various industries in 1929 and 1930, as reported to t[illegible] lines by the producers.

Distribution of white lead (dry and in oil) sales, 1929 and 1930,

Industry	1929		[illegible]
	Short tons	Per cent of total	
[illegible]	136,520	92.8	
[illegible]	4,246	2.9	
[illegible]	6,259	4.3	
[illegible]	147,031	100.0	

The United States exports about 6,000 tons of white l[illegible] of which is manufactured in bond from foreign lea[illegible]

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 stable color in the presence of sulphur gases. Sublimed white lead is also made directly from pig lead. The molten metal is blown through an atomizing nozzle into a heated furnace, and at the same time free oxygen and sulphur dioxide are introduced. The lead is vaporized, oxidized, and converted into basic lead sulphate or lead sulphate in quantity proportionate to the oxygen and sulphur dioxide introduced into the furnace. The resultant fume is collected in settling chambers. It is claimed that this product is the whitest of the lead pigments. Sublimed white lead is used chiefly in the manufacture of prepared paints and mixed pigments. It is also used in the manufacture of storage-battery plates and rubber.

The blue variety is generally a by-product of the smelting of pig lead and is collected from the fumes leaving the smelting furnace. Its color is due to small amounts of carbon and lead sulphide. Paints made from blue lead are especially useful as protective coatings on metallic surfaces. Some blue lead is also used in the manufacture of rubber.

The following table shows the sales of basic lead sulphate to various industries in 1929 and 1930, as reported to the Bureau of Mines by the producers.

Distribution of basic lead sulphate sales, 1929 and 1930, by industries

Industry	1929		1930	
	Short tons	Per cent of total	Short tons	Per cent of total
Paints	13,436	79.9	9,573	
Storage batteries	2,327	13.8	1,104	
Rubber	955	3.9	394	
Other	307	2.4	456	
	16,814	100.0	11,527	

LITHARGE

Litharge is the monoxide of lead and when pure contains roughly 93 per cent of lead and 7 per cent of oxygen. Commercial litharge usually contains some red lead (Pb_3O_4). Litharge is made by oxidizing pig lead with air at moderate temperatures in reverberatory or cupel furnaces. Powdered litharge is usually produced in the reverberatory furnace, whereas flake litharge is produced in the cupel furnace. Flake litharge is sometimes ground into powdered litharge.

The texture and color of the litharge, which affect its use in various industries, are controlled by the temperature of the furnace and the method of cooling.

The chief use of litharge is in the manufacture of storage-battery plates. The negative plates are usually made of straight litharge, whereas the positive plates are a mixture of red lead and litharge. The next largest use of litharge is in the oil-refining industry, where it is used to remove objectionable sulphur compounds from gasoline.

More than 12,000 tons of litharge was so used in the regeneration of the litharge used in oil refi recently.

Litharge acts as a toughener and cure accelerator of mechanical rubber goods and rubber clothing, in the manufacture of lead chromate color pigments, pottery, enamel ware, and glass, and as a drier in varnish and linoleum.

The following table shows the sales of litharge to 1929 and 1930, as reported to the Bureau of Mines:

Distribution of litharge sales, 1929 and 1930, by

Industry	1929	
	Short tons	Per cent of
Storage batteries	37,160	
Oil refining	13,615	
Rubber	6,651	
Ceramics	8,663	
Chrome pigments	8,112	
Varnish	3,124	
Linoleum	322	
Other	10,269	
	87,916	

Of this quantity about 6,000 tons was reported sold for use as insecticide as not separately reported.

RED LEAD

Red lead is the tetroxide of lead (Pb_3O_4) and is powdered litharge at a moderate temperature in air. Pure red lead contains about 91 per cent of lead. Commercial contain from 70 to 98 per cent of red lead, the remainder litharge which 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 pottery. It is an important pigment in paints used for coating on metal surfaces and accounts for the famous red on practically all steel construction. A recent development in underground pipe lines is the use of a baked red lead coating with asphaltic or bituminous protective coatings. Red lead is important of the lead compounds used in the production of optical glass. It is also used in potter's glaze and in enamels as a drier in the manufacture of varnish.

The following table shows the sales of red lead to consumers in 1929 and 1930, as reported to the Bureau of Mines:

Distribution of red lead sales, 1929 and 1930, by

Industry	1929	
	Short tons	Per cent of t
Storage batteries	25,689	
Ceramics	11,555	
Glass	903	
Other	4,874	
	43,021	

Chemical and Metallurgical Engineering, Regenerating Litharge for Sodium February, 1931, p. 76.

ORANGE MINERAL

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

The following table shows the sales of orange mineral to variou
industries in 1929 and 1930, as reported to the Bureau of Mines by th
producers.

Distribution of orange mineral sales, 1929 and 1930, by industries

Industry	1929		1930	
	Short tons	Per cent of total	Short tons	Per ce of tot
Color pigments	487	71.8	188	
Ink manufacture	151	22.3	88	
Other	40	5.9	80	
	678	100.0	356	10

ZINC OXIDE

Zinc oxide, the monoxide of zinc, is made in the United States b
two processes—the French and the American. In the former, meta
lic zinc is heated in a current of air and the resultant oxide fume
collected in long chambers. The product is graded according to it
fineness and is labeled "white seal," "green seal," or "red seal."
The white-seal variety is the finest and whitest grade. Its specifi
gravity is much lower than those of the coarser grades. It is use
chiefly in high-grade enamel paints. Green seal and red seal are th
intermediate and heavy grades, respectively.

American process zinc oxide is made by heating a mixture of zin
ore and anthracite to produce a metallic zinc vapor, which in turn
treated with air to form the oxide. The oxide fume is collected in
bag houses. As lead is usually present in the ore the resultant oxid
contains some lead compounds. It is usually not quite as white a
French oxide but in other respects is very similar. The America
process for making zinc oxide predominates in the United States.

Zinc oxide has been used as a paint pigment to a moderate exten
for several centuries, but the increase in production in the Unite
States during the twentieth century has been due mainly to th
growth of the rubber industry. No recent data on the consumptio
of zinc oxide by industries are available, but in 1926 it was estimate
that the rubber industry consumed more than half of the zinc oxid
produced in the United States. Zinc oxide increases the tensil
strength of rubber and its resistance to abrasion and tear. It im
proves the aging qualities by counteracting the tendency of rubb
goods to deteriorate under action of light and heat. All of th

roperties are essential in making automobile tires
ries, which represent about 75 per cent of the enti
Zinc oxide is seldom used alone as a paint pign
hard, smooth surface which on aging tends to
ving an unsatisfactory surface for repainting
ble color and costs less than white lead, has ex
d covering properties, and is durable. These
ake zinc oxide a useful constituent of mixed p
nds a large usage. It is generally mixed wit
d, and inert pigments.
Zinc oxide is also used in the manufacture of oil
ottery glazes and glass, celluloid, druggists' supp
d leather finishes and for many other purposes.
The use of zinc oxide as a lubricant was repo
ixture of zinc oxide and oil in equal parts is sai
on of bearings and to improve the bearing sur
reon a thin film of zinc.
Exports of zinc oxide in 1930 amounted to 9 pe
oduction.

LEADED ZINC OXIDE

Leaded zinc oxide is made by a method simila
ocess of making zinc oxide. The ore used conta
portions, and the finished product may contai
nt of basic lead sulphate. The properties of
milar to those of zinc oxide and basic lead sul
ding power but is not so white as American
aded zinc oxide is used chiefly in the manufactu
th lithopone it is said to produce a good exteri

LITHOPONE

Lithopone is the newest of the important white
troduction into the United States dates back t
neteenth century. It contains about 70 per cent
d about 30 per cent of zinc sulphide. The latt
ent, is responsible for the useful pigment qual
e process of manufacture consists in mixing
olutions of barium sulphide and zinc sulpha
cipitate is heated to a red heat and plunged int
ich it is ground, dried, and powdered.
The use of high-strength lithopone, containing
inc sulphide, has been increasing in recent ye
be made directly or by mixing zinc sulphide w
al. The increase in imports of zinc sulphide
tons in 1926 to more than 315 tons in 1929
he increased manufacture of high-strength lith
is said to possess very high hiding powe
erties which make it particularly suitable for
lf goods.

y and Industry, vol. 48, Nov. 22, 1929, p. 1136.

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 account 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 printers' inks.

Imports of lithopone into the United States in 1930 amounted to 7,018 short tons, or the equivalent of 4 per cent of the domestic sales. Exports amounted to 3,665 tons.

The following table shows the sales of lithopone to various industries in 1929 and 1930, as reported to the Bureau of Mines by the producers:

Distribution of lithopone sales, 1929 and 1930, by industries

Industry	1929		1930	
	Short tons	Per cent of total	Short tons	Per cent of total
Paints, varnish, and lacquers	150,804	73.1	126,076	[illegible]
Floor coverings and textiles	37,506	18.2	23,656	[illegible]
Rubber	7,176	3.5	5,997	[illegible]
Other	10,829	5.2	8,336	[illegible]
	206,315	100.0	164,065	[illegible]

ZINC SALTS

Zinc sulphate, sometimes known as white vitriol, is usually made by treating secondary zinc material with dilute sulphuric acid, which upon evaporation yields the white crystalline salt. One of the principal uses of zinc sulphate is as a depressing reagent in the flotation of lead-zinc ores. It has recently been used as a weed killer in the tree nurseries of the United States Forestry Service. It is also used in the solutions of electro-galvanizing cells, to some extent in calico printing and in dyeing, as a drier for linseed oil, as a disinfectant and astringent, and as a sizing on cement prior to painting. In addition to these uses, several thousand tons is used yearly in the manufacture of lithopone; as this sulphate represents an intermediate product it is not separately recorded by the Bureau of Mines.

Zinc chloride may be prepared by treating zinc directly with chlorine or with hydrochloric acid, the latter being more generally used. Practically all zinc chloride produced in the United States is made from scrap metal or secondary materials, such as drosses, ashes, skimmings, and galvanizer's scrap. Owing to its hygroscopic properties it is usually marketed in solution, although the fused salt may be obtained in air-tight containers. Zinc chloride is used chiefly as a preservative of timber. It is also used as a germicide and disinfectant, in the refining of petroleum, in the textile industry, in the manufacture of hard fiber, for medical purposes, and in dentistry.

A new wood preservative, zinc meta-arsenite, $Zn(AsO_2)_2$, has recently been developed and according to reports is being used in increasing amounts, particularly where large quantities of moist[illegible]

[illegible] encountered. The chemical is insoluble in water [illegible] have the disagreeable properties of creosote, such as [illegible] ck, and unpaintability.

PRODUCERS AND PLANTS

The following companies reported having sold or [illegible] nc pigments and zinc salts of their own production

hite lead:

Anaconda Lead Products Co. (electrolytic process)	East Chic
Carter White Lead Co	West Pull
Eagle-Picher Lead Co	East St. L
Do	Cincinnati
Euston Lead Co	Scranton,
W. P. Fuller & Co	South San
John T. Lewis & Bros. Co	Philadelph
National Lead Co	Chicago, I
Do	St. Louis,
Do	Perth Amb
Do	Brooklyn,
Do	Port Richr
Do	Cincinnati,
National Lead Co. of California	Melrose, C
National Lead & Oil Co. of Pennsylvania	New Kensi
Sherwin-Williams Co	Chicago, I
Wetherill & Bro	Philadelph

ic lead sulphate, or sublimed lead:

Eagle-Picher Lead Co	Joplin, Mo
Eagle-Picher Mining & Smelting Co	Galena, Ka
St. Louis Smelting & Refining Works of National Lead Co	Collinsville

lead, orange mineral, and litharge:

Eagle-Picher Lead Co	East St. Lo
Do	Joplin, Mo
Do	Newark, N
Do	Cincinnati,
Evans Lead Co	Charleston,
Franklin Lead Oxide Co	Franklin, P
W. P. Fuller & Co	South San
Grasselli Chemical Co	East Chica
Morris P. Kirk & Son	Los Angele
John T. Lewis & Bros. Co	Philadelphi
Metals Refining Co	Hammond,
National Lead Co. of California	Melrose, C
National Lead Co	Chicago, Il
Do	St. Louis, M
Do	Brooklyn, I
National Lead & Oil Co. of Pennsylvania	New Kensi
Sherwin-Williams Co	Chicago, Il

oxide and leaded zinc oxide:

American Zinc Co. of Illinois	Hillsboro, I
American Zinc Oxide Co	Columbus,
Eagle-Picher Lead Co	Hillsboro, I
Empire Zinc Co	Canon City
Grasselli Chemical Co	East Chicag
International Lead Refining Co. (French process)	Do.
Do	Akron, Ohio
Mineral Point Zinc Co	Mineral Poi
New Jersey Zinc Co. (of Pennsylvania)	Palmerton,
Do. (French process)	Freemansbu
Ozark Smelting & Mining Co	Coffeyville,
St. Joseph Lead Co	Herculaneu

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.
Grasselli Chemical Co	East Chicago, Ind.
Do	Cleveland, Ohio.
Do	Weirton, W. Va.
Harshaw Chemical Co	Cleveland, Ohio.
Charles Lennig & Co. (Inc.)	Philadelphia, Pa.
Merrimac Chemical Co	Everett, Mass.
Ozark Smelting & Mining Co	Coffeyville, Kans.

During 1930 the St. Joseph Lead Co., at Rochester, Pa., complet a new zinc oxide plant in which zinc sulphide concentrates are co verted into the oxide by a new electrothermic process. The plant h a capacity of 120 tons of concentrates daily, and the first furnace w put into operation early in 1931. The by-product, sulphur dioxi gas, is converted into sulphuric acid by the contact process. Zi oxide was produced during 1930 at the experimental plant of t company at Herculaneum, Mo.; this plant was closed toward the e of the year.

Morris P. Kirk & Son (Inc.), control of which was acquired by t National Lead Co., began producing lead oxides in 1930 at L Angeles, Calif. The lead oxide plant and assets (at Charleston, W Va.) of the Evans-Wallower Lead Co. of St. Louis, Mo., were al purchased by the National Lead Co. during 1930.

The lead smelter and sublimed lead plant of the Eagle-Picher Le Co. at Galena, Kans., were acquired in 1930 by the newly creat subsidiary, the Eagle-Picher Mining & Smelting Co.

TARIFF

The tariff act of 1930 became effective June 18, 1930. The on changes in the schedules on lead and zinc pigments and salts were increase from 1½ cents to 3 cents per pound on zinc sulphide, and increase from 1¾ cents per pound to 1¾ cents per pound plus 15 cent ad valorem on lithopone containing by weight 30 per cent more of zinc sulphide. The rates on lead and zinc pigments and sa provided in the 1930 act are shown in the following statement.

Import duties on lead and zinc pigments and salts under the

Item	
Lead pigments:	
Litharge	2½
Orange mineral	3 c
Red lead	2¾
White lead	2½
All pigments containing lead, dry or in pulp, or ground in or mixed with oil or water, not specially provided for	30
Lead chemicals:	
Acetate, white	2½
Acetate, brown, gray, or yellow	2 c
Nitrate, arsenate, and resinate	3 c
All other lead compounds, n. s. p. f.	30
Zinc pigments:	
Zinc oxide and leaded zinc oxide containing not more than 25 per cent of lead—	
Dry powder	1¾
Ground in or mixed with oil or water	2¼
Lithopone, and other combinations or mixtures of zinc sulphide and barium sulphate containing by weight—	
Less than 30 per cent of zinc sulphide	1¾
30 per cent or more of zinc sulphide	1¾
Zinc chemicals:	
Zinc chloride	1¾
Zinc sulphate	¾ c
Zinc sulphide	3 c

IMPORTS AND EXPORTS

LEAD PIGMENTS

Imports of lead pigments into the United Stat important. Exports of white lead pigments incre 1930 and amounted to 6 per cent of the total s ite lead; exports to the United Kingdom increase mounted to 73 per cent of the total. Combined ex tharge, and orange mineral increased 43 per ce mounted to 4 per cent of the total sales by domesti ports of these three pigments to Canada, Netherl the United Kingdom amounted to 39, 22, and 1 tal, respectively; exports to Netherland West rly 700 tons, or 325 per cent; those to the Unit nada increased 162 and 4 per cent, respectively.

ic carbonate white lead, red lead, litharge, and orange m consumption in the United States, 1921–193

Year	Basic carbonate white lead		Red lead		Litharge	
	Pounds	Value	Pounds	Value	Pounds	Va
	124,176	$12,598	12,236	$689	100	
	222,465	21,335	1,405	94	1,770	
	336,892	31,286	3,600	220	22,525	1,
	141,156	13,478	1,874	155	1,838	
	213,028	21,535	3,452	268	2,417	
	297,567	31,690	9,591	817	122	
	330,421	29,901	51,688	4,403	1,182	
	166,236	15,889	24,675	1,510	2,100	
	196,478	19,086	10,197	745	3,763	
	147,132	13,496	19,115	1,334	968	

White lead and red lead exported from the United States, 1921–1930

Year	White lead [1]		Red lead [2]	
	Short tons	Value	Short tons	Value
1921	5,161	$993,130	548	$115,[illegible]
1922	4,598	710,705	1,683	294,[illegible]
1923	[1] 5,172	836,261	[1] 1,840	372,[illegible]
1924	[1] 5,055	853,444	[1] 940	210,[illegible]
1925	[1] 6,832	1,203,108	802	183,[illegible]
1926	[1] 6,230	1,119,350	775	176,[illegible]
1927	[1] 6,047	947,226	[1] 1,429	271,[illegible]
1928	[1] 6,476	952,316	[1] 2,084	364,[illegible]
1929	[1] 5,908	921,509	[1] 2,890	503,[illegible]
1930	[1] 6,546	923,281	[1] 4,128	690,[illegible]

[1] Exports of white lead and basic lead sulphate or sublimed lead not classified separately after 1922; figures for 1923–1930 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 1927–1930; the figures for those years may include an unknown quantity of litharge; the figures for 1928–1930 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, 1929 and 1930, by destinations

Destination	1929		1930	
	Short tons	Value	Short tons	Value
North America:				
Canada	122	$19,807	66	$10,[illegible]
Cuba	58	10,207	67	[illegible]
Mexico	127	28,776	98	21,[illegible]
Panama	568	117,561	101	15,[illegible]
Other	65	13,588	56	11,[illegible]
	940	189,939	388	80,[illegible]
South America:				
Argentina	400	65,413	434	67,[illegible]
Brazil	12	2,231	33	[illegible]
Colombia	18	4,206	8	[illegible]
Uruguay	32	5,080	43	[illegible]
Venezuela	19	4,213	11	[illegible]
Other	15	2,648	51	[illegible]
	496	83,800	575	[illegible]
Europe:				
Netherlands	532	66,715	257	[illegible]
United Kingdom	3,382	482,627	4,760	652,[illegible]
Other	23	4,656	68	[illegible]
	3,937	553,998	5,075	670,[illegible]
Asia:				
Philippine Islands	228	47,912	380	74,[illegible]
Other	266	37,948	104	14,[illegible]
	494	85,860	484	88,[illegible]
Africa	5	744	8	[illegible]
Oceania, including Australia	36	7,108	16	[illegible]
	5,008	921,509	6,546	92[illegible]

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

ZINC PIGMENTS AND SALTS

Imports of lithopone, the principal zinc pigment imported into the United States, decreased 17 per cent in 1930 and were equivalent to 4 per cent of the domestic sales. Imports of zinc oxide declined 18 per cent and were equivalent to less than 1 per cent of the

[illegible]estic production. Imports of zinc sulphide, which i[illegible]om 1926 to 1929, declined 75 per cent in 1930. N[illegible]gments imported in 1930 came from Europe. B[illegible] per cent, France 20 per cent, and the United King[illegible] the zinc oxide; the Netherlands supplied 86 per c[illegible] per cent of the lithopone; and Germany supplied 9[illegible]nc sulphide. The United Kingdom and Canada to[illegible]nt, respectively, of the zinc oxide exported in 19[illegible]k 88 per cent of the lithopone exported.

[illegible] oxide, lithopone, zinc sulphide (white), zinc chloride, an[illegible]
ported for consumption in the United States, 1921

Year	Zinc oxide			
	Dry		In oil	
	Short tons	Value	Short tons	Val
[illegible]	1,286	$145,071	57	$17,[illegible]
[illegible]	2,712	361,599	42	8,[illegible]
[illegible]	1,036	169,415	89	21,[illegible]
[illegible]	1,703	229,629	110	25,[illegible]
[illegible]	1,274	205,582	132	31,[illegible]
[illegible]	1,127	198,897	94	23,[illegible]
[illegible]	1,399	220,427	77	18,[illegible]
[illegible]	1,348	208,557	107	25,[illegible]
[illegible]	1,267	203,080	110	27,[illegible]
[illegible]	1,056	148,891	79	16,[illegible]

Year	Zinc sulphide [1]		Zinc chloride	
	Pounds [1]	Value	Short tons	Val
[illegible]	93,537	$8,330	2,199	$213,[illegible]
[illegible]	27,159	8,453	1,374	87,[illegible]
[illegible]	11,844	5,403	551	44,[illegible]
[illegible]	9,678	5,727	319	28,[illegible]
[illegible]	14,604	5,589	469	50,[illegible]
[illegible]	7,800	4,125	568	51,[illegible]
[illegible]	132,223	22,984	470	40,[illegible]
[illegible]	338,030	47,235	563	47,[illegible]
[illegible]	630,565	84,200	638	50,[illegible]
[illegible]	159,533	23,552	351	28,[illegible]

[illegible] sulphide is stated in pounds rather than tons because of its high value a[illegible]

Zinc oxide and lithopone exported from the United States

Year	Zinc oxide	
	Short tons	Value
[illegible]	2,511	$426,253
[illegible]	3,977	593,128
[illegible]	5,024	743,577
[illegible]	3,927	606,030
[illegible]	10,856	1,503,561
[illegible]	14,661	1,917,420
[illegible]	14,494	1,821,786
[illegible]	14,799	1,849,889
[illegible]	17,638	2,301,643
[illegible]	10,753	1,446,904

[illegible]ssified separately prior to 1922.

Zinc oxide exported from the United States, 1929 and 1930, by destinations

Destination	1929		1930	
	Short tons	Value	Short tons	Value
North America:				
Canada	7,702	$1,002,618	4,547	$628,[illegible]
Cuba	117	17,508	91	12,[illegible]
Mexico	73	13,448	20	4,[illegible]
Panama	87	15,486	101	18,[illegible]
Other	18	4,483	53	8,[illegible]
	7,997	1,113,543	4,812	671,[illegible]
South America:				
Argentina	24	4,799	68	13,[illegible]
Brazil	5	1,129	9	1,[illegible]
Other	40	8,931	28	6,[illegible]
	69	14,859	105	20,[illegible]
Europe:				
France	452	50,836	428	52,[illegible]
Italy	69	11,361	115	16,[illegible]
United Kingdom	6,360	702,010	4,719	573,[illegible]
Other	1,144	125,904	116	18,[illegible]
	8,025	950,171	5,378	660,[illegible]
Asia:				
Philippine Islands	88	12,264	69	8,[illegible]
Other	819	110,415	107	20,[illegible]
	907	122,679	176	28,[illegible]
Africa	3	594	14	2,[illegible]
Oceania, including Australia	637	99,797	268	54,[illegible]
	17,638	2,301,643	10,763	1,445,[illegible]

PRICES AND VALUE

The total value and the average price received by producers fro[illegible] sales of lead and zinc pigments and salts are given on preceding pag[illegible] of this chapter. The range of market quotations as reported by [illegible] Oil, Paint and Drug Reporter is shown in the following table.

Range of quotations on lead pigments and zinc pigments and salts at New Y[illegible] 1928–1930, in cents per pound

Product	1928	1929	1930
Basic lead sulphate, or sublimed lead, dry, casks	7.75	7.75–8.50	6.75–[illegible]
White lead, or basic lead carbonate:			
Dry, casks	8.25–8.50	8.25–9.00	7.25–[illegible]
In oil, carload lots	10.73	10.73–11.54	10.60–[illegible]
Litharge, American, commercial, powdered, casks	8.50–9.00	8.75–10.25	7.75–[illegible]
Red lead, dry, casks	9.50–10.00	9.75–11.25	8.75–[illegible]
Orange mineral, American, casks	11.50–12.00	11.75–13.25	10.75–[illegible]
Lead acetate, brown, broken, barrels	12.00–12.50	12.00–13.50	10.50–[illegible]
Lead arsenate, powdered, drums	13.00–15.00	13.00–15.00	13.00–[illegible]
Zinc oxide:			
American process, lead-free, bags, car lots	6.50	6.50	[illegible]
American process, leaded, barrels, car lots	6.88	6.88	[illegible]
French process, red seal, bags, car lots	9.38	9.38	[illegible]
French process, green seal, bags, car lots	10.38	10.38	[illegible]
French process, white seal, barrels, car lots	11.63	11.63	[illegible]
Lithopone, American, bags, car lots	5.25	5.25	4.50–[illegible]
Zinc chloride:			
Solution,[1] drums	2.75–3.25	2.75–3.25	2.25–[illegible]
Fused	5.25	5.25–5.75	[illegible]
Zinc sulphate, barrels	3.50–3.75	3.00–3.75	3.00–[illegible]

[1] At works.

Quotations on each of the lead pigments declined [illegible] pound during 1930 as a result of the decrease in th[illegible] New York) from 6.25 cents at the beginning of the [illegible] the end; the trend of prices was downward thro[illegible] April producers of lead pigments increased the [illegible] provide a larger margin of profit to dealers and pr[illegible] incentive to dealers to push the sale of lead pigm[illegible] hite lead.

Quotations in 1930 on the various grades of [illegible] maintained at the level of the three preceding ye[illegible] rice of zinc (St. Louis) declined from 5.45 cents a[illegible] 930 to 4.12½ cents at the end. The average price [illegible] on, received by producers reporting to the Bureau o[illegible] om $128 in 1929 to $125 in 1930, due probably to a [illegible] oduction of the cheaper grades of zinc oxide in 1[illegible] on for ordinary lithopone was maintained at 5¼ [illegible] 11 months of the year, but in December it dro[illegible] llowing a cut in the price of titanium pigment. [illegible] lithopone per ton, received by domestic produ[illegible] 30 as compared with $96 in 1929. This increas[illegible] decrease in quotations, may have been due to [illegible] on of the higher priced high-strength lithopone.

SEARS, GEORGE W. Progress in production and use of tantalum. Am. Meta Market, vol. 37, Feb. 21, 1930, p. 5. Metals and Alloys, vol. 1, April 1930, p. 471.

Tantalum is receiving increasing attention as an acid-resistant metal. Tantalum ores and produc tion and some alloys are briefly discussed. The extraction and metallurgy of tantalum and of columbiu are touched upon.

SWOBODA, K., AND HORNY, R. Determination of tantalum, tungsten, vanadium and molybdenum in high-speed steel. Ztschr. anal. Chem., vol. 80, 193 pp. 271–288. Chem. Abs., vol. 24, Aug. 20, 1930, p. 3966.

WAYLAND, E. G., AND SPENCER, L. J. Bismuto-tantalite, a new mineral, fro Uganda. Mineralog. Mag., vol. 22, 1929, pp. 185–192. Chem. Abs., v 24, 1930, p. 1321.

The mineral is found at Gamba Hill, Busiro County, in pegmatite. It contains about 50 per ce Bi_2O_3 and 47 per cent $Ta_2O_5+Cb_2O_5$. The indicated formula is $Bi_2O_7.(Ta,Cb)_2O_5$. Crystallograph data and a complete chemical analysis are given.

PATENTS

BALKE, C. W. (TO FANSTEEL PRODUCTS CO. (INC.)). Removal of carbon im purities from tantalum. U. S. Patent 1,754,453, Apr. 15, 1930. Chem and Ind., vol. 49, Oct. 3, 1930, p. 915.

Powdered tantalum containing small amounts of graphite is purified by heating it, in vacuo, wi magnesia at a temperature at which the carbon will be oxidized and the resulting magnesium volatilize

CANADIAN WESTINGHOUSE CO., LTD. Production of tantalum by electrolysis fused compounds. Canadian Patent 300,953, June 10, 1930.

The electrolytic bath is made up of a mixture of fluorides, including an alkali fluoride and a dou fluoride of an alkali metal and a refractory rare metal.

FANSTEEL PRODUCTS CO. (INC.) Method of removing carbon impurities fro tantalum. Canadian Patent 299,739, Aug. 19, 1927.

———. Process for eliminating carbon from difficultly fusible rare metal particularly tantalum. French Patent 693,417, Apr. 5, 1930.

RAMAGE, J. H. (TO WESTINGHOUSE LAMP CO.). Tungsten-tantalum alloy. U Patent 1,741,953, Dec. 31, 1929.

TITANIUM

GENERAL CONDITIONS

Countercurrent to the general business depression that engulfe other industries the titanium industry made marked progress in 193 Not until 1920 were titanium dioxide pigments marketed on a co mercial scale; by 1929 the domestic consumption was in the neighbo hood of 6,000,000 pounds. In 1930, despite a substantial reductio in the aggregate consumption of other pigment materials, the use titanium pigments seems to have been well maintained. Only on price reduction was made during 1930 as compared with two reduc tions in 1929. The change was made in December and amounte to three-fourths cent a pound for barium and calcium base titaniu pigments. These progressive reductions are interpreted as a reflectio of continued economies in manufacture that have resulted from th rapidly increasing scale of production, rather than as an indication an urgent necessity to work off stocks. It is, furthermore, significa that the announcement of this reduction was promptly followed by 15 per cent reduction in the price of lithopone.

Among many diversified applications probably the chief factor the growing popularity of titanium pigments is their employment brush and spray lacquers; in bakelite and similar synthetic phen and cresol condensation products; and in celluloid or pyroxyl plastics. Titanium dioxide is whiter than most of the other pigme and has a remarkably high covering power. Being virtually in it does not react with the solvents ordinarily used. New color

ments have been developed to accompany titanium tain purposes, and practically all lithopone makers offer special mixtures of lithopone and titanium di m pigments also find growing use in the manufactur ated textiles, rubber, wall papers, printing inks, glass re.

The use of titanium in pigments is by far the leading but there is also a substantial demand for titanium a 1930 it was found that the addition of titanium in binations may permit the production of a steel tha ergranular corrosion even when high-carbon stock n alloy with 0.15 per cent carbon and 0.75 titanium carbon content) showed the same resistance to rosion as a material of 0.09 to 0.06 per cent carbon. titanium in glass formulas progressed during the ye small use of the bichloride and sulphate in the tetrachloride may also be employed for smoke scre Navy air corps maneuvers and possibly for " tallic titanium is so difficult to produce that little prog e in introducing commercial uses for the metal, but i been in progress in the National Physical Laborato determine the effects of titanium, added as titanium various metals. This volatile compound is easily p should impart valuable qualities to any of the comm use in industry could be established without apparen new domestic source of titanium was being develop At Piney River, the dividing line between Nelson unties in Virginia, the Southern Mineral Products C olly owned subsidiary of the Vanadium Corporation nstructed a group of chemical and mechanical concen ildings for the production of titanium and phosph company owns mineral rights underlying some 3,50 nite belt. This belt which, according to Watson and 2½ miles wide, includes the property of the Am at Roseland, Va. The mine product is separated w netic machines yielding as principal materials ilme es and apatite concentrates. The former of these ted further to recover titanium dioxide, and the ap ed into phosphoric acid and phosphates. Opera , said to have cost between $1,250,000 and $1,500, bed in the Manufacturers Record: [16]

* To the right of the mill building are steel silos on rein ations, with a capacity of 600 tons of ilmenite. From th ite is conveyed by a pneumatic handling system to the iln and from an interior mill storage, apatite is transported by matic system to the phosphate plant. Ilmenite and apatite concentrates are chemically treated in for the production of titanium dioxide and phosphoric acid ary and technically pure products are either sold as such dary plant units into titanium salts and phosphates.

[16] Lewis, Robert T., Use of Lacquers Has Given a Rebirth to Lithopone and and Ind. (London), vol. 49, No. 6, Feb. 7, 1930, p. 81T. Canadian Mining Journal, A Titanium Research: Vol. 51, No. 35, Aug. 29, 1930, Watson, T. L., Geology of the Titanium and Apatite Deposits in Virginia: Virginia 1918, pp. 100–155. Manufacturers Record, New Chemical Industry for the South: Apr. 9, 1931, pp.

The principal reagent used for both primary processes is sulphuric acid, a
because of the large quantities required, the plant units at Piney River includ
contact sulphuric acid plant of the latest type, using a vanadium mass as
catalyst. The sole raw material for this process of sulphuric acid manufact
is sulphur, brought from Texas to Norfolk or Newport News by steamer,
thence by a comparatively short rail haul to Piney River.

A considerable amount of the sulphuric acid used in the manufacture of titan
dioxide by the Southern Mineral Products Corporation process reappears at
end of the operation as an impure dilute acid. A recovery system has b
devised and a recovery unit installed so that impurities are removed, the di
acid is concentrated, and a strong acid, entirely suitable for re-use is recove
The other reagents used in the processes are employed in small quantities;
essentially, ilmenite, apatite, and sulphur are the basic raw materials, with
two most important—ilmenite and apatite—produced by a mine and mill adja
to the chemical plants.

The chemical processes at Piney River demand large quantities of water
most of the reactions are carried out in solution stage, and several of the pro
steps demand thorough washings of precipitates so that traces of foreign mate
can be removed. The Piney River, which flows through the center of the p
erty, provides an ample water supply. Even in the drought period of 1930
river had a minimum flow several times that required by the plant. Test w
have also proven the existence of an underground water strata.

Steam required for the various process units is developed in a compact, c
fired boiler plant designed by the Stone and Webster Engineering Corpora
and electric power is obtained over a special transmission line from the Ap
lachian Electric Power Company. In addition to the mill and process units,
plant group includes two warehouse buildings, mechanical, electrical, and
penter shops, and a series of strategically located fire hose houses, which with
independent high pressure stand pipe system, provide adequate fire protect

Rutile has been mined in the United States principally at Roselan
Va., although minor quantities of rutile as well as ilmenite w
formerly produced in Florida from the treatment of beach sa
Rutile has been identified at a few other localities in the So
Atlantic States, but the deposits as a rule have not proved extens
A possible new commercial source of rutile was reported to the aut
by E. L. Dinning of the Harford Talc Co. The deposit, whic
about 1¼ miles west of Pylesville Post Office, Harford County, M
has been exposed across a large open pit, and a drill hole shows a c
tinuation of the rutile-bearing formation to a depth of at least 80
Laboratory tests indicate that a recovery of about 6 per cent of
gross weight of the material may be made in the form of clean c
centrates by means of table concentration followed by magn
separation. The final concentrates should contain 93 to 96 per
TiO_2. Magnetite and amphibole are present in the table con
trates, which therefore contain only about 21 per cent of titan
oxide. The crude rock assayed about 8.6 per cent TiO_2.

Both in the United States and Canada the search continues
means of utilizing titaniferous magnetites and low-grade ilmen
What may prove another large body of such ores is reported in a le
addressed to the Bureau of Mines by L. W. Fargo, secretary of
Vermillion Range Land Co., Chicago, Ill. The deposit, whic
south of Gunflint Lake in Cook County, Minn., is said to yield
containing 1⅞ per cent vanadium as well as 12 per cent titan
A year or two ago a metallization process was worked out in
laboratories of the Canada Department of Mines for low-g
ilmenite containing 31.75 per cent TiO_2, 39 per cent iron,
per cent alumina, 7 per cent silica, and 2.6 per cent magn
At 990 to 1050° C. 94 per cent of the iron could be reduced to
in a rotary furnace by means of coal. Leaching the product

per cent sulphuric acid yielded a residue cont
O_2, 6.27 per cent iron, and 0.8 per cent carbo
ndry other processes for separating iron fro
problem concerns disposal of the iron sulphat
copperas or ferrous sulphate are sold annually
ll supplied by existing sources, notably the pi
el works. New outlets for this by-product are
emists as a result of research into the more e
s in water purification and sewage disposal.

DOMESTIC PRODUCTION

During 1930 the American Rutile Co. (a subsid
ermit Corporation) shipped ilmenite and rutile
Roseland, Va. This plant formerly operate
, but recently the demand has increased so th
ly occupied. The output of titanium mineral
e, so far as data are available to the Bureau o
, is shown in the following table, which, howev
er than production:

Titanium minerals produced in the United States

Year	Rutile concentrates			
	Short tons	Percentage of TiO_2	Value	Short
	310	95	(1)	5
	270	95	(1)	6
	46	95	[2] $11,000	5
	30	95	[2] 7,500	4
	524	95	129,881	8
	176	93–96	[2] 37,700	
	(1)	(1)	(1)	(1)
	(1)	(1)	(1)	(1)

roduction reported for 1921.
an of Mines not at liberty to publish figures.
rary value.
s for Florida only. Bureau of Mines not at liberty to publish figu

e new plant of the Southern Mineral Produc
ome into production until early in 1931.
done on the beach deposits in California,
has no record of shipments being made.
(W. T. Eckhoff, secretary), of San Francis
concentration its black sands along Mon
ot, containing 8.70 per cent TiO_2, 4.65 per ce
rcent iron. The Aluminum Co. of Americ
oducts in the purification of bauxite for alum
anium pigments were manufactured in the
te by the Titanium Pigment Co., a subsidia
Co., with plants at St. Louis and Niagara
mercial Pigments Co., a subsidiary of the Co
ration, with a plant at Baltimore. Early in
y Co. announced its intention to transf
to St. Louis. Fifty-five men were reporte

the change. The manufacture of ferrocarbontitanium by the Titanium Alloy Manufacturing Co. (an affiliated concern) will be continued at Niagara Falls. Carbide-free ferrotitanium is produced by the Metal & Thermit Corporation. Ilmenite is the chief raw material for these alloys, as well as for the pigments. Rutile is used chiefly in the ceramic industry, especially in tile and in dinner ware, to add color and strength.

IMPORTS

Ilmenite sand is imported extensively from Travancore, India, and from Senegal. From time to time shipments have also been made from Brazil. The imports of ilmenite, as recorded by the Bureau of Foreign and Domestic Commerce, amounted to 24,97[illegible] short tons, valued at $150,466, in 1930. This quantity is a trifle less but the value 43 per cent more than the imports of 25,072 tons, valued at $104,887, in 1929. Much of the ilmenite imported is from beach deposits, in which it occurs associated with monazite and zircon. In former years undoubtedly much ilmenite was included in the statistics for sand and other items, which, like ilmenite, are exempt from duty. A study of the records for 1929, however, indicated that this situation was much improved, although even now some of the ilmenite imported probably escapes being recorded under its specific category. In Quebec, for example, deposits of massive ilmenite are worked at Ivry and at Baie St. Paul; the ore, which contains up to 38 per cent of TiO_2, is shipped to the United States, but this movement does not appear in the import statistics.

Rutile is imported from Norway, but only in small amounts. The mineral is also associated with the ilmenite produced at St. Urbain, near Baie St. Paul, in Quebec, and shipped to the General Electric Co. works at West Lynn, Mass. In 1930 the total imports of rutile were 3 short tons, valued at $974.

WORLD PRODUCTION

The world production of titanium minerals in 1929 and 1930, as gathered from Government reports and other available sources, is shown in the following table:

World production of titanium minerals, 1929 and 1930

Mineral and country	1929			1930		
	Ore produced	Content of TiO_2	Value[1]	Ore produced	Content of TiO_2	Value[1]
Ilmenite:	*Metric tons*	*Per cent*		*Metric tons*	*Per cent*	
Brazil[2]	6,361	(3)	$75,109	80	(3)	
Canada (Quebec)	2,493	(4)	7,304	374	(3)	
India (Travancore)	24,050	(4)	130,067	(4)	(3)	
Norway	7,023	43	63,500	7,630	43	
Portugal	56	50	250	(3)	(3)	
Senegal	[5] 7,240	(4)	24,280	[5] 5,322	(4)	
United States	(4)	(4)	(4)	(4)	(4)	
Rutile:						
Norway[2]	43	90-93	13,000	46	90-93	
United States	(4)	(4)	(4)	(4)	(4)	

[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] Bureau of Mines not at liberty to publish figures.
[5] Concentrates.

THE INDUSTRY IN FOREIGN COUNTRIES

Exports from Brazil, which increased to 6,361 metric ton[illegible] dropped to small proportions in 1930. The deposits are be[illegible] on the coast of the States of Rio de Janeiro, Espirito S[illegible] Bahia. Three firms were recently reported to be working [illegible]lian deposits. In Ceylon several large deposits of con[illegible] black sand have been discovered; the largest of these, at Pu[illegible] estimated to contain at least 2,000,000 tons of ilmenite.[17] [illegible]r the exploitation of such beach deposits may be granted [illegible]Government decree passed in 1926, but none have bee[illegible] ommercially as yet. A Ceylonese firm, however, is re[illegible]ave obtained a concession from the Indian Government f[illegible]g deposits in the southern Travancore area that will [illegible]lmenite, monazite, and zircon. The Radium & Rare Eart[illegible]ent Co., owning property at Olary, South Australia, e[illegible]German chemist to develop a process for making pigment[illegible]lmenite ores.

The Fabriques de Produits Chimiques of Thann and [illegible]arted the manufacture of titanium white in France in 19[illegible]e processes of the Société Française de Produits Chim[illegible]rres Rares.[18] This is the same process employed in th[illegible]ates by the Commercial Pigments Corporation at Balti[illegible]o by the Italian company, the Società Anonima Tita[illegible]ovisa-Milano and by The United Manufacturers of Ch[illegible]etallurgical Products at Aussig in Czechoslovakia. Th[illegible]oduct is sold under the name of "Thann" white, and the [illegible]ound 600 tons annually. The Compagnie Générale de [illegible]imiques de Louvres is planning to operate a plant using a[illegible]ocess. In Germany the Titanium Pigment Co. has lic[illegible]ocess to the Titan G. m. b. H., a subsidiary of the [illegible]e Trust, with a titanium pigment plant at Leverkusen [illegible]G. Farbenindustrie's lithopone interests are also centered.

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[illegible]ICAN METAL MARKET. Hiduminium—a new alloy developm[illegible]7, June 26, 1930, pp. 3–4. Metallurgia, vol. 2, June, 1930, [illegible]Metals and Alloys, vol. 1, No. 18, December, 1930, p. 898.

[illegible]ws, A. I. Titanium, zirconium and antimony in enamels. Ce[illegible]ol. 14, p. 295. Foote-Prints, vol. 3, No. 1, 1930, p. 52.

[illegible]itanium oxide improves the acid resistance and does not increase the refractoriness as [illegible]m oxide is satisfactory as a mill addition. Antimony oxide, substituted for silica, [illegible]

[illegible], H. O. Titanium in New Zealand soils. New Zealand Jour. [illegible]ol. 12, 1930, pp. 173–179.

[illegible]anium in New Zealand soils ranges from 0.25 to 1.50 per cent. There appears to [illegible]itanium and iron content, both elements increasing together, but none between [illegible]

[illegible]Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals and [illegible], No. 9, Mar. 2, 1931, p. 4.

[illegible], Jean, France Satisfactorily Balances Chemical Production and Consum[illegible]al, 28, February, 1031, p. 145.

BALDWIN, ROBERT T. Use of lacquers has given a rebirth to lithopone and titanium dioxide. Chem. and Ind. (London), vol. 49, No. 6, Feb. 7, 19 p. 81T.

The spreading use of lacquers has given a rebirth to titanium dioxide. This valuable filler and ment has a superior covering power, a permanent whiteness, and a compatibility with some solvents assures it a place in the lacquer sun. Practically all lithopone makers in America now offer special mix of lithopone and titanium dioxide. At least one process of manufacture of titanium dioxide yields fe sulphate as a by-product, and ingenious uses for it have been recently put into operation in water cation and sewage disposal.

CHEMISTRY AND INDUSTRY (LONDON). The chemistry and geochemistry of titanium group. Hugo Muller lecture. Chem. Soc., Annual General M ing. Vol. 49, No. 14, Apr. 4, 1930, p. 278.

The percentages of the various elements in igneous rocks were given as follows: Ti 0.5, Zr 0.0 4 x 10⁻⁴, Th 1 x 10⁻⁴, V 0.02, Nb 1 x 10⁻⁴, Ta 6 x 10⁻⁴, Pa 4 x 10⁻¹⁰.

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HEATON, NOEL. Titanium oxide pigments. Chem. and Ind., vol. 48, 19 pp. 1090–1091. Jour. Am. Ceram. Soc., vol. 13, No. 2, February, 19 p. 87.

The industrial development of titanium compounds since the formation of the first compa Norway in 1860 is described.

HIRSCH, HANS. Action of titanic acid on refractory materials. Tonind.-Z vol. 54 (47), 1930, pp. 773–776. Jour. Am. Ceram. Soc., Abs. Bull., vol No. 10, October, 1930, p. 851.

The best-known titanium minerals are titanium dioxide, appearing as rutile, anatase, and broo titanium iron ores and ilmenite, perosskite, and titanite. Titanium dioxide is a refractory material vestigations showed that objects with 99% of titanium dioxide and only traces of iron could be fu Seger cone 35. Its behavior at fusion resembles that of quartz and shows a similar viscosity. Rutil consequence of its iron-oxide content has a lower fusing temperature. Additions of TiO_2 to raw mat used in the refractory industry have apparently no influence on their fusion. Investigations were c on to find the proportion of TiO_2 in different clays and grogs, and showed an average content of 1 to TiO_2. The results of further experiments are as follows: (1) A 2% addition of TiO_2 only slightly im refractoriness and softening under pressure. (2) A 10% addition lowers refractoriness about 3 Seger c In binding and sagger clays the action of TiO_2 is greater. The process of shrinkage is not much influe in sagger and binding clays. (3) A 2% addition of TiO_2 does not influence shrinkage of kaolin, but a addition greatly increases it. A change of color to ivory and yellow also takes place. (4) The influe 1% titanium dioxide in combination with other fluxes, 2% iron oxide, 0.5% magnesium oxide, and calcium oxide, was tested. The two latter together with titanium dioxide do not influence in gener softening under pressure and refractoriness. These tests showed that titanic acid in small quantities not change materially the properties of refractory clays.

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A study made with Chevenard dilatometer and Saladin-Le Chatelier recalescence point app showed that for 0.10–0.17% C steels, 0.5 and 0.8% Ti raise Ac_1 to 780° and bring Ac_3 respectively, to 1080°. Added to 13% Cr low carbon steel it acts more pronouncedly raising the transformation p 890° with 0.11% Ti, to 900° with 0.14% Ti and pushing it beyond 1140° by 0.60% Ti. Quenching from 1300° develops in Cr steels only martensite, above it delta phase appears and the amount of it in with the rise of temperature. Microscopical evidence is clear in case of 13% Cr, 0.84% Al steels bu not show anything definite in Cr-Ti steels. 17 curves and 5 microphotographs are given.

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Titaniferous iron ores are ground with fluorspar and carbonaceous material and reducing atmosphere to produce iron sponge and calcium fluotitanate. The reduc igh steam into water containing a small proportion of sodium hydroxide, and ound wet, screened to remove coarse iron, and concentrated on Wilfley tables o eparator.

HENFELD, J. Production of oxides of titanium. British Mar. 11, 1929. Chem. and Ind. (London), vol. 49, No. 33 p. 765.

A titanium halide (e. g., tetrachloride) distributed upon a soluble salt, e. g., ate, is treated with steam and the mass is calcined, cooled, and extracted with the product is obtained in a finely divided form suitable for use as a pigment.

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Titanium dioxide, silicate, or aluminate is added to the clay bond used in the m d carborundum crucibles. When fired at cone 5–10 a very strong mass is prod which prevents the oxidation of the graphite, etc.

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Ilmenite is heated with barium sulphate, calcium chloride, and carbon in a roduct is extracted with boiling water and then with weak acid.

TSCHE GASGLUHLICHT-AUER-GES. M. B. H. Purification of dioxide. British Patent 309,598, Apr. 10, 1929. Chem. don), vol. 49, No. 20, May 16, 1930, p. 419. British Chem

The dioxide is freed from contaminating chromium oxide by mixing with a sm a earth (magnesia, alkali, carbonate, etc.), drying, roasting at incandescent e soluble chromate with water or dilute acid. Oxidizing agents may be ad ion of chromate.

TSCHE GOLD UND SILBER-SCHEIDEANSTALT VORM. ROESSLER Tin, titanium and zirconium oxides. British Patent 32 1930. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, August, 19

To obtain highly dispersive oxides of tin, titanium, or zirconium, suitable for agents for vitreous enamels, etc., soluble compounds of these metals are allo conditions or in the presence of limited quantities of solvents with substances nto oxides, e. g., alkaline lyes, steam, ammonia, etc., and the oxides or hyd in the case of pigments from 500 to 800° C. and turbidity agents from 900 to 150 voluminous form. The initial reaction can take place either in the liquid phase reactants. If the reaction in the vapor phase takes place above 600° C., th omitted. In examples, (1) titanium tetrachloride in the form of vapor is ated steam at 500° C. and the oxide formed is washed, dried, and heated from pigment; (2) zirconium oxychloride or a concentrated solution thereof is stirr s solution, the pasty mass diluted with water, and the precipitate washed, d 400° C. and a turbidity agent obtained; (3) the vapor of stannic chloride f team at 300° C., and the oxide product is washed, dried, and heated to a l a turbidity agent. See also Brit. 296,780, Ceram. Abs., vol. 8 (2), p. 151 (19

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Ti compounds are manufactured by working up ilmenite with strong or fuming H_2SO_4 acid, dissolving the strongly acid material in water with the addition of a suitable quantity of K_2SO_4, isolating the double sulphate thus obtainable, and hydrolyzing. E. g., 1000 parts of strongly acid material obtainable by working up ilmenite with H_2SO_4, which contains $Ti(SO_4)_2$ in a quantity equivalent to about 17% TiO_2, is quickly heated with 2500 parts of water and 400 parts of K_2SO_4 to 95°. The solution is filtered while hot. In the cold, i. e., at about 0 to 5°, the double sulphate separates in about 65 to 75% the quantity calculated on the dissolved Ti. The greatest part of the rest of the double salt may be isolated by evaporating.

———— Titanic acid. French Patent 35,377, May 25, 1928. Addition to 653,893. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, No. 11, November, 1930, p. 990.

Easily soluble Ti compounds and very pure TiO_2 are prepared by rapidly heating with K_2SO_4 and water the product obtained by treatment of ilmenite with H_2SO_4, filtering this solution, and washing the residue with H_2SO_4.

———— Manufacture of concentrated titanyl and titanic sulphate solutions. British Patent 309,090, Apr. 4, 1929. Chem. and Ind. (London), vol. 49, No. 38, Sept. 19, 1930, p. 862.

A moderately hot solution (e. g., not exceeding 60°) of metatitanic acid in sulphuric acid is saturated with metatitanic acid, and then orthotitanic acid is added and the mixture concentrated in vacuo (e. g., at 70–90°). The titanic acids may be added in solid form or in aqueous solution. The solutions obtained are substantially free from iron and are adapted for use as tanning agents and mordants.

———— Titanium compounds from ores. German Patent 490,600, Mar. 12, 1926. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, No. 8, August, 1930, p. 681.

Ti ores are treated at high temperature with dilute H_2SO_4 in the presence of reducing agents, preferably compounds of tervalent Ti compounds. Thus, ilmenite, containing approximately 55% TiO_2 and 33% Fe, is heated with 40% H_2SO_4 and Cu to 180° for 6 hrs. On lixiviating the matrix, H_2TiO_3 with about a 0.5% Fe content is obtained. Without the reducing agent, the Fe content is about 20%. Other examples are given.

———— Process for extracting titanium ore. German Patent 497,931, Dec. 18, 1926. Metals and Alloys, vol. 1, No. 13, July, 1930, p. 641.

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FARUP, PEDER. Precipitating titanium compounds. U. S. Patent 1,773,72[illegible] Aug. 26, 1930. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, No. 11, November, 1930, p. 989.

The process of precipitating titanium compounds by hydrolysis which comprises heating a titanium solution to cause precipitation of titanium compounds therein, and adding during the precipitation another titanium solution in amount sufficient to maintain a substantially constant composition and make up for the titanium compounds so precipitated.

GREGORY, ARNOLD WILLIAM. Treatment of ores for the recovery of titanium. U. S. Patent 1,734,034, Nov. 5, 1929. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, No. 1, January, 1930, p. 69.

Process of removing the iron from titanic iron ores which consists in pulverizing the ore, mixing pulverized ore with sufficient free carbon to combine with substantially all of the oxygen in the iron of the ore and with a fusible alkaline salt, heating the mixture in the absence of free oxygen to a bright heat to cause combination of the carbon with substantially all of the oxygen of the iron oxide content, production of free iron in a dispersed state, and immediately treating the whole mass with dilute capable of combining with the free iron in quantity at least sufficient to combine with all the free and to neutralize the alkaline salt whereby to resolve all the iron content of the ore to an iron salt in solu

KENDALL, SYDNEY W. Proofing textile materials against insects, etc. U[illegible] Patent 1,739,840, Dec. 17, 1929. Chem. Abs., vol. 24, 1930, p. 977.

Fatty acid salts of yttrium, thallium, or titanium are used as impregnating agents.

LAPORTE, B., WEBER, I. E., and BENNETT, A. N. C. Pigment from titani[illegible] oxide and barium sulphate. British Patent 315,904, Apr. 17, 1928. Ch[illegible] Abs., vol. 24, 1930, p. 1753.

A mixture for calcination is prepared by adding $BaSO_4$ to, or forming it in, a fine dispersion of titan[illegible] oxide and coagulating the dispersed oxide. Various details of procedure are described.

MATHESIUS, W., and MATHESIUS, H. Production of titanium steel. Br[illegible] Patent 329,705, Feb. 25, 1929. Chem. and Ind. (London), vol. 49, No[illegible] Aug. 8, 1930, p. 720.

Steels containing not more than 1 % C and 0.8 % Ti with small additions of silicon, manganese, [illegible] mium, and other metals which improve the properties are claimed, a preferred composition being C, 0.2 % Ti, 0.5 % Si, 0.6 % Mn, and 0.5 % Cr. The steel is produced by deoxidizing a bath containing than 0.1 % C by the addition of carbon-free silicides of ferromanganese, ferrochromium, or ferromang[illegible] chromium having such a carbon content that 0.1 % C remains in the bath; the requisite titanium is added as carbon-free ferrotitanium.

MATHESIUS, W., and MATHESIUS, H. Production of titanium steel. [illegible]ent 337,715, Mar. 16,1929. Chem. Age, vol. 23, No. 595, Nov [illegible] 485.

———— Titanium. British Patent 333,816, Oct. 8, 193[illegible] Ceram. Soc., Abs. Bull., vol. 9, No. 12, December, 1930, p. 11[illegible]

In a process for producing homogeneous titanium or ferrotitanium melts by aluminc [illegible]alts of the acids derived from the oxides of the heavy metals are added to the mixture [illegible]egular decomposition of the regulus. Chromates, tungstates, manganates, permangan[illegible] are specified, either as salts of iron, nickel, cobalt, manganese, uranium, tungsten, molybd[illegible] the latter case, the metallic radical passes together with the metal of the acid radical in [illegible]rotitanium regulus.

———— Titanium steel. Australian Patent 25,628. In[illegible] and Min. Stand., vol. 84, No. 2169, Nov. 20, 1930, p. 378.

To produce homogeneous titanium steel, briquetted or pulverized titanium thermic [illegible]a ladle, and upon this mixture molten deoxidized decarbonized steel is discharged fro[illegible] second ladle. The steel to be alloyed with titanium is first deoxidized and decarbonized [illegible]e a relatively large discharge opening, through which this prepared steel is discharged [illegible] second ladle, containing the pulverized or briquetted thermic mixture, which is immedi[illegible]g up violent movement, which causes the titanium separated out in the reaction to be [illegible] the molten steel to form a perfectly homogeneous alloy.

———— Process for obtaining iron-titanium alloys conta[illegible] percentage of titanium. French Patent 684,474, Nov. 6, 1[illegible] and Alloys, vol. 1, No. 12, June, 1930, p. 584.

———— Process for producing homogeneous or ferrotit[illegible] capable of being poured. French Patent 684,210, Oct. 30, 1[illegible] and Alloys, vol. 1, No. 12, June, 1930, p. 584.

MECKLENBURG, WERNER. Production of titanium dioxide. U[illegible] 1,758,528, May 13, 1930. Jour. Am. Ceram. Soc., Abs. Bull., [illegible] July, 1930, p. 586.

(1) A process for preparing a seed suspension which comprises reducing the acidity [illegible]hate solution to a hydrogen-ion concentration of about 2.5 to 6.0, heating the mixture t[illegible] to 30 minutes, and cooling the mixture. (2) A process for the production of titaniu[illegible] comprises adding a mixture containing titanium hydroxide in aqueous suspension contai[illegible]ate to a solution of titanium sulphate, and maintaining the mixture at a temperature [illegible]int. (3) A process for the hydrolysis of titanium sulphate solution which comprises [illegible]kali to a small portion of the solution to reduce the acidity of 2.5 to 6.0 and to precipitate [illegible]e therein, heating the mixture to about 80° C for 15 to 30 minutes, adding the mixture [illegible]itanium sulphate solution, and maintaining the mixture at a temperature near the boili[illegible]

MONE, R. H. Production of titanates of alkaline earths. Br[illegible] 655,399, Dec. 17, 1928.

MONE, R. H., AND FIRING, L. (The latter assr. to J. Irwin.) P[illegible] alkaline-earth titanates. U. S. Patent 1,760,513, May 27, 1[illegible] and Ind., vol. 49, No. 52, Dec. 26, 1930, p. 1151.

An aqueous paste of freshly-precipitated titanium hydroxide is treated with an ac[illegible]etal or ammonium to react with any sulphate ions, which are detrimental to the format[illegible] after washing with water to remove the sulphate, an alkaline-earth carbonate, e. g., bariu[illegible] added in the form of paste to produce a compound such as $BaTiO_3$. Hydrochloric acid or b[illegible] added to accelerate the reaction and give the product a pure, white color, and the mixture [illegible] 750–880°.

[illegible]LMER, RALPH M. Titanium oxide. U. S. Patent 1,760,992, J[illegible] Chem. Abs., vol. 24, 1930, p. 3614.

The residue from a digestion process for recovering the aluminum content of bauxit[illegible] at concentration to separate iron oxide; TiO_2 is magnetically separated from the ferrotita[illegible] iron oxide, and the ferrotitanium oxide and iron oxide are magnetically separated from ea[illegible]

[illegible]IGH, MALCOLM N. (to Canadian Westinghouse Co., Ltd.) Separ[illegible] zirconium, titanium, and hafnium. Canadian Patent 301,654, J[illegible] Chem. Abs., vol. 24, Aug. 20, 1930, p. 4126.

Titanium, zirconium, and hafnium are extracted from their ores and precipitat[illegible] oxides. The metals are then separated according to the solubility of the oxides in acid alk[illegible]

[illegible]AN, L. W. (to Titanium Pigment Co.) Titanium compounds. Br[illegible] 308,725, Mar. 27, 1928. Chem. Abs., vol. 24, 1930, p. 473.

Hydrolytic precipitation of titanium compounds from aqueous solutions containing [illegible]ted in the presence of organic acids such as tannic, citric, oxalic, or gallic acids or of H[illegible] base or similar acids. The hydrolysis product may be calcined at 700–1000° to obtain a [illegible]O_4, which may contain, e. g., 0.6–1.3 per cent P_2O_5. Various details of procedure are

[illegible]NETKA, MORITZ. Production of titanic oxide. U. S. Patent 1,75[illegible] 13, 1930. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, July, 1930

(1) In the process for the hydrolytic precipitation of white titanic acid from sulphuri[illegible] taining titanium sulphate and iron sulphate, the step which comprises carrying out the [illegible] presence of a compound of the group consisting of hydrofluoric acid and water-sol[illegible] carrying out the precipitation in the presence of hydrofluoric acid.

TITANIUM PIGMENT CO. (INC.). Manufacture of titanium oxide. U. S. Patent 1,758,472, Sept. 6, 1927. Chim. et Ind. (France), vol. 24, No. 2, August, 1930, p. 397.

Titanium white is precipitated from solution of sulphates of titanium and iron in presence of hydrofluoric acid or with addition of soluble fluorides in solution.

———— Paints. British Patent 329,333, Nov. 12, 1928. Chem. Abs., vol. 24, No. 21, Nov. 10, 1930, p. 5516.

An oil paint is formed comprising a pigment of Ti compounds such as the oxide, a vehicle composed mainly of a drying oil such as linseed oil and a small proportion of cellulose nitrate which may be dissolved in BuOAc or like solvent. Usual driers and an extender base such as $BaSO_4$ may be added. Details of manufacture are given. Cf. C. A. 24, 1527.

———— Titanium compounds. French Patent 672,002, Mar. 25, 1929. Jour. Am. Ceram. Soc., Abs. Bull., vol. 9, No. 8, August, 1930, p. 681.

Ti compounds are precipitated in a very fine state by adding organic acids, e. g., oxalic acid, to a solution containing Ti and an inorganic acid, such as H_2SO_4, at a temperature of about 90°. French Pat. 672,003 describes a similar process in which a mixture of an organic acid and phosphoric acid or a compound thereof are added to the solution.

URBAIN, E. Process for the simultaneous preparation of calcium titanate and ferrophosphorus. French Patent 684,889, Feb. 13, 1929. Metals and Alloys, vol. 1, No. 13, July, 1930, p. 640.

VON BICHOWSKY, F. Production of titanium (di) oxide. U. S. Patent 1,742,674, Jan. 7, 1930. Chem. and Ind. (London), vol. 49, No. 19, May 9, 1930, p. 418.

Titanium nitride prepared as previously described (cf. U. S. Patent 1,408,661) is treated with dilute nitric acid: $6Ti_2N_2 \cdot 8HNO_3 \cdot 10TiO_2 \cdot 4H_2O \cdot 9N_2$. Alternatively, the nitride may be heated with concentrated sulphuric acid containing a metal (sodium) nitrate or nitric acid; the cooled solution is then poured into cold water, when all the titanium enters solution as sulphate and is precipitated as pure oxide on boiling. Any iron present must be kept in solution by having hydrochloric acid, chlorine, or sulphuric acid present. The oxide obtained is finely divided and suitable for pigments. A method of directly obtaining a titanis-barytes paint base is described.

WADE, H. (from Titanium Pigment Co. (Inc.)). Titanium paints. British Patent 329,333, Nov. 12, 1928. Chem. and Ind., vol. 49, Aug. 22, 1930, p. 779.

Paints comprising titanium pigments, a vehicle consisting principally of a drying oil, and a small proportion (e. g., 5 per cent of the weight of the paint) of cellulose nitrate as hardening agent are claimed.

WILLETTS, PAUL G. Refractory for molten glass. Canadian Patent 301,903, July 8, 1930. Chem. Abs., vol. 24, 1930, p. 4370.

A refractory for use in contact with molten glass. The composition is as follows, aluminum oxide 35.23 per cent, silica 62.54 per cent, titanium oxide 1.37 per cent, iron oxide, 0.78 per cent, lime 0.04 per cent, magnesia 0.16 per cent, and sodium oxide 0.45 per cent.

MANGANESE AND MANGANIFER

By ROBERT H. RIDGWAY[1]

CONTENTS

INTRODUCTION

Before the World War the domestic productio was very small compared with the domestic cons age annual output from 1900 to 1914, inclusive, v tons; imports during the same period averaged tons. At the time of the World War the require in the United States expanded, and some of th ported ore was seriously menaced. Domestic pro the impetus of exceptionally high prices and u requests for increased output. In 1918 it reach 306,000 tons, which was about 38 per cent of the requirements in the United States during that rade of domestic ore was not, however, as high from foreign sources, but domestic ores were co igher-grade foreign ores. Pre-war requirement lso greatly modified, the manganese content

[1] Work on manuscript completed July, 1931. Statistics on domestic output prepared by H. W. Davis a data compiled from records of the Bureau of Foreign and Dorsey, both of the Bureau of Mines.

Producers of zinc dust in the United States in 1930

	Location of plant
The Alloys Co	San Francisco, Calif.
American Smelting & Refining Co	Sand Springs, Okla.
Federated Metals Corporation	Trenton, N. J.
John Finn Metals Works	San Francisco, Calif.
Grasselli Chemical Co	Meadowbrook, W. Va.
New Jersey Zinc Co	Palmerton, Pa.
Superior Zinc Corporation	Philadelphia, Pa.

ZINC PIGMENTS AND SALTS

Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc, and the chloride and sulphate are the principal salts. These products are manufactured from various zinciferous materials such as ores, metal, and secondary substances. In 1930 the total zinc content of all zinc pigments and salts produced in the United States amounted to 153,955 tons, a decrease of 25 per cent from that in 1929. This was derived from the following sources:

Zinc content of zinc pigments and salts made in the United States, 1929 and 1930, by sources, in short tons

Source	1929	1930
Domestic ore	[1] 138,104	104,561
Metal	39,620	27,000
Secondary material	[1] 26,795	22,394
	[1] 204,519	153,955

[1] Revised figures.

The following table gives the primary zinc content (that is, zinc derived directly from ores) of zinc pigments and salts produced for market in the United States during the past 10 years.

Primary zinc content of zinc pigments and salts made in the United States, 1921–1930, in short tons [1]

Year	Pigments	Salts	Year	Pigments	Salts
1921	53,480	3,749	1926	127,685	[2] 3,220
1922	93,112	1,801	1927	121,899	[2] 567
1923	115,970	1,573	1928	123,964	[2] 800
1924	108,282	1,075	1929	137,147	[2] 951
1925	110,554	[2] 1,010	1930	103,298	1,261

[1] Includes some zinc derived from primary drosses from zinc-reduction plants.
[2] Revised figures.

The use of zinc ore, metallic zinc, and secondary material in the manufacture of pigments and salts decreased 24, 32, and 17 per cent respectively, in 1930.

Ore was used in the manufacture of the following pigments and salts in 1930, the percentages representing the proportion of the total recoverable zinc content of the ore used in each product:

	Per cent
American process zinc oxide	68
Lithopone	20
Leaded zinc oxide	11
Zinc salts	1

ZI

The metallic zinc was practica
French process zinc oxide.
The secondary zinc was distribu

Lithopone	
Zinc salts	
Zinc oxide and leaded zinc oxide	

Further details of the product
given in the Mineral Resources c
and Salts.

SECOND

Secondary zinc production as
includes zinc recovered from indu
zinc recovered in the same plant i
is excluded. The accompanying
the Bureau of Mines, shows the q
in the United States as metal an
zinc salts, 1927 to 1930.

Secondary zinc recovered in the Un

Secondary zinc, redistilled	
Secondary zinc, remelted	
Total secondary zinc recovered unalloyed	
Recovered zinc in alloys, excluding old brass remelt	
Recovered zinc in remelted brass (estimated)	
Total secondary zinc recovered as metal	
Secondary zinc recovered in zinc dust	
Secondary zinc recovered in pigments	
Secondary zinc recovered in zinc salts	
Total secondary zinc recovered	

[1] Includes 22 tons of secondary electrolytic

The recovery of secondary zinc
lowest output since 1921, while t
creased 20 per cent.
Secondary zinc recovered in th
cent, due to decreases of 26 per c
per cent in remelted zinc, 34 per
and 36 per cent in remelted brass
and salts decreased 16 per cent.
Since 1910, the first year for wh
production of secondary zinc has s
the production of primary zinc ha
there has been little change in the
From 1910 to 1914 the recovery of
lent to 23 per cent of the total
war and postwar periods the ratio
tions, but during the past seven y
In 1930 the ratio was 20 per c
copper was 43 per cent; that for le
advantageous position of zinc is p

LEAD[1]

By ELMER W. PEHRSON[2]

CONTENTS

GENERAL SUMMARY

Salient figures of the lead industry in the United States, 1929

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

[1] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not

[1] Work on manuscript completed November, 1931.

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

Salient figures of the lead industry in the United States, 1929 and 1930—Continu

		1929	193
World smelter production of lead	short tons	1,961,000	1,82
United States	per cent of total	36	
Mexico	do	13	
Australia	do	10	
Canada	do	8	
Spain	do	8	
All other	do	25	

Conditions in the lead industry throughout the world were far from satisfactory during 1930. The general industrial depression caused a marked decline in lead consumption with which producers failed to keep pace, so that there was a large increase in stocks and a resultant decline in prices.

In the United States the production of refined primary lead from domestic ores decreased 15 per cent in 1930 and that from foreign ore and base bullion decreased 32 per cent, making a decrease of 17 per cent in the total refined primary lead produced. Monthly production varied considerably but declined toward the end of the year, the average for the last 6 months being 11 per cent under the average for the first 6 months. The highest monthly output occurred in March and the lowest in November.

The New York quotation declined from a high of 6.25 cents per pound on January 2 to a low of 5.10 cents on December 31. The average for the year was 5.52 cents, a decrease of 19 per cent from the 1929 average of 6.83 cents and 39 per cent under the record 1925 price. The quotation was unchanged from the first of the year until the last few days in February. Thereafter a downward trend began, which continued with few interruptions until July when the price was stabilized for a time at 5.25 cents. In August and September there was a flurry upward due to some increase in demand, but early in October the price fell to 5.10 cents, where it remained for the rest of the year.

The recovery of secondary lead in pig lead and alloys declined 11 per cent in 1929 and was the lowest on record since 1925; it was equivalent to 45 per cent of the primary lead produced from domestic ores.

The consumption of lead in the United States in 1930, as estimated by the American Bureau of Metal Statistics, declined 21 per cent and was the lowest recorded since 1922. Consumption in the three major uses declined; storage batteries used 22 per cent less lead in 1930 than in 1929, cable covering 5 per cent less, and white lead 30 per cent less as a result of the marked decline in the use of lead in storage batteries. Cable coverings ranked first in lead consumption in 1930. The quantity of lead used in the manufacture of white lead in 1930 was only 54 per cent of that used in the record year 1922.

Mine production of lead decreased 14 per cent in 1930. There were large decreases in the principal lead-producing States of the West and in the tri-State (Joplin) area, but the southeastern Missouri district increased its production slightly. Production in Idaho and Utah, which ranked second and third to Missouri, decreased 10 and 23 per cent, respectively. Nevada, Missouri, California, and New York showed noteworthy increases in production; New York reported lead production for the first time in more than a decade.

General imports of lead in base bullion decreased 53 per ce result of a 68 per cent decrease in shipments from Mexico and nt decrease in shipments from Peru. Receipts of lead in o atte increased 26 per cent; Canada's shipments increased 3 nt, whereas Mexico's decreased 30 per cent. Exports of refi ad declined from 73,251 tons in 1929 to 48,307 tons in 1930, he fact that much of the Mexican base bullion formerly refined ported from the United States is now being refined in Mexi ported from there directly.

World smelter production of lead in 1930 amounted to 1,8 hort tons, a decrease of 7 per cent from 1929. Lead smelted nited States decreased 13 per cent, whereas foreign proc creased only 3 per cent.

The lead output of the principal foreign lead-producing co hanged as follows: Mexico declined 6 per cent, Australia dec r cent, Canada increased slightly, Spain decreased 14 pe ermany increased 13 per cent, India declined slightly, and B o declined slightly. These 7 countries and the United oduced nearly 90 per cent of the world's lead.

The London price of lead in 1930 averaged £18.075 per long 2 cents per pound, 22 per cent below the 1929 average and t yearly average in pounds sterling since 1912. The London a 1930 was 1.60 cents per pound below the New York aver mpared with 1.79 cents in 1929.

The members of the European lead cartel, known as the Lea ucers' Reporting Association, were unable to agree in 193 oduction-curtailment program to offset the decline in consu d the resultant increase in stocks and decline in price. By 31, however, the situation had become so acute, by reason nounced decline in price during the early part of 1931, the r cent curtailment program was agreed upon to become effec ay 1. In July, it was reported that curtailment was to be inc 20 per cent. The association maintains a statistical of ondon.

Development and construction continued on a large scale at aa, Queensland, and production of lead bullion began in June Development at the Rosebery mine, Tasmania, and at Captain New South Wales, was stopped owing to unfavorable marke itions. In British Columbia the principal developments i ere the increased production at the Sullivan mine and the star perations at the Monarch mine. The latter and virtually all mall mines in the Province were closed down by the end of th wing to low metal prices. At the Buchans mine, Newfoundlan uction was maintained at the rate of about 500 tons of ore p nd the mill capacity was being increased to 1,000 tons pe Production at the Stantrg mine, Yugoslavia, began in August nd by the end of the year 700 tons of ore per day were being t No extensive discovery of lead ore was reported in the United 1930.

PRODUCTION

GENERAL

Pig lead produced in the United States for domestic mark xport is derived from three main sources—domestic ore, forei nd base bullion, and secondary materials.

The following table shows the quantity of pig lead produced from each of these sources from 1921 to 1930.

Pig lead produced in the United States, 1921–1930, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1921	398,222	50,367	46,370	494,959
1922	468,746	63,916	75,480	608,142
1923	543,841	74,481	96,430	714,752
1924	566,407	124,086	90,400	780,893
1925	654,921	112,048	112,420	879,389
1926	680,685	118,256	125,000	923,941
1927	668,320	128,210	119,000	915,530
1928	626,202	154,869	138,000	919,071
1929	672,498	102,135	138,500	913,133
1930	573,740	69,293	129,000	772,033

The total production of pig lead in the United States in 1930 decreased 141,100 tons, or 15 per cent. Production from domestic ores and base bullion decreased 15 per cent, and that from foreign ore and base bullion decreased 32 per cent. Production of pig lead from secondary materials decreased 7 per cent.

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 junk and 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 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 1930.

Refined primary lead produced in the United States, 1720–19

Year	Short tons							Average price per pound
	Desilverized lead [1]	Desilverized soft lead	Soft lead [2]	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	
1720–1912	7,176,497	326,991	2,929,180	10,432,668	8,545,383	1,887,285		
1913	301,160	20,433	131,867	462,460	411,878	13,223	37,359	$0.04
1914	340,307	43,506	158,219	542,122	512,794	7,039	21,689	.03
1915	344,503	44,001	161,461	550,055	507,026	9,581	33,448	.04
1916	335,376	68,244	167,515	571,134	552,228	6,085	12,821	.06
1917	366,998	56,268	188,503	610,769	548,450	15,872	46,447	.08
1918	382,314	47,418	210,403	640,195	539,905	15,334	84,956	.07
1919	266,538	67,038	147,744	482,220	424,433	7,656	50,131	.05
1920	273,135	66,668	189,854	529,657	476,849	8,414	44,394	.08
1921	238,329	52,747	157,513	448,589	398,222	7,120	43,247	.04
1922	249,107	74,305	209,250	532,662	468,746	13,898	50,018	.05
1923	366,241	61,332	190,749	618,322	543,841	24,288	50,193	.07
1924	423,429	63,449	203,615	690,493	566,407	46,385	77,701	.08
1925	457,477	48,932	260,560	766,969	654,921	47,024	65,024	.08
1926	484,669	55,707	258,565	798,941	680,685	48,210	70,046	.08
1927	507,099	55,487	233,944	796,530	668,320	32,369	95,841	.06
1928	500,603	49,465	225,003	781,071	626,202	20,632	128,237	.05
1929	483,622	55,666	235,345	774,633	672,498	29,675	72,460	.06
1930	396,094	45,578	201,361	643,033	573,740	34,348	34,945	.05
	13,898,077	1,313,135	6,460,711	21,672,523	18,372,528	3,299,995		

[1] The lead content of antimonial lead is excluded (see p. 487). [2] Desilverized soft lead
[3] Corrected figures.

The total production of refined primary lead in the Unit in 1930 was 17 per cent less than that in 1929 and less tha any year since 1923. The total value of the output in 19 per cent less than that in 1929 because of decreases in both and average price. The value of the output in 1930 was one-half that in the record year 1925.

Outstanding features in the production of primary lea United States in 1930 were the increased output from for the sharp decrease in production from foreign base bullion decrease in production from domestic ores. Lead smelted eign ores increased 16 per cent in 1930 and was equivalent per cent of the total primary output; that produced fro base bullion decreased 52 per cent and amounted to onl more than 5 per cent of the total as compared with 9 per c total in 1929. The total lead derived from foreign primary terials was 11 per cent of the total in 1930, as compared wi cent in 1929 and 20 per cent in 1928. The production of re from domestic ores decreased 15 per cent in 1930 and was that recorded for any year since 1924.

The following table shows the quantity and value of ref produced in the United States from domestic ores from 1921

Refined lead produced in the United States from domestic ores, 1921

Year	Short tons	Value	Year	Short tons
1921	398,222	$35,840,000	1926	680,685
1922	468,746	51,562,000	1927	668,320
1923	543,841	76,138,000	1928	626,202
1924	566,407	90,625,000	1929	672,498
1925	654,921	113,956,000	1930	573,740

GEOGRAPHICAL SOURCE OF LEAD RAW MATERIALS SMELTED OR REFINED IN THE UNITED STATES

The following table shows the source of the ore and foreign base bullion from which refined lead was produced in the United States from 1921 to 1930. A large part of the base bullion produced in the Western States is shipped to the Mississippi Valley and Eastern States for refining. In reporting the production of lead by sources most of the refiners make the distribution on the basis of base bullion so that the total lead given in this table as from domestic ore includes both base bullion and refined lead and thus contains a large part of the antimonial lead produced from domestic ores. The domestic total given here for 1930 exceeds the total production of refined lead from domestic ores, as shown in the preceding table, by 6,273 tons. The production of antimonial lead from domestic ores in 1930 amounted to 8,918 tons.

Primary lead smelted or refined in the United States, 1921–1930, by sources, [illegible] *short tons*

Source of ore	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Domestic ore:										
Alaska	773	324	400	582	699	1,018	1,010	962	1,266	1,32[illegible]
Arizona	3,313	7,218	8,828	9,372	10,281	10,646	7,918	8,144	8,153	4,22[illegible]
Arkansas [1]										41[illegible]
California	614	3,018	5,168	2,305	4,148	4,044	1,232	637	1,469	1,84[illegible]
Colorado	12,104	11,108	23,885	25,491	31,855	37,553	37,040	28,683	23,075	26,091
Idaho	99,707	91,487	127,797	123,709	123,303	132,564	150,618	141,748	147,595	135,411
Illinois [1]	271	760	1,286	1,089	474	357	222	398	777	26[illegible]
Kansas [1]	10,939	10,900	20,207	12,895	15,001	20,884	[2]25,463	[2]27,014	[2]26,104	[2]13,10[illegible]
Kentucky [1]	41	73	66	201	96	27	139	268	303	[illegible]
Missouri [1]	151,028	202,245	169,323	191,501	208,547	218,083	210,366	192,789	211,345	201,06[illegible]
Montana	11,565	14,551	18,345	21,226	22,008	26,350	23,041	20,470	26,795	15,41[illegible]
Nevada	3,553	4,284	8,044	8,070	10,978	11,379	8,680	6,823	13,256	14,06[illegible]
New Mexico	384	1,230	1,638	2,263	3,782	4,383	8,377	8,469	12,249	11,25[illegible]
New York [1]										[illegible]
Oklahoma [1]	46,902	67,436	59,602	56,017	78,487	70,004	[2]47,857	[2]46,692	[2]45,653	[2]23,20[illegible]
Oregon		37	47		6	5	2	7	15	[illegible]
South Dakota	2	2		2	2	1	79	37		[illegible]
Tennessee [1]		751	1,020	985	436	770	19			2[illegible]
Texas	1	5	40	27	31	102	275	437	559	[illegible]
Utah	51,872	63,130	104,678	119,318	166,844	151,127	155,199	151,724	157,085	122,31[illegible]
Virginia [1]				1,582	2,179	1,714	2,214	4,944	(3)	(3)[illegible]
Washington	325	478	2,008	2,067	2,802	2,262	442	537	447	[illegible]
Wisconsin [1]	1,079	1,323	601	1,973	2,889	2,052	2,067	1,812	1,729	1,62[illegible]
Undistributed	101	75	691	15	2				5,624	7,44[illegible]
Zinc residues	713	1,284	362	1,320	1,541	505	1,905	102	1,903	[illegible]
	395,287	481,689	554,036	582,000	686,451	695,830	684,165	642,697	685,992	580,6[illegible]
Foreign ore:										
Africa			99	6		6	12			[illegible]
Australia							2	2	5	[illegible]
Canada	2,877	3,604	3,632	4,633	10,676	5,385	4,138	10,123	9,499	14,[illegible]
Central America	6	14	18	30	6		18	3		[illegible]
Europe	17	519	139	328	470	233	19	67	28	[illegible]
Mexico	1,912	7,260	18,807	33,328	31,107	32,693	22,844	14,839	16,807	14,[illegible]
South America	2,235	2,468	1,461	7,663	4,496	9,893	5,506	1,568	3,285	3,[illegible]
Other foreign	73	43	72	307	269			30	51	1,[illegible]
Foreign base bullion:										
Canada	1,599	2,900								[illegible]
Mexico	41,648	47,118	50,193	77,701	65,024	70,046	95,841	117,193	51,295	18,[illegible]
South America								11,044	21,165	16,[illegible]
	50,367	63,916	74,481	124,086	112,048	118,256	128,380	164,869	102,135	69,[illegible]
Grand total	445,654	545,605	628,517	706,086	798,499	814,086	812,545	797,566	788,127	649,[illegible]

[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 substantial decreases in lead produ[illegible] most of the important lead-producing States. Incre[illegible] was recorded for Alaska, California, Colorado, Neva[illegible] and Wisconsin. Production was reported for Ark[illegible] York in 1930 for the first time since 1918. Foreign or[illegible] United States in 1930 came largely from Mexico, Ca[illegible] America (chiefly Bolivia). Shipments of ore from [illegible] originating in Siberia) accounted for the increase sh[illegible] foreign" countries. Production of refined lead in th[illegible] from Mexican base bullion was 64 per cent less in 19[illegible] and 84 per cent less than in 1928; this decline was du[illegible] tion of new refining capacity in Mexico in 1929. Prod[illegible] lead from South American (Peruvian) base bullion d[illegible] cent.

SPECIFICATIONS FOR PIG LEAD

The American Society for Testing Materials classi[illegible] three grades—corroding, chemical, and common. Th[illegible] as to chemical composition are shown in the following

Allowable chemical composition of the various grades of pig lead, American Society for Testing Materials

	Corroding lead,[1] not over—	Chemical lead [2]
	Per cent	*Per cent*
Silver	0.0015	0.005–0.015
Copper	.0015	.04 – .08
Copper and silver together	.0025	(3)
Arsenic	.0015	(3)
Antimony and tin together	.0095	(3)
Zinc	.0015	(3)
Iron	.002	(3)
Bismuth	.05	(4)
Lead, by difference	99.9300	(4)

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

SOFT LEAD

Soft pig lead is smelted from nonargentiferous lea[illegible] purity, most of which are produced in the Mississipp[illegible] The recoverable lead content of all ores mined in the U[illegible] 1930 was about 559,000 tons, of which 246,000 tons or 4[illegible] contained in nonargentiferous or soft lead ores. The[illegible] Missouri district contributed 81 per cent of the total so[illegible] the tri-State district (Joplin) contributed 15 per cent; [illegible] New York, and Wisconsin contributed most of the re[illegible] mt.

The production of soft pig lead in 1930 amounted to [illegible] crease of 15 per cent from that in 1929 and equivalent [illegible] the total production of domestic refined primary lead. [illegible] er cent of the soft pig lead produced in 1930 was mar[illegible]

rizing, and 18 per cent was desilverized. The former, which is in the trade as chemical lead, contains 1 to 4 ounces of silver to and 0.04 to 0.08 per cent copper; it is used chiefly in the manufe of cable, pipe, and sheets. Desilverized soft lead is used in the manufacture of white lead, where a very pure product ired.

bstantial quantity of high-grade lead concentrates from the ssippi Valley is used each year in the manufacture of lead pig- principally basic lead sulphate (white sublimed lead) and zinc oxide. In 1930 over 6,600 tons of soft lead were recovered manner.

lead recovered in soft pig lead and lead pigments amounted to cent of the total domestic primary lead recovered in pig lead, ts, and antimonial lead in 1930.

following table summarizes the production of soft lead from o 1930.

t produced in the United States from domestic ores, 1922–1930, in short tons

Year	Soft pig lead			Soft lead recovered in pigments	Total soft lead	Total domestic lead [1]	Soft lead percentage of domestic lead
	Undesilverized	Desilverized	Total				
	209,250	74,305	283,555	13,892	297,447	488,448	61
	190,749	61,332	252,081	13,612	265,693	567,247	47
	203,615	63,449	267,064	15,338	282,402	593,486	48
	260,660	48,932	309,492	17,547	327,039	684,968	48
	258,565	55,707	314,272	13,685	327,957	710,990	46
	233,944	55,487	289,431	13,136	302,567	695,500	44
	226,003	49,405	274,408	10,485	284,933	652,492	44
	235,345	55,666	291,011	9,429	300,440	696,678	43
	201,361	45,578	246,939	6,686	253,625	588,042	43

[1] domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

ANTIMONIAL LEAD

monial lead is an important by-product of the refining of base . In 1930, 13,711 tons of primary antimonial lead were pro a decrease of 47 per cent from the 1929 output and equivalent per cent of the total refined lead produced from base bullion. decreased importation of base bullion from Mexico had d effect upon the production of primary antimonial lead. In 3,600 tons were produced from the smelting and refining o ores and base bullion, whereas in 1930 only 4,800 tons were l from the same source. Foreign ores also yield a higher per o of antimonial lead. The production of antimonial lead from ores was equivalent to 8.4 per cent of the refined lead produce hose ores in 1929 and to 6.9 per cent in 1930, while the yiel omestic ores was 4.5 and 2.7 per cent, respectively.

principal uses of antimonial lead are in the manufacture o batteries, bearing metal, and type metal. The consumptio monial lead in storage batteries decreased about 14 per cent i

following table shows the production of primary antimonia om 1921 to 1930.

By-product primary antimonial lead produced in the United States, 192

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	Percentage
1921	238,329	4.2	7,881	2,183	10,064	$870,059	1,589	15.8
1922	249,107	3.2	7,068	1,007	8,075	844,993	1,441	17.8
1923	366,241	3.9	11,635	2,555	14,190	1,950,370	2,170	15.3
1924	423,429	4.9	13,593	7,194	20,787	3,376,713	2,763	13.3
1925	457,477	4.3	14,472	5,195	19,667	3,785,647	2,624	13.3
1926	484,669	4.6	18,909	3,615	22,524	3,916,714	2,693	12.0
1927	507,099	4.8	16,040	8,307	24,347	3,277,043	2,736	11.2
1928	506,603	6.5	17,930	15,128	33,058	3,978,318	3,432	10.4
1929	483,622	5.3	17,062	8,607	25,669	3,267,095	3,052	11.9
1930	396,094	3.5	8,918	4,793	13,711	1,392,524	1,685	12.3
Average		4.7						12.6

SECONDARY LEAD

Much of the lead consumed in the United States is used in the facture of articles from which there is a large return of sec metal. This is particularly true of the storage-battery in which is a leading consumer of lead and in which there is and rapid return of secondary metal. This industry is resp for much of the increase in the ratio of secondary lead produc domestic primary lead production. In 1914 the secondary was equivalent to only 12 per cent of the primary output from tic ores; in 1930 the ratio was 45 per cent, a decrease from 46 p in 1929. Other important lead-consuming industries in whic is a large return of secondary metal include cable manufacture ing, bearing-metal manufacture, and type-metal manufacture. The quantity of secondary lead recovered in 1930 was equally divided between that recovered as pig lead and that rec in the form of alloys.

The following tables show the recovery of secondary lead ratio to the refined primary lead produced in the United State domestic ores. Further details of the secondary lead industr be found in the Mineral Resources chapter on Secondary Met

Secondary lead recovered in the United States, 1922–1930 [1]

Year	Pig lead (short tons)	Lead in alloys (short tons)	Total recove	
			Short tons	
1922	75,480	84,080	159,560	
1923	98,430	98,060	194,490	
1924	90,400	114,100	204,500	
1925	112,420	114,460	226,880	
1926	125,000	152,300	277,300	
1927	119,000	157,000	276,000	
1928	138,000	170,600	308,600	
1929	138,500	172,500	311,000	
1930	129,000	126,800	255,800	

[1] Compiled by J. P. Dunlop, of the Bureau of Mines.

o of secondary lead recovered to refined primary lead produced in the United States from domestic ores, 1913–1930

Year	Refined primary lead		Secondary lead	
	Short tons	Average price per pound (cents)	Short tons	Ratio to refined primary lead (per cent)
	411,878	4.4	72,834	1
	512,794	3.9	61,062	1
	507,020	4.7	78,900	1
	552,228	6.9	96,300	1
	548,450	8.6	93,800	1
	539,905	7.1	97,100	1
	424,433	5.3	122,100	2
	476,849	8.0	124,650	2
	398,222	4.5	103,780	2
	468,746	5.5	189,560	3
	543,841	7.0	194,490	3
	566,407	8.0	204,500	3
	654,921	8.7	226,880	3
	680,685	8.0	277,300	4
	668,320	6.3	276,000	4
	626,202	5.8	303,600	4
	672,498	6.3	311,000	4
	573,740	5.0	255,800	4

PIGMENTS

ead pigments manufactured in 1930 contained 197,557 tons o
l derived from the sources shown in the following table. Refined
lead is used in the manufacture of white lead, litharge, red lead
limed lead, and orange mineral. In 1930 about 190,000 tons of th
l contained in lead pigments were derived from refined pig lead
te lead accounted for 45.9 per cent; litharge, 35.5 per cent; re
l, 16 per cent; and sublimed lead and orange mineral, 2.6 per cent
limed lead and leaded zinc oxide are the principal pigments i
ch the lead content is derived from ores.
urther details of the production and value of lead pigments in th
ted States are given in the Mineral Resources chapter on Lead and
c Pigments and Salts.

Lead in pigments,[1] 1922–1930, by sources, in short tons

Year	Lead in pigments from—				
	Domestic ore	Foreign ore	Metal	Scrap	Total
	13,892		241,096	111	255,0
	13,612		236,541		250,1
	16,338	545	250,930		266,8
	17,547		256,064		273,6
	13,685		240,902	1,029	255,6
	13,136		242,713	1,246	257,0
	10,465		242,914	654	254,0
	9,429		248,657	2,427	260,5
	6,686		190,182	689	197,5

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

LEAD

MINE PRODUCTION

BY STATES

The following table shows the mine production of recover
by States from 1921 to 1930.

Mine production of recoverable lead, 1921–1930, by States, in sho

State	1921	1922	1923	1924	1925	1926	1927	1928	
Alaska	759	377	410	631	789	778	1,008	1,019	
Arizona	3,271	7,535	8,146	9,321	11,938	11,629	9,933	7,190	
Arkansas	21	42	25	20	58	18	23	38	
California	562	3,166	4,775	2,382	3,283	4,047	1,369	946	
Colorado	9,830	11,739	22,849	23,779	31,483	34,494	33,386	26,751	2
Georgia		4							
Idaho	99,235	97,917	121,178	124,475	126,521	136,490	151,019	145,323	14
Illinois	672	1,325	1,381	1,464	1,001	655	277	385	
Kansas	18,679	23,271	17,598	18,560	22,775	28,463	27,497	25,276	2
Kentucky	69	92	53	175	152	58	139	39	
Massachusetts				(1)					
Missouri	180,085	178,412	169,743	189,929	211,566	207,012	198,760	195,393	19
Montana	10,183	14,884	17,978	19,738	18,765	21,153	17,949	16,880	1
Nevada	3,594	4,695	9,078	10,030	12,288	11,184	7,892	7,874	
New Mexico	339	1,506	1,916	1,817	3,210	3,480	8,026	7,805	1
New York									
Oklahoma	41,552	62,856	66,904	71,358	79,946	69,704	51,680	43,687	4
Oregon		38	14	(2)	3	6	3	7	
South Dakota	2						69	37	
Tennessee		732	1,250	937	448	800			
Texas		4	13		8	42	244	348	
Utah	44,594	67,666	101,724	116,955	153,335	147,635	151,285	145,915	14
Virginia				1,275	2,229	2,450	2,393	(3)	
Washington	72	691	1,453	1,968	2,814	2,273	478	542	
Wisconsin	972	691	734	1,254	1,877	1,546	2,069	1,698	
Undistributed									
	414,491	477,633	547,217	596,068	684,439	683,917	665,489	[4] 627,153	[4]

[1] It is said that a few tons of lead ore were mined at the old Chipman mine in Massachusetts
small smelter owned by the mine operators.
[2] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.
[3] 613 pounds.
[4] Bureau of Mines not at liberty to publish figures.
[5] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at libe

Mine production decreased 14 per cent in 1930. There w
decreases in the principal lead-producing States of the We
he tri-State (Joplin) area. Missouri again ranked first in pr
having contributed 36 per cent of the total; its output wa
higher in 1930 than in 1929, due to increased production in t
astern Missouri district. Idaho and Utah ranked second
production in 1930 and showed decreases of 10 and 23
espectively. Percentage decreases in other important lea
ng States were: Oklahoma, 50 per cent; Colorado, 9 per cent
ll per cent; Montana, 46 per cent; New Mexico, 7 per cent;
ona, 47 per cent. Noteworthy increases were recorded in
Missouri, California, and New York; New York reported
uction for the first time in more than a decade.
Detailed information concerning the mining activities in th
istricts of the United States can be found in the chapters of t
ealing with the mine production of gold, silver, copper, l
inc in the various States.

BY DISTRICTS

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

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1922–1930, in short tons

District	State	1922	1923	1924	1925	1926	1927	1928	1929	1930
Southeastern Missouri region.	Missouri	176,768	167,458	187,737	208,915	203,002	190,251	194,270	197,435	198,0
Coeur d'Alene region.	Idaho	91,216	114,426	118,327	120,856	128,834	141,948	139,276	141,558	129,8
Bingham	Utah	19,348	25,353	34,786	54,982	54,997	55,508	52,375	49,447	42,8
Joplin region	Kansas, Missouri, Oklahoma.	87,771	86,787	92,110	105,372	102,117	81,686	70,086	74,143	56,0
Park City region	Utah	16,129	26,220	33,346	40,656	35,910	41,403	41,427	42,570	30,8
Tintic	do	23,646	38,906	40,674	45,889	47,108	45,046	44,096	44,113	29,1
San Juan Mountains.	Colorado	5,332	13,157	13,148	17,092	19,237	21,739	18,555	17,386	11,7
Rush Valley	Utah	586	1,284	926	2,465	5,022	7,346	7,222	11,751	10,1
Leadville	Colorado	2,742	2,804	4,795	6,931	9,266	6,781	5,168	5,172	6,8
Willow Creek	New Mexico						4,353	5,193	5,720	5,4
Ploche	Nevada	932	2,697	2,152	2,806	2,420	639	1,167	2,986	4,3
Barker	Montana	971	846	1,272	1,420	1,387	412	264	6,137	4,8
Central	New Mexico	176	656	592	1,182	1,306	954	1,180	3,766	3,9
Tybo	Nevada			1	3	1			1,991	3,6
Eagle County	Colorado	161	230	1,145	2,041	1,305	2,059	750	198	2,3
Butte	Montana	10,070	12,745	13,648	12,091	13,678	12,769	12,330	8,239	2,1
San Francisco	Utah	1,118	1,489	1,069	1,999	1,325	420	199	691	1,8
Warm Springs	Idaho	1,758	925	357	355	149	478	1,307	1,507	1,7
Inyo County	California	3,135	4,744	2,306	3,098	3,278	1,081	872	670	1,7
Upper Mississippi Valley.	Iowa, Northern Illinois, Wisconsin.	1,259	948	1,639	2,355	1,819	2,141	1,706	1,536	1,3
Jack Rabbit	Nevada	791	536	120	224	578	1,266	2,561	2,430	1,1
Eagle	Montana									1,0
Pend d'Oreille	Idaho	238	304	67	113	481	1,048	694	863	1,0
Banner	Arizona	2,140	1,731	160	49	7	13	490	2,938	1,0
Dome	Idaho			276	602	246	1,182	1,074	1,870	1,0
Yellow Pine	Nevada	158	736	3,855	2,644	952	826	1,105	535	9
Magdalena	New Mexico	462	763	818	1,217	700	819	498	481	9
Aspen	Colorado	1,778	1,486	455	1,820	1,632	1,203	806	710	8
Kentucky-Southern Illinois.	Kentucky-Illinois	849	1,220	1,254	675	440	344	416	730	8
Northport	Washington	534	1,002	1,232	2,218	1,984	325	503	76	7
Spruce Mountain	Nevada	237	261	508	647	1,099	636	529	388	6
Eureka	do	251	673	888	2,163	2,784	1,132	466	378	5
Boulder	Idaho			(1)	(1)	(1)	(1)	(1)	(1)	5
Bisbee (Warren)	Arizona	4,187	4,221	5,719	6,657	5,729	5,256	2,917	1,020	4
Big and Little Cottonwood.	Utah	2,754	3,831	3,128	2,374	1,597	1,009	146	173	4
Cedar Plains	Montana	23	274	230	175	346	373	657	1,177	4
Vulture	Arizona	3		4	26	133	133	1,291	777	3
Texas	Idaho	2,168	2,417	2,197	1,714	2,882	3,895	1,195	182	3
Montana	Montana	775	912	1,241	1,427	2,069	1,866	1,432	493	3
Summit County	Colorado	280	1,946	1,105	1,707	1,481	614	786	369	3
Bryant	Montana	168	968	1,743	1,150	730	398	195	344	3
Ophir	Utah	2,921	3,443	1,414	2,945	217	157	101	25	3
Troy	Montana	1,528	1,059	530	259	231	181	33	49	2
Port Hill	Idaho	1,440	2,116	2,317	1,506	1,597	468	414		2
New Placers	New Mexico			3	125	527	1,100	48		2
Mammoth	Nevada	5	2	21	331	365	1,195	21		2
Bell	do	612	1,160		128	455	143			2
Austinville [2]	Virginia			1,275	782	1,582	2,393	(1)	(1)	(1)
Embree [2]	Tennessee	732	1,250	937	448	800				
Oro Blanco [2]	Arizona			1	4		7	707	(1)	
St. Lawrence County. [2]	New York									

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

LEAD BALANCE SHEET OF THE UNITE

Most of the lead ore mined in the United States is lead content emerges in marketable form as primary and antimonial lead. Some of the ore is used in t of pigments and some may be exported, but for s amount exported has been negligible. The total p lead in the various products in which it is produce compared in the following table with the estimates of in the ore mined. The table begins with 1907, the fir the mine production of the entire country was dete quantities compared were determined by independent producers and consumers of lead-bearing ore, the tab on the accuracy of the figures.

Comparison of mine production of lead and primary domestic le lead products manufactured in the United States, 1907–193

Year	Mine production	Primary lead accounted for		
		Refined lead	Antimonial lead	Pigments made from ore
907–1918	5,653,706	5,249,081	124,168	121,756
919	429,589	424,433	8,339	11,179
920	496,814	476,849	8,032	15,212
921	414,491	398,222	6,675	9,989
922	477,633	468,746	5,810	13,892
923	547,217	543,841	9,794	13,612
924	596,068	566,407	11,741	15,338
925	684,439	654,921	12,500	17,547
926	683,917	680,685	16,620	13,685
927	665,489	668,320	14,044	13,136
928	[1] 627,153	626,202	15,825	10,465
929	[2] 647,995	672,498	14,751	9,429
930	558,313	573,740	7,616	6,686
919–1930	6,829,118	6,754,864	131,747	150,170
907–1930	12,482,824	12,003,945	255,915	271,926

[1] Includes 8,325 tons of lead produced from domestic ores smelted outside the co
[2] Includes 3 tons of lead produced from domestic ores smelted outside the count
Exclusive of the output from Virginia, figures for which the Bureau of Mines is

The table shows substantial discrepancies for in probably due largely to variations in mine and smelt but in none of the last 12 years has the discrepancy nt of the total lead produced. From 1907 to 1918, oduction exceeded the primary lead accounted for 150,000 tons, or less than 3 per cent. From 191 as an excess of 208,000 tons, or about 3 per cent, in ontained in the lead products. For the total peri 907 to 1930, the primary lead content of lead pro ine production by only 57,290 tons, or less than o nt.

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. (Smelt 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. Bett electrolytic process.)
Kansas: Galena—Galena plant, Eagle-Picher Mining & Smelting Co. (Smelter)
Missouri:
Granby—American Zinc, Lead & Smelting Co.[3] (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.)
Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (Smelt and refinery.)
New Jersey:
Newark—Balbach plant, U. S. Metals Refining Co. (Smelter and refiner
Perth Amboy—Perth Amboy plant, American Smelting & Refining C (Smelter and refinery.)
Oklahoma: St. Louis—Ontario smelter, Eagle-Picher Lead Co. (Smelter.)
Pennsylvania: Carnegie—Pennsylvania Smelting Co.[5] (Smelter and refiner
Texas: El Paso—El Paso plant, American Smelting & Refining Co. (Smelte
Utah:
International—International Smelting Co.[3] (Smelter.)
Midvale—United States Smelting, Refining & Mining Co. (Smelter.)[1]
Murray—Murray plant, American Smelting & Refining Co. (Smelter.)

CANADA

British Columbia: Trail—Consolidated Mining & Smelting Co. of Canada (Lt (Smelter and refinery. Betts electrolytic process.)
Ontario: Galetta—Kingdon Mining, Smelting & Manufacturing Co. (L (Smelter.)

MEXICO

Chihuahua: Chihuahua—American Smelting & Refining Co. (Smelter.)
Coahuila: Torreon—American Metal Co. (Ltd.). (Cia. Metalúrgica de Torre (Smelter.)
Hidalgo: Zimapan—Cia. Min. y Fundidora de Zimapan. (Smelter.)
Nuevo Leon:
Monterrey—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S (Smelter and refinery.)
Monterrey—American Smelting & Refining Co. (Smelter and refinery.)
San Luis Potosi: San Luis Potosi—American Smelting & Refining Co. Minera Asarco.) (Smelter.)
Sinaloa: Mazatlan—Cia. Mexicana de Minerales.[5] (Smelter.)
Zacatecas: La Fé—American Metal Co. (Ltd.). (Cia. Minera de Peñol S. A.) (Smelter.)

[1] Subsidiary of Anaconda Copper Mining Co.
[3] Subsidiary of the United States Smelting, Refining & Mining Co.
[5] Plant idle in 1930.

TARIFF

The tariff act of 1930 became effective June 18, 19 change in the lead schedules from the 1922 act was in ticles or wares not specially provided for, if compose chief value of lead, but not plated with platinum, gol colored with gold lacquer, whether partly or wholly n The import duty on articles coming under this cla increased from 40 per cent to 45 per cent ad valorem. able gives the duties on the principal lead items und

Import duties on lead commodities under the tariff act

Paragraph	Item
391	Lead-bearing ores, flue dust, and matte of all kinds. (Duty shall not apply to lead content of copper, gold, or silver ores, or copper mattes unless actually recovered.)
392	Lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead, antimonial scrap lead, type metal, Babbitt metal, solder, all alloys or combinations of lead not specially 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 value of lead, but not plated with platinum, gold, or silver, or colored with gold lacquer, 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 or mixed with 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.

WORLD ASPECTS

WORLD SMELTER PRODUCTION

The following table shows the world smelter prod rom 1926 to 1930, so far as statistics are available. re used wherever possible. For countries for which o t yet available the figures are taken from the ye merican Bureau of Metal Statistics and other re ut in later reports the official statistics will be ceived.

There is always a possibility of duplication in fi orld production, for some countries send "work lead ion to other countries for refining. Furthermore, s nd antimonial lead are often included in the figure reign production, whereas the figures for the United St nly refined primary lead that was smelted in this cou e source of the ore; refined lead produced from fore ion is excluded.

EXPORTS

The chief lead export of the United States is refined pig lead deriv
from the treatment of foreign ores and base bullion. Exports d
creased 34 per cent in 1930 owing primarily to a 53 per cent decrea
in imports of base bullion. Europe took 58 per cent of the tot
Asia 36 per cent, South America 5 per cent, and North America an
Africa 1 per cent. Exports to Asia almost equaled those in 1929; th
falling off of exports to Europe accounted for most of the total d
crease. In Europe the United Kingdom, Sweden, Denmark, an
France were the largest importers; in Asia and South America, Japa
and Argentina, respectively, ranked first. Japan took 32 per ce
and the United Kingdom 19 per cent of the total United States export

Refined pig lead exported from the United States, 1929 and 1930, by destinatio

Destination	1929		1930	
	Short tons	Value	Short tons	Value
North America:				
Canada	141	$24,662	9	$1,
Cuba	248	27,890	107	10,
Mexico	83	16,696	40	6,
Panama	52	6,981	91	10,
Other	169	29,107	71	8,
	693	105,345	318	37,
South America:				
Argentina	599	57,845	934	75,
Brazil	1,538	154,135	874	66,
Chile	989	112,220	224	21,
Colombia	93	13,481	25	3,
Ecuador	33	4,465	(1)	
Peru	88	8,693	11	1,
Uruguay	448	43,248	364	30,
Other	64	7,318	10	1,
	3,852	401,405	2,442	198,
Europe:				
Belgium	896	92,085	576	61,
Denmark	4,322	419,031	5,205	398,
France	2,202	205,009	3,001	239,
Germany	9,745	945,400	823	65,
Italy	103	9,700	532	41,
Netherlands	1,522	149,812	22	2,
Sweden	7,255	708,255	7,557	601,
United Kingdom	23,732	2,295,238	9,157	710,
Other	872	84,945	1,026	79,
	50,649	4,909,535	27,899	2,202,
Asia:				
China	813	78,439	953	78,
Japan	16,416	1,594,706	15,653	1,292,
Philippine Islands	111	14,417	543	49,
Other	715	74,154	140	11,
	18,055	1,761,716	17,289	1,432,
Africa	2	215	358	32,
Oceania:				
Australia			1	
French	(1)	121		
	73,251	7,178,337	48,307	3,904,

[1] Less than 1 ton.

The following table shows the exports of lead from
tes from 1921 to 1930. Of the lead exported with bene
k in 1930 miscellaneous lead manufactures (principall
ounted for 21.9 per cent, white lead 38.9 per cent, red le
t, babbitt 2.9 per cent, lead-covered cable 4.8 per
al 2.6 per cent, shot shells 1.9 per cent, and others 6

Refined lead exported from the United States, 1921–1930

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)	Year	Pigs, bars, and old	
	Short tons	Value			Short tons	Value
	20,624	$2,462,033	9,369	1926	71,936	$9,505,6
	38,178	3,781,905	5,677	1927	125,267	12,817,2
	50,735	5,455,743	12,526	1928	116,209	10,369,2
	82,090	10,396,766	15,275	1929	73,251	7,178,3
	103,519	15,695,331	11,699	1930	48,307	3,904,2

CONSUMPTION

REFINED PRIMARY PIG LEAD AVAILABLE FOR DOME SUMPTION

The manufacturing industry of the United States co
four main forms; namely, refined primary pig lead, pr
onial lead, primary lead in the form of ore, and seco
he following table shows the refined primary pig lead a
nsumption from 1925 to 1930.

ined primary pig lead available for consumption in the United Stat in short tons

	1925	1926	1927	1928	
pply:					
Stock in bonded warehouse Jan. 1	5,045	8,162	10,711	9,464	
Imports of pigs, bars, and old [1]	7,021	11,152	2,467	662	
Production	766,969	798,941	796,530	781,071	7
	779,035	818,255	809,708	791,197	7
ithdrawn:					
Exports—					
Pig lead	103,519	71,936	125,267	116,269	
In manufactures, with benefit of drawback	11,699	17,955	12,004	13,224	
Stock in bonded warehouse Dec. 31	8,162	10,711	9,464	4,139	
	[2]123,380	100,602	146,735	133,632	
pply available for consumption	655,655	717,653	662,973	657,565	6

[1] Includes 622 tons of "old, reclaimed, and scrap" in 1925 and 1,135 tons in 1926. Corr
other years not separately recorded.
[2] Figures not available. For purpose of calculating quantity available for domestic co
warehouse are estimated to have remained unchanged from the beginning of the year.

The foregoing table is intended to include only primary lead or lead smelted directly from ore. There are, however, some small discrepancies which should be pointed out. Many primary lead smelters produce from secondary materials some lead that is inseparable from the primary lead in the final product. Exports of lead as reported above may therefore contain some secondary lead. There are also some inaccuracies in the statistics of imports, exports, and warehouse transactions. Nevertheless, on the basis of the data available, the table gives approximately the quantity of new refined lead available to American industry each year. As the table does not consider fluctuations in producers' and consumers' stocks, it indicates the trend of consumption only in a general way.

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 1930 yearbook of that bureau.

Lead consumed in the United States,[1] 1922–1930, in short tons

Purpose	1922	1923	1924	1925	1926	1927	1928	1929	1930
White lead [2]	156,000	130,000	150,000	131,000	120,000	126,000	123,000	119,700	83,900
Red lead and litharge [3]	30,000	46,000	34,000	42,000	36,000	38,000	31,000	30,000	32,000
Storage batteries [4]	130,000	143,000	170,000	180,000	190,000	175,000	220,000	210,000	163,000
Cable covering [4]	93,000	131,000	138,000	156,000	185,000	161,000	180,000	206,000	195,000
Building [5]	71,000	75,000	83,100	88,400	93,700	88,000	96,000	96,000	67,000
Automobiles [6]	7,200	10,400	10,700	12,800	16,700	12,000	17,000	18,000	11,000
Railway equipment [6]	3,350	8,100	5,600	5,200	4,800	3,350	2,500	5,700	5,200
Shipbuilding [6]	100	100	200	100	100	200	100	300	500
Ammunition [4]	38,000	40,000	27,000	31,500	32,000	34,000	39,600	41,100	33,300
Terneplate [4]	4,700	4,600	4,050	4,500	4,100	3,900	4,400	4,200	2,700
Foil [4]	26,800	33,300	35,000	32,500	35,000	30,000	35,000	30,000	24,000
Bearing metal [4]	26,000	28,000	32,000	34,000	36,000	31,000	32,000	33,000	20,000
Solder [7]	20,000	30,000	30,000	35,000	37,000	35,000	37,000	37,000	27,000
Type metal [7]	9,500	12,000	13,000	15,000	16,000	16,000	17,000	18,000	16,000
Calking [7]	20,000	25,000	26,500	30,000	32,000	30,000	32,000	31,500	21,000
Castings [7]	15,000	15,000	15,000	18,000	18,000	17,000	18,000	18,000	12,000
Other uses [8]	32,500	36,500	38,000	40,500	44,500	40,500	46,000	50,000	40,000
Total	683,150	768,000	812,150	856,500	900,900	840,950	930,600	948,500	753,600

[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 1928. Later figures have been determined by an improved method.
[3] Exclusive of orides for storage batteries.
[4] Based on reports from a large proportion of manufacturers in each industry.
[5] Based on estimates of manufacture and the quantity of lead used per unit of manufacture. Under this 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 1930 amounted to 753,600 tons, which is less than that consumed in any year since 1922. In the following table the individual uses of lead have been arranged according to their percentage relation to the total lead consumed in 1930.

Percentage of total lead consumed in the United States, 1925–193

Use	1925	1926	1927	1928
Cable coverings	18.21	20.53	19.15	19.3
Storage batteries	21.02	21.09	20.81	23.6
White lead	15.29	13.32	14.98	13.2
Building	10.32	10.40	10.46	10.3
Ammunition	3.68	3.55	4.04	4.2
Litharge and red lead	4.90	4.00	4.52	3.3
Solder	4.09	4.11	4.16	3.9
Foil	3.80	3.89	3.57	3.7
Calking	3.50	3.55	3.57	3.4
Bearing metal	3.97	4.00	3.69	3.4
Type metal	1.75	1.78	1.90	1.8
Castings	2.10	2.00	2.02	1.9
Automobiles	1.49	1.85	1.43	1.8
Railway equipment	.61	.53	.40	.2
Terneplate	.53	.46	.46	.4
Shipbuilding	.01	.01	.02	.0
Miscellaneous	4.73	4.94	4.82	4.9

From 1923 to 1929 storage batteries were the largest lead, but in 1930 cable coverings required more lead tha use due to the fact that the decline in the storage-batte in 1930 was much more pronounced than that in th industry. The quantity of lead used in the manufactur batteries declined 22 per cent, while that used in cab declined only 5 per cent.

The use of lead as a protective coating for copper employed chiefly in telephone and underground transm appears sure to increase. General expansion of the use power, such as the large electrification programs announ of the railway companies and the development of the B and other great power projects, will require large amou covered cable. Increasing civic consciousness will undoub in placing many of the present unsightly overhead tel transmission lines underground, as has been the custom in D. C., for many years. Research work now in progress t the causes and remedies of certain defects in lead-covere have limited its use in some industries should yield profi in expanding the market for lead-covered cable.

Storage batteries are used chiefly in motor vehicles; co the decreased production in the automotive industry was smaller requirements of lead for the manufacture of stora The production of batteries for automobiles, however, di decline proportionate to that suffered by the automoti largely because of the battery replacements required for in service. The American Bureau of Metal Statistics ha the production of automobile storage batteries at 13,000, and 16,000,000 in 1929. Exports of storage batteries steadily from a total of about 207,000 in 1925 to 399,000 increase of 93 per cent. Until 1930, the expansion of the industry and export trade had more than offset the decr storage batteries in radios, which resulted from the intr "socket power" sets. The American Bureau of Metal S estimated that about 60,000 radio storage batteries were m in 1930, as compared with 170,000 in 1929 and 400,000 in

The manufacture of white lead is the third largest use of lead, but one that appears to be on the decline. Prior to 1923 this industry was the largest consumer of lead and in 1922 took 156,000 tons or 23 per cent of the total estimated lead consumption. In 1930 only 83,900 tons (11.1 per cent of the total) were so used. The declining use of white lead is due to the substitution in paints of the cheaper pigments, principally lithopone and zinc oxide, and to the increased use of nitrocellulose paints in which white lead is seldom used on account of its chemical instability in contact with nitrocellulose products.

F. E. Wormser, secretary of the Lead Industries Association, has summarized developments in the uses of lead as follows: [13]

So far as the industrial applications of lead are concerned it is interesting to observe that more data were forthcoming during 1930 to show that the new lead-calcium alloy developed for cable sheathing promises to find a place in toll cable construction, if not ultimately in power cables as well, although power cable fabricators have not, as a rule, turned to any alloy of lead, preferring common lead for their use. The lead-calcium alloy would naturally displace the widely used antimony-lead combination, if it is finally adopted as standard on toll lines. It is understand trial sections of lead-calcium sheathed cable are still being tested experimentally.

During 1930 the use of lead-asbestos antivibration mattresses under the columns of huge buildings made further progress. In fact, the application of this device has been extended to moving machinery such as printing presses and rubber machinery. In some cases other nonmetallic vibration dampening substances are used in place of asbestos and enclosed in sheet lead.

An interesting revival of an ancient use of lead occurred in 1930—the manufacture of an all lead casket (hard lead). In view of the renowned corrosion resisting quality of lead one wonders why this metal has not been more widely used for sepulchral equipment other than casket hardware.

Recent British research has tended to show that, contrary to popular impression, the presence of antimony up to 3 per cent is not an objectionable constituent of lead-tin solder but is generally advantageous, although it is objectionable when soldering zinc or galvanized iron.

A stream-line fitting for copper tubing using a solder film was placed upon the market in 1930.

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 1928, 1929, and 1930, and the average yearly prices from 1910 to 1930.

Wormser, F. E., Lead: Metal Ind., vol. 29, No. 1, January, 1931, p. 7.

Average monthly quoted prices of lead at St. Louis, New York, and London, 1928–1930, in cents per pound [1]

Month	1928			1929			1930	
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York
January	6.29	6.50	4.74	6.50	6.65	4.79	6.10	6.25
February	6.08	6.34	4.41	6.73	6.86	5.01	6.09	6.24
March	5.82	6.02	4.34	7.38	7.50	5.50	5.56	5.67
April	6.00	6.11	4.42	7.03	7.20	5.37	5.43	5.53
May	6.02	6.13	4.46	6.77	7.00	5.19	5.41	5.51
June	6.16	6.30	4.57	6.80	7.00	5.13	5.31	5.39
July	6.05	6.22	4.47	6.61	6.80	4.94	5.15	5.23
August	6.05	6.25	4.68	6.55	6.75	5.02	5.33	5.49
September	6.29	6.45	4.77	6.69	6.89	5.10	5.35	5.49
October	6.32	6.50	4.78	6.67	6.87	5.05	5.00	5.15
November	6.23	6.39	4.60	6.13	6.29	4.71	4.95	5.10
December	6.34	6.50	4.62	6.10	6.25	4.68	4.95	5.10

[1] St. Louis: Metal Statistics, 1931, p. 377. Average daily quotations of soft Missouri lead, f. o. b. (open market), as reported daily in the American Metal Market.
New York: American Metal Market, daily issues. Pig lead, New York (outside market) prompt from West.
London: Metal Statistics, 1931, p. 381. 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 Board.

Average yearly prices of lead at St. Louis, New York, and London, 1910–

Year	St. Louis [1] (per pound)	New York [2] (per pound)	London [3]	
			Per long ton	Per pound
	Cents	*Cents*		*Cents*
1910	4.33	4.49	£12.950	2.81
1911	4.81	4.46	13.403	2.92
1912	4.38	4.48	17.792	3.87
1913	4.26	4.40	18.308	3.98
1914	3.74	3.87	18.688	4.09
1915	4.57	4.67	22.883	4.85
1916	6.80	6.83	30.975	6.58
1917	8.92	8.71	30.000	6.37
1918	7.25	7.46	30.133	6.40
1919	5.55	5.81	28.196	5.57
1920	7.93	8.08	38.229	6.25
1921	4.39	4.55	22.725	3.90
1922	5.52	5.71	23.742	4.69
1923	7.35	7.25	26.817	5.48
1924	8.10	8.08	33.696	6.64
1925	8.92	9.02	36.863	7.73
1926	8.25	8.42	31.075	6.74
1927	6.52	6.75	24.192	5.25
1928	6.14	6.31	21.058	4.58
1929	6.66	6.83	23.246	5.04
1930	5.38	5.52	18.075	3.92

[1] Compiled from daily quotations in open market at St. Louis, as published in Metal Statistics, 1931, p. 375.
[2] Average prices based on quotations of American Smelting & Refining Co., as published in Metal Statistics, 1931, p. 309.
[3] Prices of foreign lead in London, as published in Metal Statistics, 1931, p. 381, converted to cents per pound on basis of average exchange rates published in the reports of the Federal Reserve Board.
[4] Import duties on refined pig lead have been as follows: Aug. 6, 1909, to Oct. 3, 1913—2¼ cents per pound; Oct. 4, 1913, to Sept. 21, 1922—25 per centum ad valorem; average tariff collected—1 1/10 cents per pound; Sept. 22, 1922, to date (1930)—2½ cents per pound.

To facilitate the settlement of its buying and selling contracts the American Smelting & Refining Co., which controls a large part of the United States lead production, at frequent intervals publishes an official contract price based on the New York market.

following are the company's quotations for 50-ton lots, f. o. b. Ne
York, in 1929 and 1930, in cents per pound.

1929		1930	
Jan. 2	6. 65	Feb. 27	6.
Feb. 6	6. 75	Mar. 3	6.
Feb. 11	6. 85	Mar. 6	5.
Feb. 19	6. 95	Mar. 7	5.
Feb. 27	7. 10	Mar. 8	5.
Mar. 6	7. 25	Mar. 10	5.
Mar. 19	7. 50	Mar. 25	5.
Mar. 20	7. 75	Mar. 26	5.
Apr. 4	7. 50	Apr. 4	5.
Apr. 8	7. 25	Apr. 7	5.
Apr. 10	7. 15	May 13	5.
Apr. 15	7. 00	May 20	5.
July 5	6. 90	June 17	5.
July 10	6. 75	June 23	5.
Sept. 5	6. 90	Aug. 1	5.
Oct. 29	6. 75	Aug. 4	5.
Oct. 31	6. 50	Oct. 1	5.
Nov. 6	6. 35	Oct. 4	5.
Nov. 7	6. 25	Oct. 8	5.
		Oct. 9	5.
		Oct. 10	5.

The price of lead in 1930 continued the downward trend whic
began in April, 1929, and by the end of the year it had declined to th
lowest level since the early part of 1922. The New York quotation o
January 2, 1930, and the average for that month was 6.25 cents pe
pound. This price was maintained until the last few days in Februar
when weakness in the European market caused a downward trend i
prices, which continued with few interruptions until July when th
quotation was stabilized for a time at 5.25 cents. In August an
September the price was maintained at a higher level because of mor
active demand; but early in October it fell to 5.10 cents, where
remained throughout the rest of the year. The drop from 6.25
5.10 cents, the high and the low for the year, represented a decrease o
18 per cent. The average quotation for the year was 5.52 cent
compared with 6.83 cents in 1929, a decrease of 19 per cent and
per cent under the record 1925 price. The New York market ave
aged 0.14 cent per pound over the St. Louis market in 1930, as com
pared with 0.17 cent in both 1929 and 1928.

The average price, including domestic and foreign sales, receive
by lead producers in the United States in 1930, according to report
of producers to the Bureau of Mines, was 5.0 cents a pound; in 192
it was 6.3 cents.

The London quotation followed the same general trend as the Ne
York quotation. The average for January was 4.68 cents per poun
and for December 3.31 cents. The average for the year was 3.9
cents, a decrease of 22 per cent from 5.04 cents in 1929 as compare
with a decrease of 19 per cent in the New York quotation. The 193
London average was 1.12 cents below that for 1929, whereas the Ne
York average dropped 1.31 cents. The London price was 1.60 cen
under the New York price in 1930, as compared with 1.79 cents i
1929. In December, 1930, the London price reached the lowest leve
since 1911.

GOLD, SILVER, COPPER, LEAD, AND Z
NEVADA[1]

(MINE REPORT)

By V. C. Heikes[2]

CONTENTS

SUMMARY

The total value of the mine production of gold, silver,
nd zinc from Nevada mines in 1930 was $21,455,517,
11,574,720 compared with 1929, and the number of
orting (280) was 58 less. The quantity and value of
nd copper decreased in 1930; the lead output was exce
hat in 1916, 1917, 1918, and 1925, and the zinc out
eeded only by that in 1916. The gold output dec
63,711.22 to 149,064.47 ounces, the silver output from
,219,832 ounces, and the copper output from 14
09,203,512 pounds. The lead output increased fro
23,058,381 pounds and the zinc output from 16,92
68,117 pounds. The total value of the metals dec
33,030,237 to $21,455,517.

Nevada, often spoken of as the "Silver State," was so
he Comstock lode was almost entirely responsible for
utput of the United States from an insignificant amou
lace in world production. Compared with the other St
as first in output of silver between 1861 and 1878 and a
910 and 1915. Colorado and then Montana were leade
nt periods from 1880, followed in 1920 by Utah whi
een the leading silver State. White Pine County led
metals recorded in 1930 and yielded over 69 per cent of th
f the metals produced in the State, due to the large outp
n the county. Three other counties each produced m
ore than $1,000,000—Lincoln County, with the larges
ead and zinc; Nye County, with its principal values

[1] Work on manuscript completed December, 1931.
[2] Helen M. Guylord, assisted by B. N. Lowry, both of the Bureau of Min
tatistics for this report.