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U. S. GEOLOGICAL SU
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MINERAL RE

OF THE

UNITED S

1923

F. J. KATZ
Geologist in Charge, Division of Mi

Part II—MEDA

UNITED STATES
GOVERNMENT PRINTING
WASHINGTON
1924

The average price of zinc dust, "blue powder," as calculated from sales during the year, was 8.8 cents a pound; "atomized" zinc dust brought 8 cents a pound. "Blue powder" brought a higher average price than "atomized" dust, because much of it was sold in the far West, where higher prices prevailed. The weekly fluctuation in the quoted price of zinc dust is shown in Figure 2 (p. 99).

The following operators reported the production of zinc dust in 1923:

Bartlesville Zinc Co., Bartlesville, Okla.
John Finn Metal Works, San Francisco, Calif.
Grasselli Chemical Co., Clarksburg, W. Va.
The Merrill Co., San Francisco, Calif.
Metals Disintegrating Co., Townley, N. J.
New Jersey Zinc Co., Palmerton, Pa.
United States Zinc Co., Sand Springs, Okla.
Wheeling Steel Corporation, Wheeling, W. Va.

ZINC PIGMENTS AND SALTS

Zinc forms the base, either in whole or in part, of four white pigments—zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone. Two zinc salts, the chloride and the sulphate, are likewise made in part from ore and in part from secondary zinc. Details of the production of zinc pigments and salts and of market conditions are given in the chapter on lead and zinc pigments and salts.

The zinc content of the pigments and salts made in the United States from ore, both domestic and foreign, for the period 1918–192 is given in the table below. Statistics of the secondary zinc recovered in the form of pigments and salts are given under the next heading.

Primary zinc content of zinc pigments and salts made in the United States, 1918–192 in short tons

Year	Salts	Pigments	Year	Salts	Pigments
1918	(a)	102,778	1921	3,749	63
1919	3,303	96,817	1922	1,801	93
1920	6,284	110,605	1923	1,573	11

a Figures not available.

SECONDARY ZINC[1]

Secondary zinc recovered in the United States, 1920–1923, in short tons

	1920	1921	1922	1923
Secondary zinc, redistilled	21,371	17,573	32,988	30
Secondary zinc, remelted	21,479	10,200	30,326	25
Recovered zinc in alloys, excluding old brass remelted	7,650	5,840	10,260	6
Recovered zinc in remelted brass	65,000	38,627	60,230	6
Secondary zinc recovered as metal	115,500	78,300	139,844	12
Secondary zinc recovered in zinc dust	1,061	755	3,405	
Secondary zinc recovered in pigments	12,870	4,024	8,609	10
Secondary zinc recovered in zinc salts	9,479	10,225	9,016	10
Total secondary zinc	139,000	93,000	161,000	16

[1] See page 79 for definition of secondary zinc.

BY-PRODUCT SULPHURIC ACI

An important by-product of zinc-smelting ope ric acid made from the sulphur gases evolved in lphide ores preparatory to their distillation or c ide or to zinc salts. Sulphur gases from zinc or lized by Matthiessen & Hegeler, at La Salle, Ill., are numerous acid plants using these gases. y be located at zinc smelters and zinc-oxide p magnetic separating plants, at the mines, or rkets, the roasted concentrates being shipped t other zinc plants. Figures of output of this by period 1914–1920 were given in the chapter or sources, 1920, and for 1921 in the chapter or sources, 1922. Sulphuric acid statistics for 19 Bureau of the Census, are not available at the of this report.

MINE PRODUCTION

The preceding tables give the quantity of zinc re tal by smelting and by electrolytic reduction, o nc in pigments and salts. The following table the domestic zinc that is recovered by metall origin of the zinc by States is obtained more ac orts of mines, because smelters necessarily treat metimes long after they have been received, so tput of metallic zinc may not correspond at a oduct of the mines for the same year. The data production are taken from the reports on gol and zinc in the different States.

Mine production of zinc in the United States, 1918–1923

State	1918	1919	1920	19
	1,135	859	729	
	951	189	329	
nia	2,781	236	583	
do	44,567	18,610	24,395	1,
	22,581	7,997	13,966	
	3,792	6,788	4,720	2,
	30,197	47,636	61,073	36,
ky	315	36	9	
ri	55,992	31,540	24,509	10,
a	104,629	84,382	92,169	11,
	8,362	4,502	5,349	
Hampshire	14			
Jersey	a 102,318	a 92,516	a 78,511	56,
Mexico	12,025	3,797	5,007	
ork	3,776	5,120	5,654	1,
na	161,401	178,410	219,727	121,
	21,071	23,247	19,217	9,
	9,200	2,216	4,079	
	951			
ton	19		213	
	50,014	40,765	27,285	3,
	a 636,091	a 548,846	a 587,524	256,

a Output of New Jersey for 1907–1920, inclusive, has been revised becaus to rise to slight but compensating error.

LEAD AND ZINC PIGMENTS AND

By C. E. Siebenthal and A. Stoll

GENERAL CONDITIONS

Lead and zinc pigments and salts are made both
by chemical processes. Sublimed lead, or basic lead s
arious lead oxides are examples of lead pigments p
limation in oxidizing furnaces; basic carbonate whi
ead salts are made by chemical processes. Sublim
ead sulphate, is made directly from ore, but the lea
white lead and lead salts are made from pig lead.
Zinc oxide and leaded zinc oxide are made by the A
irectly from ore by sublimation in an oxidizing fu
inc oxide is made in this country by the French p
etallic zinc is sublimated in an oxidizing furnace.
inc salts are made by chemical processes, the zinc ba
rom zinc ore, metallic zinc, galvanizers' ashes, or scr
one is made by mixing equivalent portions of solut
hate and barium sulphide, which brings about a
tation of zinc sulphide and barium sulphate eit
ombination or as a very intimate mixture.
The quantity of lead and zinc pigments and salts,
one, sold by producers in the United States in 1923
hole a slight increase over the sales in 1922. The
ent decrease in the sales of white and sublimed le
ent increase in the sales of the lead oxides. Zinc
lts showed a slight gain. Sales of lithopone indi
ear and were the largest in the history of that indu
the ownership of several lithopone plants occurred
nd one new plant was constructed. The plant o
hemicals Extraction Corporation, Oakland, Calif.
ctober and offered for sale. The works at Feder
perated by the Consolidated Chemical Products Co.
hased by the Basic Chemical Manufacturing Co
lant of the Collinsville Zinc Corporation, Collinsvill
921, was sold to the St. Louis Lithopone Co. in 1923
again near the end of the year. The lithopone p
al Refining & Chemical Corporation, of St. Loui
ismantled. A new plant for the production of lith
ucted at Depue, Ill., by the New Jersey Zinc Co.
rench process) plants of the International Lead
, Chicago, Ind., and Akron, Ohio, started oper
of the year, using electrolytic zinc made by the A
ining Co. An addition to the plant of W. P. Fu
ancisco, doubled its capacity.

PRODUCTION

In this chapter the pigments and salts sold are taken to represent the production, no account being taken of the stocks on hand at the beginning and end of the year.

Lead pigments and salts sold by domestic manufacturers in the United States in 1922 and 1923

	1922			1923		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Sublimed lead, or basic lead sulphate:						
White	13,765	$1,829,865	$132.94	11,949	$1,959,068	$163.95
Blue	972	129,230	132.95	800	134,356	167.95
Red lead	30,509	5,104,290	167.30	38,037	7,611,508	200.11
Orange mineral	370	83,022	224.38	646	181,066	280.29
Litharge	58,261	8,892,172	152.63	75,107	14,050,979	187.20
White lead:						
Dry	41,598	5,785,165	130.07	37,786	6,615,114	175.07
In oil	153,393	29,728,230	193.80	125,087	27,010,116	215.93
Lead acetate	(a)	(a)	(a)	(a)	(a)	(a)
Lead arsenate	(a)	(a)	(a)	(a)	(a)	(a)

[a] Statistics for lead arsenate and lead acetate collected biennially by the Bureau of the Census, for odd years. Figures for 1923 not available.

Zinc pigments and salts sold by domestic manufacturers in the United States in 1922 and 1923

	1922			1923		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [a]	128,465	$17,904,704	$140.07	126,087	$18,750,072	$147.66
Leaded zinc oxide [a]	19,013	2,251,601	114.80	23,504	2,815,985	119.81
Lithopone	83,300	9,214,040	110.53	98,199	11,608,443	118.21
Zinc chloride, 50° Baumé	41,027	2,009,147	48.27	42,431	1,958,187	46.15
Zinc sulphate	5,078	251,528	49.53	5,375	261,449	48.64

[a] Zinc oxide containing 5 per cent or more of lead is classed by the Geological Survey as leaded zinc oxide.

Lead pigments sold in the United States, 1919–1923, in short tons

Year	White lead		Sublimed lead or basic lead sulphate		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1919	30,685	109,005	9,068	1,350	[a] 32,362	(a)	46,739
1920	33,678	112,017	12,412	928	[a] 34,431	(a)	62,329
1921	26,738	143,545	11,568	463	21,805	381	41,909
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107

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

Zinc pigments and salts sold in the United S

Year	Zinc oxide	Le zinc
1919	117,639	
1920	99,444	
1921	74,329	
1922	128,465	
1923	126,087	

[a] Figures represent production.

SOURCE

Metal content of lead and zinc pigments and salts short tons

Source	1922			
	Lead		Zinc	
	Pigments [a]	Salts [b]	Pigments	Salts
Domestic ore	13,892	(b)	91,874	1,80
Foreign ore		(b)	1,238	
Metal	241,096	(b)	16,298	1,04
Secondary material [c]	111	(b)	8,609	9,01
	255,099	(b)	118,019	11,84

[a] Includes also lead recovered in zinc oxide and leaded zinc
[b] Statistics not collected for 1922.
[c] The source of the lead contained in lead salts is unknown made from litharge, from granulated lead, and from white- lead acetate or lead nitrate. All having been derived from pi into statistical account.
[d] Zinc ashes, skimmings, drosses, and old metal.

IMPORTS AND E

The following statistics of imports a pigments and salts have been compile records of the Bureau of Foreign and D ment of Commerce, by J. A. Dorsey, of Survey.

Basic carbonate white lead, red lead, litharge, consumption in the United St

Year	Basic carbonate white lead		Red lead	
	Pounds	Value	Pounds	Value
1919	21,213	$2,490	7,199	$1,13
1920	159,977	19,449	23,076	1,76
1921	124,178	12,598	12,236	68
1922	222,465	21,335	1,405	9
1923	336,892	31,386	3,600	22

Zinc oxide, lithopone, zinc sulphide (white), zinc chloride, and zinc sulphate imported for consumption in the United States, 1919–1923

Year	Zinc oxide				Lithopone	
	Dry		In oil			
	Short tons	Value	Short tons	Value	Short tons	Value
1919	105	$44,338	3	$1,351	739	$122,708
1920	1,431	289,800	14	3,506	1,714	263,240
1921	1,286	145,071	57	17,540	5,247	432,019
1922	2,712	361,599	42	8,595	10,203	885,671
1923	1,036	169,415	89	21,034	10,440	776,383

Year	Zinc sulphide [a]		Zinc chloride		Zinc sulphate	
	Pounds [a]	Value	Short tons	Value	Short tons	Value
1919	10,035	$4,413	1	$192	(b)	$153
1920	45,482	15,027	565	76,405	50	3,038
1921	93,537	8,330	2,199	213,905	17	820
1922	27,159	8,463	1,374	87,509	17	1,064
1923	11,844	5,403	551	44,164	20	3,466

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

White lead and red lead exported from the United States, 1919–1923

Year	White lead [a]		Red lead [b]	
	Short tons	Value	Short tons	Value
1919	14,017	$3,037,292	3,114	$735,177
1920	14,901	3,195,101	1,532	365,575
1921	5,161	993,130	548	115,503
1922	4,598	710,765	1,683	294,133
1923	[a] 5,172	836,261	[b] 1,840	372,828

[a] Sublimed lead has been classified by the Bureau of Foreign and Domestic Commerce with white lead in exports since 1922; the figures for 1923 may possibly include some sublimed lead.
[b] Exports of red lead and litharge have been combined since 1922; the figures for 1923 may include an unknown quantity of litharge.

White lead exported from the United States in 1922 and 1923

[Figures in parentheses not duplicated in totals]

Destination	1922		1923 [a]	
	Short tons	Value	Short tons	Value
Africa	1	$220	(b)	$62
Asia	60	10,897	53	8,602
Australia and Oceania	165	33,644	277	60,391
Australia	(9)	(1,566)	(11)	(2,436)
New Zealand	(1)	(375)	(b)	(45)
Philippine Islands	(141)	(28,348)	(254)	(54,800)
Canada	53	8,386	216	36,148
Cuba	65	14,194	120	25,472
Europe	2,809	391,940	2,680	362,511
Belgium	(938)	(127,275)	(1,272)	(165,115)
France	(50)	(7,821)		
Great Britain	(1,377)	(193,679)	(909)	(128,626)
Netherlands	(417)	(59,749)	(490)	(67,558)
Mexico	124	28,944	99	24,240
Panama	6	1,407	288	60,380
South America	1,199	190,110	1,309	229,054
Brazil	(6)	(1,000)	(12)	(1,961)
Colombia	(22)	(4,261)	(9)	(2,536)
Uruguay	(83)	(12,923)	(144)	(24,729)
Venezuela	(9)	(2,014)	(9)	(2,121)
Other countries	116	24,963	124	29,404
	4,598	710,765	5,172	836,261

[a] White lead and sublimed lead not classified separately after 1922; the figures for 1923 may include an unknown quantity of sublimed lead.
[b] Less than 1 ton.

Zinc oxide and lithopone exported from the U

Year	Zi
	Short to
1919	14,70
1920	11,10
1921	2,51
1922	3,91
1923	5,02

[a] Not separately enumerated prior to 1922.

Zinc oxide exported from the United Stat

[Figures in parentheses not duplicate

Destination	
	Short to
Asia	4
Australia and Oceania	64
Philippine Islands	(37
Canada	3,21
Cuba	83
Europe	381
France	(70
Great Britain	(300
Italy	(11
Mexico	109
Panama	2
South America	123
Brazil	(14
Other countries	43
	3,977

WORLD'S PRODUCTION OF

The following table showing the product official figures are available has been compi the United States Geological Survey.

Zinc oxide produced in countries where reported,

Year	Australia (New South Wales)	Germany
1913		25,17
1914		22,98
1915		15,49
1916		14,25
1917		18,67
1918		21,09
1919	172	16,44
1920	[c] 703	22,95
1921	[c] 800	362
1922		(d)
1923		(d)

[a] In addition to the countries listed, Canada reports a small amou
tion are available. The HA/S Titan Co. of Norway has a capacity o
data are not available.
[b] The only figures available for production in Poland exclusive of
metric tons was reported.
[c] Includes leaded zinc oxide.
[d] Included under Germany.
[e] Includes zinc-lead oxide.
[f] Upper Silesia only.
[g] No data available.

CUSTOMS DUTIES

Mineral Resources for 1922 contained a table comparing the tariff rates imposed on lead and zinc pigments and chemicals in the tariff acts of 1909, 1913, and 1922. The tariff act of 1922 contains the following paragraphs relating to lead and zinc pigments and salts:

Par. 47. Lead: Acetate, white, 2½ cents per pound; acetate, brown, gray, or yellow, 2 cents per pound; nitrate, arsenate, and resinate, 3 cents per pound; and all other lead compounds not specially provided for, 30 per centum ad valorem.

Par. 74. Lead pigments: Litharge, 2½ cents per pound; orange mineral, 3 cents per pound; red lead, 2¾ cents per pound; white lead, 2½ cents per pound; all pigments containing lead, dry or in pulp, or ground in or mixed with oil or water, not specially provided for, 30 per centum ad valorem.

Par. 79. Zinc oxide and leaded zinc oxides containing not more than 25 per centum of lead, in any form of dry powder, 1¾ cents per pound; ground in or mixed with oil or water, 2¼ cents per pound; lithopone, and other combinations of mixtures of zinc sulphide and barium sulphate, 1¾ cents per pound.

Par. 93. Zinc chloride, 1⅗ cents per pound; zinc sulphate, three-fourths of 1 cent per pound; and zinc sulphide, 1½ cents per pound.

SPECIFICATIONS FOR LEAD AND ZINC PIGMENTS

The departmental committee on standardization of paint specifications, later the Federal Specifications Board, has recommended specifications for the purchase of materials by the Government. Those relating to lead and zinc pigments have been published in circulars by the Bureau of Standards, as follows:

84. Basic carbonate white lead, dry and paste. Issued December 27, 1919.
85. Basic sulphate white lead, dry and paste. Issued January 26, 1920.
87. Zinc oxide, dry and paste. Issued February 16, 1920.
88. Leaded zinc oxide, dry and paste. Issued February 16, 1920.
90. Red lead, dry and paste. Issued April 3, 1920.
111. Flat interior lithopone paint, white and light tints. Issued June 24, 1922.
147. Gloss interior lithopone paint, white and light tints. Issued September 19, 1923.

PRICES AND VALUE

The total amount and the average per ton received for sales of each lead and zinc pigment and salt are given in the tables on page 120. Figure 3 shows the relation of the average weekly price of lead in New York to the weekly quotations on several pigments and salts of lead as given in the Oil, Paint, and Drug Reporter, and Figure 4 shows the relation of the weekly average quoted price of prime western slab zinc in St. Louis to the weekly quotations on certain pigments and salts of zinc as given in the same journal. The qualities and conditions of the pigments and salts on which the prices were quoted are designated as follows:

Sublimed lead, or basic lead sulphate (white), "in casks."
White lead, "American, dry, in casks."
Litharge, "commercial, powdered, in casks."
Red lead, "dry, in casks."
Orange mineral, "American."
Lead acetate, "brown, broken."
Lead arsenate, "paste."
Zinc oxide, "commercially lead-free."
Lithopone, "in barrels."
Zinc chloride, "fused."
Zinc sulphate, "industrial."

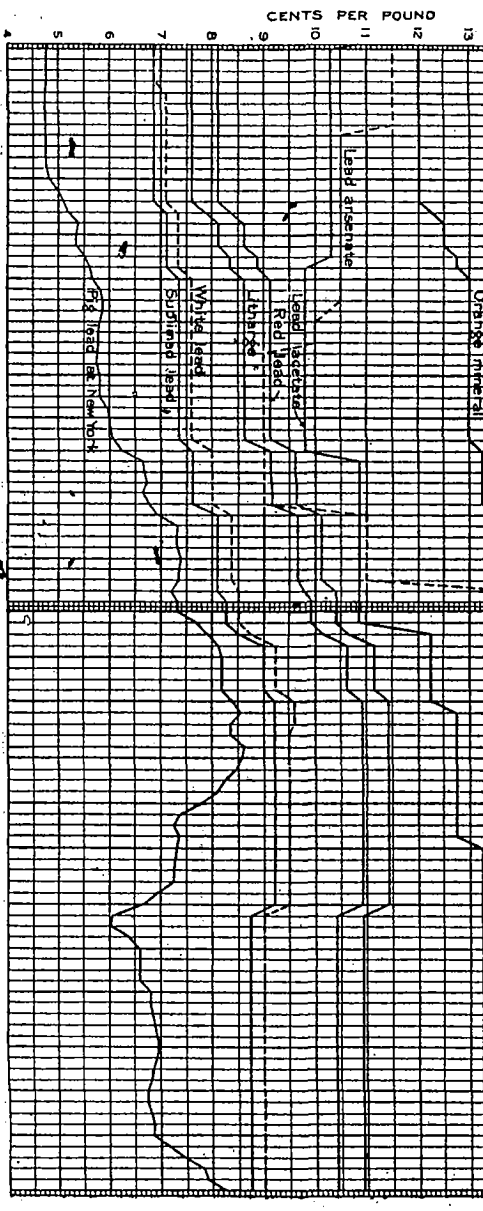

FIGURE 3.—Relation of weekly prices of lead pigments and salts to the average weekly quoted price of lead at New York, 1922-23

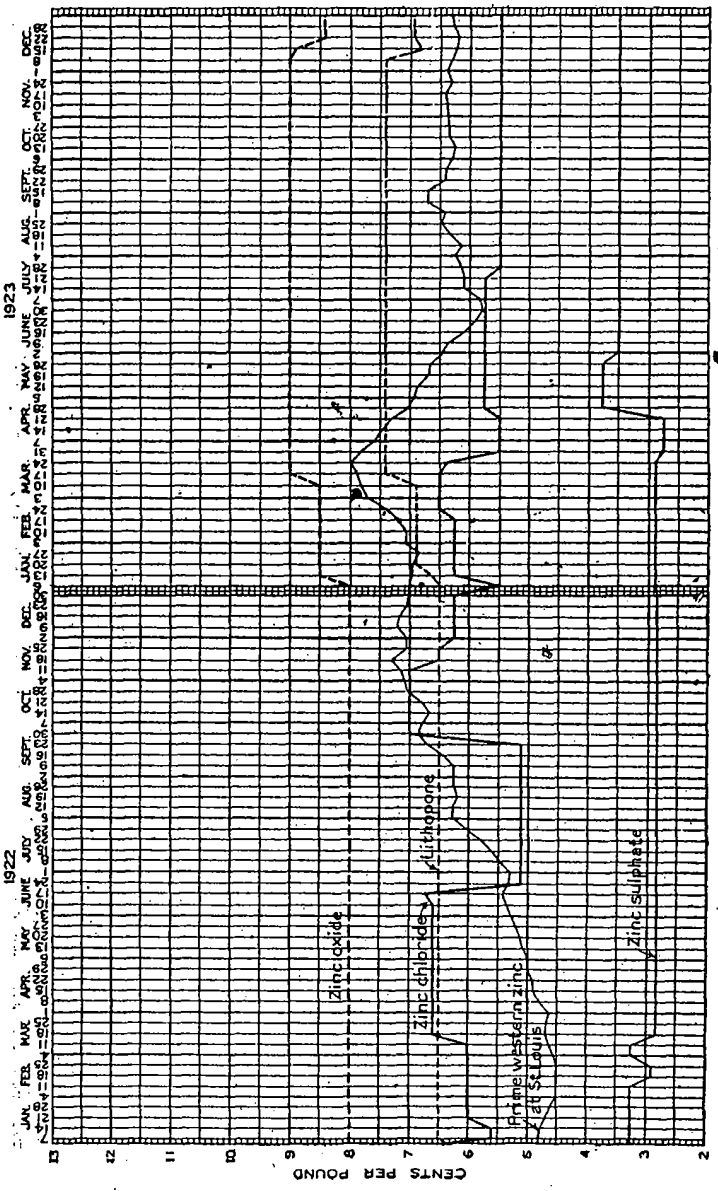

PLATE I.—Relation of yearly prices of zinc pigments and salts to the average weekly quoted price of prime western zinc at St. Louis, 1922-23.

PRODUCERS

Producers of lead and zinc pigments and
he list includes some plants that did not

White lead:
Anaconda Lead Products Co. (electrolytic p
ess)
Carter White Lead Co
E. I. du Pont de Nemours & Co
Eagle-Picher Lead Co
Do
Euston Lead Co
W. P. Fuller & Co
John T. Lewis & Bros. Co
Matheson Lead Co
National Lead Co
Do
Do
Do
Do
Do
National Lead & Oil Co. of Pennsylvania
Sherwin-Williams Co
United Lead Co
Wetherill & Bro
ublimed lead, or basic lead sulphate:
Eagle-Picher Lead Co
St. Louis Smelting & Refining Works of Nati
Lead Co.
Red lead, orange mineral, and litharge:
Chadwick-Boston Lead Co.[1]
Eagle-Picher Lead Co
Do
Do
Do
Evans Lead Co
W. P. Fuller & Co
John T. Lewis & Bros. Co
Matheson Lead Co
National Lead Co
Do
Do
Do
National Lead & Oil Co. of Pennsylvania
Pennsylvania Smelting Co
Sherwin-Williams Co
Wetherill & Bro
nc oxide and leaded zinc oxide:
American Smelting & Refining Co.[1]
American Steel & Wire Co.[1]
American Zinc & Chemical Co
American Zinc Co. of Illinois
American Zinc Oxide Co
Bartlesville Zinc Co.[1]
Bertha Mineral Co
Eagle-Picher Lead Co
Empire Zinc Co
Grasselli Chemical Co
Grubnau Chemical Co. (Inc.)[1]
International Lead Refining Co. (French p
ess)
Do. (French process)
Mineral Point Zinc Co.[1]
Do

[1] No manufacturing in 1923.

Zinc oxide and leaded zinc oxide—Continued.	
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Do. (French process)	Freemansburg, Pa.
Ohio Zinc Co.[1]	Canon City, Colo.
Ozark Smelting & Mining Co	Coffeyville, Kans.
River Smelting & Refining Co	Florence, Colo.
Shasta Zinc & Copper Co.[1]	Winthrop, Calif.
Trenton Zinc & Chemical Co	Trenton, N. J.
U. S. Zinc Co	Pueblo, Colo.
Utah Zinc Co.[1]	Murray, Utah.
Western Zinc Oxide Co	Leadville, Colo.
Lithopone:	
Chemical & Pigment Co. (Inc.)[2]	St. Helena, Md.
E. I. du Pont de Nemours & Co	Newark, N. J.
Do	Philadelphia, Pa.
Grasselli Chemical Co	Grasselli, N. J.
Krebs Pigment & Chemical Co	Newport, Del.
Metals & Chemicals Extraction Corporation	Oakland, Calif.
Midland Chemical Co. (Eagle-Picher Lead Co.)	Argo, Ill.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
St. Louis Lithopone Co	Collinsville, Ill.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc salts:	
American Zinc & Chemical Co	Langeloth, Pa.
Arkansas Preservative Co	North Little Rock, Ark.
By-Products Steel Corporation	Weirton, W. Va.
Charles Cooper & Co	Newark, N. J.
Delaware Hard Fibre Co	Wilmington, Del.
General Chemical Co	Chicago, Ill.
Grasselli Chemical Co	Grasselli, Ind.
Do	Grasselli, N. J.
Do	Cleveland, Ohio.
Great Western Electro-Chemical Co	Pittsburg, Calif.
Charles Lennig & Co. (Inc.)	Philadelphia, Pa.
Merrimac Chemical Co	Everett, Mass.
Metals & Chemicals Extraction Corporation [1]	Oakland, Calif.
Monsanto Chemical Works	East St. Louis, Ill.
New Jersey Concentrating Co. (Inc.)	Elizabethport, N. J.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Pennsylvania Salt Manufacturing Co	Wyandotte, Mich.

[1] No manufacturing in 1923. [2] Subsidiary of the Gliddon Co.

LEAD[1]

By C. E. Siebenthal and A. S

SUMMARY

Statistics of refined lead, 1922 and 1923, in

PRODUCTION	
Domestic desilverized lead	
Domestic soft lead	
Domestic desilverized soft lead	
Foreign desilverized lead	
Total refined primary [a] lead	
Antimonial lead	
Secondary lead [a]	
CONSUMPTION [b]	
Apparent consumption of primary lead, refinery stocks disregarded	

[a] "Primary lead," which is produced directly from ore, is here distin which is obtained by refining skimmings, drosses, and old metals. The given on p. 132. In this report the word "lead" used without qualificatio
[b] For method of calculating consumption see p. 141.

The output of refined lead in the United State in 1923 was 543,841 tons, valued at $76,138 selling price of pig lead, a gain, as compared wit in quantity and of 48 per cent in value.

PRODUCTION

Quantity and value.—The total refined lead pr States from 1720 to 1923 from domestic ores a and base bullion and its value are shown in the

Refined lead produced in the United States,

Year	Short tons					
	Desilverized lead [a] [b]	Desilverized soft lead	Soft lead [b]	Total production [a]	From domestic ores and base bullion	From foreig ores
1720–1912	7,176,497	326,991	2,929,180	10,432,668	8,545,383	1,
1913	301,160	29,433	131,867	462,460	411,878	13,22
1914	340,397	43,506	158,219	542,122	512,794	7,63
1915	344,593	44,001	161,461	550,055	507,026	9,58
1916	335,375	68,244	167,515	571,134	552,228	6,08
1917	365,998	56,268	188,503	610,769	548,450	15,87
1918	382,314	47,418	210,463	640,195	539,905	15,33
1919	266,538	67,938	147,744	482,220	424,433	7,65
1920	273,135	66,668	189,854	529,657	476,849	8,41
1921	238,329	52,747	157,513	448,589	398,222	7,11
1922	249,107	74,305	209,250	532,662	468,746	13,89
1923	366,241	61,332	190,749	618,322	543,841	24,28
	10,639,684	938,851	4,842,318	16,420,853	13,929,755	2,

[a] The lead content of antimonial lead is excluded; see p. 131.
[b] Desilverized soft lead is excluded.

[1] Chapters on lead giving more than ordinary detail were published in torical table of production) and 1918 (the lead industry in relation to the W

Details for years prior to 1913 are shown in the annual chapter
The value for years prior to 1917 is based upon the average pric
in New York; beginning with 1917 the value is based on the tota
sales of each producing company.

The argentiferous lead ores of the Western States are desilverized
to recover the silver and to refine the lead. The nonargentiferous or
soft lead ores of the Central and Eastern States do not carry enough
silver on the average to pay for desilverizing or to make that opera
tion necessary. For certain purposes, however, a considerable
quantity of lead ore from southeast Missouri has been desilverized
each year.

Production by States.—In addition to the domestic lead ores smelted
in this country, small quantities of domestic lead ore have been
exported to smelters in Canada. Ores from Washington yielded
1,388 tons of lead at Canadian smelters in 1918 and 3 tons in 1919,
but no lead ore from the United States was treated in Canada in
1920–1923.

Primary lead smelted or refined in the United States, 1919–1923, by sources, in short tons

Source of ore	1919	1920	1921	1922	1923
Domestic ore:					
Alaska	645	591	773	324	400
Arizona	5,407	5,987	3,313	7,218	8,823
California	2,004	2,260	614	3,018	5,168
Colorado	18,867	17,752	12,104	11,106	23,885
Idaho	89,091	117,191	99,707	91,487	127,797
Illinois *	977	948	271	750	1,286
Kansas *	7,951	8,421	10,939	10,900	20,207
Kentucky *	83	114	41	73	60
Missouri *	150,341	171,909	151,028	202,245	169,323
Montana	17,513	13,231	11,565	14,551	18,345
Nevada	5,958	8,650	3,553	4,204	8,041
New Hampshire	16				
New Mexico	1,418	1,123	384	1,230	1,638
Oklahoma *	49,984	68,494	46,902	67,436	59,002
Oregon				[b] 37	47
South Dakota	18	6	2	2	4
Tennessee *	2,371	2,705		751	1,020
Texas	8	1	1	[b] 5	40
Utah	65,102	64,000	51,872	63,130	104,678
Washington	1,090	2,460	325	478	2,008
Wisconsin *	3,975	3,841	1,079	1,323	601
Undistributed	119	201	101	[b] 75	691
Zinc residues	4,887	4,366	713	1,284	362
	427,825	494,347	395,287	481,689	554,036
Foreign ore:					
Africa	644	1,171			90
Australia	69	450			7
Canada	1,895	1,186	2,877	3,604	3,631
Central America	12	22	6	14	15
Mexico	2,261	2,729	1,912	7,200	18,867
South America	2,537	2,747	2,235	2,458	1,461
Other foreign	238	109	90	562	211
Foreign base bullion:					
Canada	567	1,919	1,599	2,900	
Mexico	49,564	42,421	41,648	47,118	50,193
South America		54			
	57,787	52,808	50,367	63,916	74,481
Grand total	485,612	547,155	445,654	545,605	628,517

* The lead produced by these States is nonargentiferous or soft lead.
[b] Revised figures.

Soft lead.—The lead ores of the Mississippi Valley are almost free
from silver, and the lead produced from them is known as "soft lead."

The output of the lead pigment basic lead sulp
derived from these ores.

The lead ores from the southeastern Miss
little more silver (slightly over an ounce to the
ton) than those from other regions of the M
likewise small quantities of other metals so th
though soft, is resistant to acids and is much
used in chambers. It is known to the trade as "

Soft lead produced in the United States from domestic or

Year	Soft pig lead			Soft lead r covere in pig manu
	Undesilverized	Desilverized	Total	
1919	147,744	67,938	215,682	[b] 11,1
1920	189,854	66,668	256,522	[b] 15,2
1921	157,513	52,747	210,260	[b] 9,9
1922	209,250	74,305	283,555	13,8
1923	190,749	61,332	252,081	13,6

[a] Includes domestic refined lead, domestic lead in antimonial lead, an
[b] Revised figures.

The zinc ores from Western States that a
may contain some lead which goes into the p
is not strictly accurate to speak of the lead
entirely soft lead.

In addition to the domestic lead so recove
is also recovered in pigments. Prior to 1919
not distinguished from that of domestic origin.
Foreign lead recovered in zinc pigments w
1920, 808 tons; and in 1921, 169 tons. No fo
pigments in 1922 or 1923.

Antimonial lead.—The production of by-pr
from argentiferous lead ores derived from all s
all lead refineries operating in this country, is
1871–1914 in Mineral Resources, 1914, and for
Resources, 1920.

By-product antimonial lead produced in the Unite

Year	Total lead refined from base bullion (short tons)	Percentage of by-product antimonial lead	Antimonia			
			From domestic ore (short tons)	From foreign ore (short tons)	Short tons	Value
1919	266,538	5.2	9,674	4,200	13,874	$1,513,9
1920	273,135	4.6	9,604	2,931	12,535	1,963,2
1921	238,320	4.2	7,881	2,183	10,064	870,0
1922	249,107	3.2	7,068	1,007	8,075	844,9
1923	366,241	3.9	11,635	2,555	14,190	1,950,3
Average		4.2				

Lead pigments.—Leaded zinc oxide, zinc-lead oxide, sublimed white lead, and sublimed blue lead are made directly from ore. Each of these pigments is discussed and the output given elsewhere in this volume in the chapter on lead and zinc pigments and salts. The lead content of pigments smelted directly from ore is given in the fourth column of the first table on page 131. The pigments manufactured from pig lead (white lead, red lead, orange mineral, and litharge) are also discussed and the output given in the chapter on lead and zinc pigments.

Secondary lead.—Secondary lead is obtained mainly from skimmings, drosses, old metal, and alloys, such as babbitt, solder, and type metal. The recovery of lead by refining these materials constitutes an integral part of the lead industry.

Secondary lead recovered in the United States, 1919–1923, in short tons

Year	Pig lead	Lead in alloys	Total recovered lead	Value
1919	55,084	66,416	122,100	$12,943,000
1920	56,350	68,300	124,650	19,944,000
1921	46,370	57,410	103,780	9,340,000
1922	75,480	84,080	159,560	17,552,000
1923	96,430	98,060	194,490	27,229,000

Mine production.—The preceding tables give the quantity of lead recovered by smelting and refining operations either as metallic lead, or in the alloy antimonial lead, or as lead in pigments. The origin of the lead is much more accurately shown by the reports of mines, because smelters necessarily treat mixtures of ores, sometimes long after they have been received, so that the actual output of metallic lead may not correspond at all closely to the product of the mines for the same year.

The following table gives the mine output of lead from 1907 to 1923, inclusive. As more fully discussed in the next section, the statistics of mine production, which for years prior to 1921 have heretofore been expressed as lead content of ore mined, have now been reduced to recoverable lead by deducting an assumed loss in smelting and refining, thus making the figures comparable to the statistics of mine production of zinc, which have always been stated as recoverable zinc. In these calculations the loss in smelting and refining has been taken as 2 per cent in smelting at plants with baghouses the soft nonargentiferous lead ores of the Mississippi Valley, and about 5 per cent in smelting and refining the argentiferous lead ores of the Western States. That these assumed factors are close to the truth is shown by the small discrepancy between the mine and smelter output totals as disclosed in the table of comparison on page 136.

State	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Alaska			19	28	24		18	23	437	820	852	594	687	875	759	377	410
Arizona	2,214	1,429	1,472	1,281	4,880	3,233	7,668	7,127	10,326	12,854	11,116	6,939	4,847	6,935	3,271	7,535	8,146
Arkansas	12	15	24	62	63	30	18	40	62	287	374	118	27	8	21	42	25
California	1,247	588	713	1,363	664	543	1,669	2,020	2,175	5,893	10,387	6,351	1,695	2,407	662	3,156	4,775
Colorado	*44,533	*30,822	*36,081	*38,029	34,840	37,621	43,949	37,106	34,405	35,457	33,995	32,980	18,535	23,315	9,830	11,739	22,849
Georgia														2		4	
Idaho	111,066	96,243	102,593	106,422	129,464	134,988	150,989	165,550	144,350	178,164	186,941	139,981	86,612	118,505	99,235	97,917	121,178
Illinois	813	391	289	366	945	1,256	940	703	935	1,051	1,410	2,228	2,063	1,708	672	1,325	1,381
Iowa	237	50		20	59	62	64			14	33						
Kansas	2,504	2,468	1,274	2,864	2,802	2,324	2,378	1,361	1,188	1,615	2,965	7,107	11,057	16,452	18,679	23,271	17,598
Kentucky	33		10	40		104	22	16	246	150	121	181	84	120	69	92	63
Maine													1				
Massachusetts														14			
Missouri	135,902	141,570	156,246	157,796	175,281	173,528	172,944	188,760	206,231	228,426	229,473	190,292	160,024	161,812	180,065	178,412	166,743
Montana	1,780	2,183	1,417	1,950	3,055	3,537	5,195	4,387	6,534	6,458	10,427	17,640	16,358	14,946	10,193	14,884	17,973
Nevada	2,979	3,442	4,674	2,314	1,550	9,263	7,763	6,085	7,903	12,178	13,147	11,075	7,291	10,100	3,594	4,665	9,078
New Hampshire									3	47	48	30					
New Mexico	1,905	437	2,515	2,160	1,483	2,747	1,973	882	2,271	4,107	4,554	4,199	1,443	1,435	339	1,506	1,916
New York												20					
North Carolina						46					1						
Oklahoma	521	1,745	3,358	2,530	2,451	3,320	6,103	7,405	7,160	11,873	25,831	54,975	52,795	64,086	41,552	62,856	66,904
Oregon						19	42	7	29	13		4				38	14
Pennsylvania									2								
South Dakota									2	18	34	27	16	6	7	2	
Tennessee		12	60	7	32	11	6	2	1	15	2,404	1,620	2,079	1,880	2	732	1,250
Texas		33	46	33	61	83	113	75	110	25	1	13	7			4	13

COMPARISON OF NEW YEAR ESTIMATES AND MINE AND SMELTER TOTALS OF LEAD PRODUCTION

The Geological Survey published annually from 1907 to 1920 the statistics of lead output by mines, but owing to lack of knowledge of the average smelting loss for the whole country, the total was, in general, given as lead content of ore mined, not as recoverable lead. Similarly, the New Year estimate of mine production of lead was expressed as lead content, and these figures were compared with each other and with the figures of smelter production of lead. Beginning with 1921, the lead output of the mines has been expressed as recoverable lead by estimating as closely as possible the losses in smelting and refining. If a considerable term of years is taken to eliminate the effects of lag in smelting by reason of which ore accumulates in the smelter bins or the effects of depression in mining on account of which the ore stocks are depleted by being smelted faster than they are renewed by mining, the mine output may be compared with the smelter output and serve as a check on the estimated smelter losses and on the accuracy of the statistics generally. A similar comparison of recoverable and recovered zinc is made in the chapter on zinc in Mineral Resources for 1923, to which the reader is referred for fuller explanation.

MINE PRODUCTION OF LEAD

In view of the generalized character of the New Year estimates of mine production of lead for years preceding 1921, it is not advisable to try to reduce them to the basis of "recoverable" lead. In the following table, therefore, the figures for those years are given in terms of lead content. To make the comparison easier the final figures for those years are also expressed as lead content, but in the other table of mine production in this chapter (p. 133) allowance has been made for smelting losses and the result expressed as recoverable lead.

The New Year estimates of mine production have generally been too low, the error ranging from a small fraction of 1 per cent to nearly 8 per cent. The discrepancy arises largely in the Joplin district, where it is impossible to obtain weekly reports of sales of lead concentrates as accurate as those of zinc concentrates.

Lead content of ore mined in the United States, 1911–1923

Year	New Year estimate (short tons)	Final figures (short tons)	Error in estimate	
			Short tons	Percentage
1911	423,000	441,160	−18,160	4.1
1912	461,000	457,365	+3,635	.8
1913	460,512	500,188	−39,676	7.9
1914	(a)	522,892	(a)	(a)
1915	600,000	561,641	+38,359	6.8
1916	622,000	622,975	−975	.2
1917	640,000	650,949	−10,949	1.7
1918	563,000	581,654	−18,654	3.2
1919	425,000	443,694	−18,694	4.2
1920	511,000	513,533	−2,533	.5
1921	b401,000	b414,491	−13,491	3.3
1922	b464,000	b477,633	−13,633	2.9
1923	b634,000	b647,217	−13,217	2.1

a New Year estimate not made. b Recoverable lead.

SMELTER PRODUCTION OF L

The error in the New Year estimates of the lead by smelters and refineries ranges from a ve 15,000 tons but has never exceeded 3 per cent. mates are based on production for 10 or 11 mon by each company of its output for the remainde ing business conditions during the final months for the small errors in the estimates.

Smelter production of refined lead, of domestic and fore

Year	New Yea estimate (short tons)
1907	(a)
1908	391,000
1909	444,303
1910	469,082
1911	487,520
1912	480,965
1913	466,843
1914	537,079
1915	605,000
1916	679,600
1917	590,000
1918	638,000
1919	493,000
1920	538,000
1921	440,000
1922	531,000
1923	615,000

a No estimate made.

COMPARISON OF MINE AND SMELT

In addition to the domestic lead recovered a desilverized lead from argentiferous ores, as soft Valley ores, as lead in antimonial lead, and in pi lead is recovered at foreign smelters from lead o United States. The Bureau of Foreign and does not enumerate separately the exports of le the later years of the World War they have not 1917, however, Canadian smelters recovered 4,5 United States ores. The lead salts and many manufactured in the United States are made fr form of manufactured lead, and therefore the l figure as recovered lead. The following table lead recovered in all forms against the estimate the ore mined, for 17 years, the whole period fo available.

Domestic primary lead balance sheet, 1907–1923, in short tons

Year	Recoverable lead (mine production)	Recovered lead (smelter production)						Mine excess (+) or smelter excess (−)
		Refined desilverized argentiferous lead	Soft lead, nonargentiferous [a]	Lead in antimonial lead	Lead in pigments [b]	Lead recovered from exported ore [c]	Total	
1907	364,715	222,751	129,630	6,551	6,574	.....	365,506	−791
1908	330,237	180,785	130,881	7,614	7,377	.....	326,657	+3,580
1909	385,113	203,149	149,690	7,202	7,292	.....	367,393	+17,720
1910	382,692	206,132	169,270	8,538	7,603	.....	391,543	−8,851
1911	426,585	200,381	191,614	8,094	7,678	.....	407,767	+18,818
1912	442,126	221,480	171,037	[d] 7,325	10,323	63	[d] 410,228	+31,898
1913	483,113	250,578	161,300	[d] 12,463	10,998	135	[d] 435,474	+47,639
1914	504,769	311,069	201,725	[d] 12,957	11,914	31	[d] 537,696	−32,927
1915	542,098	301,564	205,462	[d] 16,410	12,782	137	[d] 536,355	+5,743
1916	601,392	316,469	235,759	[d] 14,699	13,252	2,001	[d] 582,180	+19,212
1917	628,464	303,679	244,771	[d] 13,035	12,870	4,570	[d] 578,925	+49,539
1918	562,402	282,024	257,881	9,220	13,003	1,388	563,606	−1,204
1919	429,589	208,751	215,682	8,339	[d] 11,179	3	[d] 443,954	−14,365
1920	496,814	220,327	256,522	8,032	[d] 15,212	.....	[d] 500,093	−3,279
1921	414,491	187,962	210,260	6,675	[d] 9,989	.....	[d] 414,886	−395
1922	477,633	185,191	283,555	5,810	13,892	.....	488,448	−10,815
1923	547,217	291,760	252,081	9,794	13,612	.....	567,247	−20,030
	8,019,450	4,094,052	3,467,120	162,818	185,640	8,328	7,917,958	+101,492

[a] Includes desilvered soft lead.
[b] Prior to 1919 includes small quantities recovered from foreign ore.
[c] Recovered at Canadian smelters from ores exported from the United States.
[d] Revised figures.

It is not to be expected, of course, that all the recoverable lead mined during any year will be recovered at smelters and pigment plants that same year. There is always more or less lag; in some years more ore will be left in the bins at the end of the year than there was at the beginning of the year, and this will show as a mine excess—that is, more ore was mined than was smelted; in other years the demand for the metal may exceed the rate of ore production, resulting in depletion of ore stocks and giving a smelter excess—that is, more ore was smelted than was mined. But for a long series of years these factors should balance. The table shows annual smelter or mine excesses ranging from less than 400 tons in 1921 to 50,000 tons at the height of the World War.

The recoverable lead in the ore mined during the 17-year period, as shown by the table, amounted to 8,019,450 short tons, and the total lead recovered in all forms, including that recovered in Canada from United States ores, was 7,917,958 tons, constituting a mine excess of 101,492 tons, equal to 1.3 per cent of the total recovered lead.

An apparent mine excess will be shown if the smelting and refining loss is underestimated, for such a low estimate will give an exaggerated figure for the recoverable lead output of the mines. But a real mine excess results when the working stocks of ore are increased on account of increase in size or number of smelters, and similarly when there is an increase in the amount of lead "in process" at the plants, such as has come about by the increased output of the smelters in recent years. Only a very considerable total mine excess at the end of 1917 could have withstood the drain of over 50,000 tons depletion of ore stocks since that year and still have left more than 100,000 tons at the end of 1923.

LEAD SMELTERS AND REFINERIES

The following smelters and refineries were in operation i

UNITED STATES

California:
Selby—Selby plant, American Smelting & Refining Co. Refine
Colorado:
Durango—Durango plant, American Smelting & Refining Co.
Leadville—Arkansas Valley plant, American Smelting & Refini
Idaho:
Kellogg—Bunker Hill & Sullivan smelter. Refinery also.
Illinois:
Chicago—Goldsmith Bros.' Smelting & Refining Co.[2]
Chicago—Great Western Smelting & Refining Co.[2]
Chicago—Illinois Smelting & Refining Co.[2]
Chicago—U. S. Reduction Co.[2]
Collinsville—St. Louis Smelting & Refining Works of Nation
Refinery also.
Federal—Federal Lead Co.[3]
Indiana:
East Chicago—International Lead Refining Co.[4] Refinery only
Grasselli—U. S. S. Lead Refinery (Inc.).[5] Refinery only. B
lytic process.
Kansas:
Galena—Galena plant, Eagle-Picher Lead Co.
Missouri:
Granby—American Zinc, Lead & Smelting Co.
Herculaneum—St. Joseph Lead Co.
Joplin—Eagle-Picher Lead Co.
Montana:
East Helena—East Helena plant, American Smelting & Refinin
Nebraska:
Omaha—Omaha plant, American Smelting & Refining Co. R
Betts electrolytic process.
New Jersey:
Irvington—Irvington Smelting & Refining Co.[2]
Newark—Balbach Smelting & Refining Co.
Perth Amboy—Perth Amboy plant, American Smelting & Refi
Oklahoma:
St. Louis—Ontario smelter, Eagle-Picher Lead Co.
Pennsylvania:
Carnegie—Pennsylvania Smelting Co. Refinery also.
Texas:
El Paso—Kansas City Consolidated Smelting & Refining Co.[3]
Utah:
Midvale—United States Smelting, Refining & Mining Co.
Murray—Murray plant, American Smelting & Refining Co.
International—International Smelting Co.[4]

CANADA

British Columbia:
Trail—Consolidated Mining & Smelting Co. of Canada (Ltd
also. Betts electrolytic process.
Ontario:
Galetta—Estate of Jas. Robertson.

MEXICO

Aguascalientes:
Aguascalientes—American Smelting & Refining Co.
Chihuahua:
Chihuahua—American Smelting & Refining Co.

[1] Smelters of secondary materials but treating some lead ores.
[2] Subsidiary of American Smelting & Refining Co.
[3] Subsidiary of Anaconda Copper Mining Co.
[4] Subsidiary of United States Smelting, Refining & Mining Co

Coahuila:
Saltillo—Mazapil Copper Co. (Ltd.).
Torreon—Compañía metalúrgica de Torreón.[6]
Durango:
Asarco (Velardeña)—American Smelting & Refining Co.
Guerrero:
Campo Morado—Reforma Mining & Milling Co.
Nuevo Leon:
Cerralvo—Compañía minera de Peñoles (S. A.).[7]
Monterrey—American Metal Co. (Ltd.). Refinery also.
Monterrey—American Smelting & Refining Co.
San Luis Potosi:
Matehuala—American Smelting & Refining Co. (National Metallurgical Co.)
San Luis Potosi—Compañía metalúrgica mexicana.

TRADE CONDITIONS

WORLD'S SMELTER PRODUCTION

In the following table, prepared by W. I. Whiteside, of the United States Geological Survey, the figures in black-faced type are taken from the official statistics of the countries named; those in ordinary type are taken from the yearbook for 1923 of the American Bureau of Metal Statistics, an association of the copper producers, the lead producers, and the principal zinc producers of this country. The official statistics will be substituted when they are available.

There is always a possibility of duplication in figures showing world's production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are often included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

World's production of lead, 1913, 1918–1923

[In metric tons, by countries where smelted, but not necessarily refined. Figures in black-faced type are official]

Country	1913	1918	1919	1920	1921	1922	1923
Australia	110,444	163,376	83,408	5,474	51,452	105,126	124,752
Austria	22,312	4,743	1,764	3,973	3,347	3,360	4,255
Belgium	53,530	20,630	4,225	16,040	29,750	43,580	51,100
Canada	17,202	17,005	16,143	13,733	28,274	40,798	48,897
Chosen		264	653	585	(a)	(a)	(a)
Czechoslovakia	(b)	(a)	(a)	2,006	(a)	(a)	(a)
France	28,817	12,778	10,928	15,060	15,475	13,944	14,000
Germany:							
Upper Silesia	41,300	23,960	18,580	18,006	13,743	•6,188	(c)
Other Germany	146,667	40,617	39,006	52,495	70,487	57,500	(a)
Great Britain	18,420	11,083	10,441	11,136	2,474	5,036	6,815
Greece	18,309	4,093	3,841	5,016	5,575	4,408	4,235
Hungary	1,137	(a)	(a)	(a)	(a)	(a)	(a)
India (Burma)	5,951	19,380	19,396	24,203	34,258	39,843	46,484
Italy	21,674	18,332	16,530	15,947	12,494	10,710	17,132
Japan	3,777	10,684	5,771	4,167	3,138	3,239	3,000
Mexico	57,488	83,705	76,384	82,480	58,586	114,235	121,607

• Data not available.
[b] Included under Austria.
[c] First six months; for second six months see Poland.
[d] See Poland.
[6] Subsidiary of Compañía minera de Peñoles (S. A.).
[7] Subsidiary of American Metal Co. (Ltd.).

World's production of lead, 1913, 1918–

Country	1913	1918	1919	1
land:				
Upper Silesia	(a)	(a)	(a)	
Other Poland	(a)	(a)	836	
desia	295	9,935	12,859	1
mania	(a)	(a)	544	
sia	1,000	(a)	(a)	
th America	2,476	4,781	6,505	
ain	198,829	169,709	125,721	17
eden	1,235	2,241	827	
nis		16,533	5,800	
rkey	13,900	2,500	1,000	
ited States (refined)	385,643	503,703	391,982	4
goslavia	(b)	(a)	5,727	
known production	1,150,000	1,140,000	859,000	9

[a] Data not available.
[b] Included under Austria.
[c] See Germany.
[d] Second six months; for first six months see Germany.
[e] Included under Russia.

IMPORTS AND EXPO

The following tables were compiled from ... Foreign and Domestic Commerce by J. ... States Geological Survey.

Lead remaining in warehouse in the United States ... pounds

[Stated in the form in which the material was en...

	1919	1920
Ore	29,543,811	32,923,299
Base bullion	61,408,873	69,517,026
Pigs, bars, and old	468,154	2,644,576

Lead imported for consumption in the Uni...

Year	Lead in ore •		Base bullion		Pigs, bars, and old	
	Pounds	Value	Pounds	Value	Pounds	Value
1919	4,106,823	$196,363	31,796,693	$1,130,937	10,174,115	$415,...
1920	13,700,499	908,619	66,816,820	3,340,600	68,901,959	3,887,...
1921	6,842,807	327,046	56,819,980	1,668,410	61,909,094	1,972,...
1922	•23,649,851	812,603	55,859,422	1,815,142	•8,563,110	• 335,...
1923	•22,420,046	1,190,414	11,124,151	626,201	•42,925,265	•2,510,...

• Includes also lead in matte beginning Sept. 22, 1922.
• Includes also imports of antimonial lead, antimonial scrap lea... Sept. 22, 1922.

Type metal imported for consumption in the U...

Year	Type met...	
	Pounds	
1919	13,394,803	
1920	29,887,353	
1921	38,971,351	
1922	43,365,120	
1923	(a)	

[a] Figures not available.

General imports of lead into the United States, 1919–1923, by classes, in pound

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1919	10, 573, 856	112, 024, 518	10, 214, 753	141, 813, 1
1920	29, 488, 810	96, 103, 603	71, 437, 108	197, 029, 5
1921	14, 234, 030	71, 733, 838	62, 602, 534	148, 570, 4
1922	24, 474, 481	124, 074, 465	7, 101, 623	155, 650, 5
1923	66, 882, 850	101, 496, 495	42, 198, 848	270 578, 1

General imports of lead into the United States, in ore, base bullion, and refined, 191 1923, by sources, in pounds

Year	Canada	Mexico	South America	Europe	Other countries	Total
1919	10, 391, 115	125, 541, 614	5, 504, 416	89, 840	286, 142	141, 813, 1
1920	8, 199, 234	131, 815, 278	7, 085, 351	38, 766, 504	11, 163, 160	197, 029, 5
1921	8, 127, 158	106, 400, 238	2, 381, 365	30, 224, 701	1, 430, 949	148, 570, 4
1922	8, 663, 236	141, 216, 136	3, 803, 478	1, 454, 384	513, 335	155, 650, 5
1923	11, 399, 671	242, 352, 788	5, 300, 161	11, 004, 938	520, 635	270, 578, 1

The high price of lead shortly before and during the World Wa made it profitable to export domestic lead. Beginning in March 1914, the exports soon reached large quantities, but they declined rapidly after the war.

Refined lead, made from domestic ores, exported from the United States, 1914–192

Year	Short tons	Value	Year	Short tons	Value
1914	58, 722	$4, 501, 674	1919	10, 510	$1, 471, 2
1915	88, 306	7, 928, 518	1920	2, 730	462, 22
1916	100, 500	13, 494, 065	1921	1, 624	177, 92
1917	53, 688	9, 560, 598	1922	5, 823	604, 60
1918	41, 831	5, 889, 381	1923	1, 909	260, 48

The lead of foreign origin which has been smelted, refined, or manufactured in this country and then shipped abroad is shown below.

Foreign lead exported from the United States, 1919–1923

Year	Exported from warehouse			Exported in manufactures with benefit of drawback (pounds)
	Pigs, bars, and old *		All other manufactures	
	Pounds	Value		
1919	81, 951, 396	$4, 536, 273	$44	3, 872, 130
1920	34, 725, 501	2, 570, 535	35, 146	12, 350, 794
1921	50, 000, 259	2, 284, 107	613	18, 738, 927
1922	64, 709, 305	3, 177, 360	146	11, 354, 070
1923	97, 471, 328	5, 195, 258	(b)	25, 052, 107

* Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has classed all foreign lead smelted or refined in this country and exported as "domestic exports of pigs, bars, etc., produced from foreign ore." The above figures include also the exports of foreign lead imported in the form of pigs and bars.
b Not separately classified in 1923.

mestic and foreign pig lead exported from the Uni nations

[Figures in parentheses are not duplicated

Destination	Dor
	Short tons
1922	
	305
Japan	(246)
Philippine Islands	(38)
alia and Oceania	1
	337
	84
	3, 819
	(112)
Denmark	(1, 737)
France	(594)
Germany	(1, 374)
Great Britain	(1)
Netherlands	78
	1, 120
th America	(337)
Argentina	(456)
Brazil	
Uruguay	1
ama	78
ther countries	
	5, 823
1923	
	124
Japan	(112)
Philippine Islands	(8)
straila and Oceania	126
anada	104
uba	690
urope	
Denmark	(336)
France	(*)
Germany	(185)
Great Britain	(112)
Netherlands	96
exico	743
outh America	(384)
Argentina	(257)
Brazil	(34)
Uruguay	58
anama	58
ther countries	
	1, 909

Less than 1 ton.

CONSUMPTION

Apparent consumption of refined primary lead in th disregarded, in short tons, 19

	1919	
upply:		
Stock in bonded warehouse Jan. 1	472	
Imports of pigs, bars, and old	6, 107	
Production	482, 220	
	487, 799	
ithdrawn:		
Exports of foreign lead—		
From warehouse	40, 976	
In manufactures, with benefit of drawback	1, 936	
Exports of domestic lead	10, 510	
Stock in bonded warehouse Dec. 31	234	
	53, 656	
Apparent consumption	434, 143	

CUSTOMS DUTIES ON LEAD

In the chapter on lead in Mineral Resources for 1922 there was a tabular comparison of the duties on lead in ore and as metal imposed in the tariff acts of 1909, 1913, and 1922. The tariff act of 1922 contains the following paragraphs relating to lead ore and lead in metallic forms:

Par. 392. Lead-bearing ores and mattes of all kinds, 1½ cents per pound on the lead contained therein: *Provided*, That such duty shall not be applied to the lead contained in copper mattes unless actually recovered: *Provided further*, That on all importations of lead-bearing ores and mattes of all kinds the duties shall be estimated at the port of entry and a bond given in double the amount of such estimated duties for the transportation of the ores or mattes by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores or mattes at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments and who shall submit the samples thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

Par. 393. 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, 2½ cents per pound on the lead contained therein; lead in sheets, pipe, shot, glazier's lead, and lead wire, 2⅝ cents per pound.

PRICES AND VALUE

Lead was quoted for immediate delivery in New York at the beginning of 1923 at 7.23 cents a pound. The price rose to 8.6 cents in March, dropped to 6 cents by the middle of July, and after a sharp recovery to 6.65 cents in August remained nearly stationary until December, when a sharp rise brought it to 8.12 cents at the end of the year.

The average quoted price of lead for prompt delivery at New York for the year was 7.4 cents a pound, as compared with an average quoted price of 5.7 cents in 1922. The average selling price, figured on the total sales during the year, was 7 cents, as compared with 5.5 cents in 1922. The average selling price is used in calculating the value of lead produced from domestic ores in the United States.

Prices quoted on lead by the American Smelting & Refining Co. in 1923, in cents a pound

Jan. 9	7.40	May 9	7.25	July 27	6.50
Jan. 10	7.50	June 21	7.00	Aug. 27	6.75
Jan. 22	7.75	July 2	6.65	Sept. 13	6.85
Jan. 23	8.00	July 3	6.50	Oct. 25	6.75
Feb. 23	8.10	July 5	6.35	Nov. 13	6.85
Mar. 1	8.15	July 6	6.25	Dec. 1	7.00
Mar. 2	8.25	July 9	6.10	Dec. 5	7.25
Apr. 19	8.00	July 10	6.00	Dec. 19	7.40
Apr. 28	7.75	July 23	6.25	Dec. 29	7.50
May 3	7.50				

The London price of lead ranged from about 2 to about 3 cents lower than the New York price through the first half of the year,

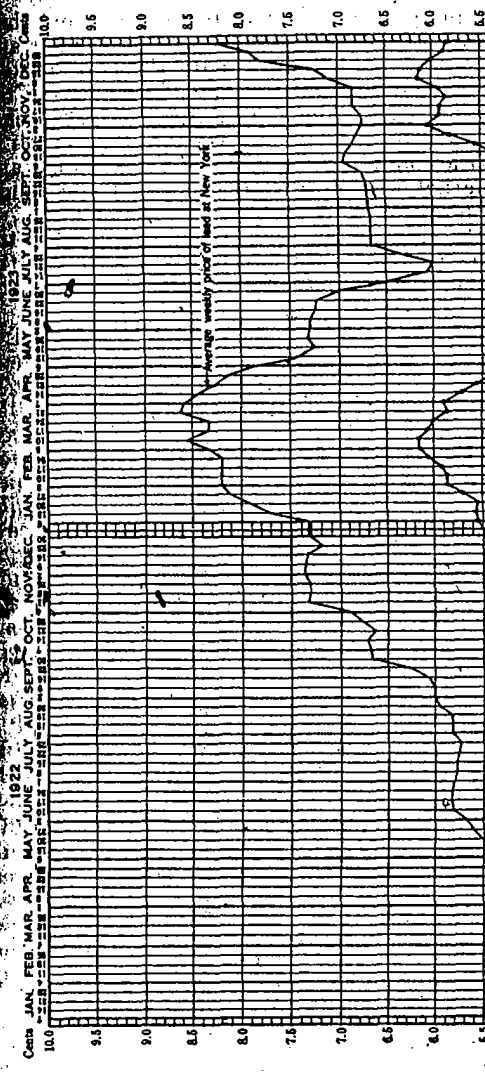

FIGURE 5.—Average weekly quoted price of lead at New York exchange being taken into accou

but in July the decline in price at New York left scarcely more than a cent difference in the price in the two markets. In November and early December the rise in lead at London brought the two markets within less than a cent of each other, but by the end of the year the spread was equal again to more than the tariff differential, 2½ cents a pound. These facts are shown in a striking way by the graphs in Figure 5, which take into account the fluctuations in exchange and show that the London market was more responsive to trade conditions than the New York market.

As stated on page 129, the value of the refined lead produced in the United States from domestic ores in 1923 was $76,138,000 at the average price of refined lead, as compared with $51,562,000 at the average price in 1922, a gain of 48 per cent.

MANGANESE AND MANGANI

By HELENA M. MEY

INTRODUCTION

The year 1923 marked an interesting pe
manganese industry, affording the first cha
of what domestic operators would produce
Although the tariff became effective Septe
not sufficient time before the end of that ye
not a large increase in production would
shipments in 1922 were slightly lower than
shipments of ore containing 35 per cent o
creased to more than two and one-third tim
considerably less than tariff advocates ho
amounted to only a little over 4 per cent of th
for the production of ferromanganese in 19
was slightly less than in 1923. Sixty-two
high-grade ore shipped in 1923 was chemi
Mont., and a large part of the remainder wa
ferromanganese.

The imports of manganese ore in 1923
1918, when domestic production was nearl
1923. The domestic production plus impo
tons) was less than three-fifths of product
(797,000 gross tons). As nearly 95 per cen
in industries in the United States is consu
ferromanganese and spiegeleisen for steel
assumption from the foregoing comparison
bly less steel was produced in 1923 than in
however, there was an increase in steel pr
gross tons in 1918 to 44,943,696 gross tons
only in 1917 (45,060,607 tons). The large
was possible, in spite of the low total of
imports of manganese, mainly because large
ore were imported and stocked at the furna
1922, and because in both 1922 and 1923
imported than in any other year since 1913

In 1923 an average of about $28 a ton
manganese ore, compared with about $
decrease is apparently due to the fact that
large part contained only from 35 to 45
whereas in 1922 little of this grade was
containing 50 per cent or more.

Nickel, nickel oxide, and matte exported from the United States, 1917–1923

Year	Pounds	Value	Year	Pounds	Value
1917	21,992,820	$8,936,620	1921	425,851	$103,87
1918	17,469,500	6,927,041	1922	9,317,520	1,015,0
1919	3,810,656	1,607,544	1923	• 11,200	•
1920	1,215,232	574,845			

• Nickel oxide and matte only. Separate figures for nickel not available. See following table.

Beginning with 1922, additional classes of nickel exports were shown. The complete exports for 1922 and 1923 are given in the following table:

Nickel exported from the United States in 1922 and 1923, by classes

Class	1922		1923	
	Pounds	Value	Pounds	Value
Oxide and matte	9,311,680	$1,013,060	11,200	$
Nickel	5,840	3,022	868,158	307,2
Monel metal and other alloys	913,983	196,702		
Manufactures	240,467	179,094	488,088	290,4
Nickel or German silver in bars, rods, or sheets	402,922	121,755	481,178	146,5

TANTALUM

Tantalum and its close associate, columbium, are yet among the experimental metals—those which possess attractive properties but which have not been shown to have extensive uses that some other and cheaper metal or alloy will not serve as well or better. With the numberless new uses for the elements and their alloys and compounds that constant experimentation is developing, it seems probable that for these metals also places will be found that they will fill better than any others.

To obtain these metals in a pure state, or a state of purity comparable to that of the iron, aluminum, or copper of ordinary commerce, is very difficult and tedious, though not impracticable, as it is with vanadium. However, like vanadium, they can be made into ferroalloys with comparative ease. Several patents for their use in steel have been taken out, but the steels have been made only in experimental lots. So far as is known, the steels made have all contained both tantalum and columbium, and it is therefore not known what the effect of either metal alone would be.

The only known output of ores of these metals made in the United States for several years has been that shipped by Dr. A. T. Roos, Rapid City, S. Dak., who states that the production of columbite in 1923 was 1,350 pounds,[8] valued at $540, and in 1922 was 600 pounds, valued at $240. In 1921 Doctor Roos shipped 3,400 pounds of columbite guaranteed to contain 70 per cent of the combined tantalum and columbium oxides. The material was valued at about $1,150. The columbite came from pegmatite dikes near Keystone and Hill City, in the southern part of the Black Hills. Previous shipments by Doctor Roos have been as follows: 1920, 4,000 pounds, valued at $1,450; 1919, 300 pounds, valued at $90; 1918, 4,500 pounds, valued at $2,250;

[8] Figures are published with the express permission of Doctor Roos.

[illegible] the ore is thought to have been used for experi[illegible]ost of it in ferro-tantalum-columbium, without [illegible]ro metals.

No imports of tantalum ores were recorded in 1[illegible] the Bureau of Foreign and Domestic Commerc[illegible]ounds of "tantalum steel-hardening ores," value[illegible]mported for consumption in 1923.

American ores are not sufficiently free from co[illegible]hem suitable for the manufacture of tantalu[illegible]rocesses.

During the year the Fansteel Products Co., o[illegible]ll., placed on the market a charger for storage [illegible]antalum is used as an electronic valve.

TITANIUM

During 1923 the American Rutile Co. (owned[illegible] Metal Corporation, 120 Broadway, New Yo[illegible]quarry at Roseland, Nelson County, Va., a part[illegible]produced 270 short tons of rutile concentrates c[illegible]er cent of titanium dioxide and as a by-proc[illegible]lmenite concentrates carrying about 52 per cent of[illegible] The production of rutile and ilmenite from this[illegible]he last five years has been as follows:

[illegible]le and ilmenite produced by American Rutile Co., 191[illegible]

Year	[illegible]
[illegible]919	
[illegible]920	
[illegible]921	
[illegible]922	
[illegible]923	

[illegible] Buckman & Pritchard (Inc.), a subsidiary of t[illegible]ment Co. (Inc.), with works at Niagara Falls, N[illegible]beach sands 4 miles south of Pablo Beach, Fla., [illegible]has been concentrated between high and low tide[illegible]also contains considerable zircon, a little rutile, and[illegible] During the year 5,804 tons of ilmenite carrying pro[illegible]cent of titanium dioxide was shipped to Niagara F[illegible]the manufacture of both titanium pigment by t[illegible]ment Co. (Inc.) and ferrotitanium by the Titaniu[illegible]ffiliated company. This is an increase of 1,223 t[illegible]ments in 1922. The company also shipped 153 ton[illegible]the year.

The use of titanium pigment is growing. The[illegible] not used alone but is precipitated with barium o[illegible]both, so that titanium dioxide forms only about 2[illegible]mass. Even this is not used alone for most work, [illegible]"chalk." It is therefore mixed with zinc oxide a[illegible]form an excellent pigment. In the manufacture [illegible]is of course advantageous to start with as pure a[illegible]sible, because the iron and other impurities must

iron is the most troublesome of the impurities, because it was
chemical reagents and has a high coloring power.

The price of concentrated rutile ranges from 10 to 25 cents
pound, depending on quality, quantity, fineness of grinding, an
other factors. The price of ilmenite ranges from $15 to $25 a sho
ton.

The imports of "titanium-potassium oxalate and all compound
and mixtures containing titanium" in 1923 amounted to 39,76
pounds, valued at $6,423. In 1922, after September 22, when th
new tariff became effective, the imports were 82,544 pounds, value
at $20,596. The duty is 30 per cent ad valorem.

The market for rutile, used mostly for arc-light electrodes and fo
potassium-titanium oxalate to be used in dyeing and in the manu
facture of leather, is small, and that for ilmenite, to be used in fe
rotitanium, is apparently not growing much, but the use of ilmeni
in the manufacture of pigments is increasing and the substitution
of titanium oxide pigments for white lead should increase ver
greatly and tend to conserve the supply of lead for other uses.

TUNGSTEN

In 1923 the first domestic tungsten ore mined in three years wa
produced by the Wolf Tongue Mining Co. and the Vasco Mining Co
in the Boulder field, near Nederland, in Boulder County, Colo. Th
two companies produced and shipped an equivalent of 241 sho
tons of ferberite concentrates carrying 60 per cent of tungsten tr
oxide, though the ore shipped ranged from 55 to 63 per cent.

William Loach, manager for the Wolf Tongue Mining Co., esti
mates that tungsten can not be mined in Boulder County at a cos
of less than $12 a unit, and this figure probably does not include
amortization. There are few if any known deposits in the United
States that can be profitably operated even at that price. The duty
on tungsten ore ($7.14 a unit) has thus far not stimulated mining
but has benefited those holding ores in stock. The Vasco Mining Co
closed its mines and mills and probably will not again open them
Both companies operated because they were largely owned by steel
companies that used the ore themselves even though it cost more than
the market price.

Chinese ores, as before, dominated the world's markets. Th
centers of production are reported to have swung southwestward
from Kiangsi to northern Kwangtung. It is said that Chinese co
centrates can be landed in New York or London at $2.75 or less
long-ton unit.

Ore still reaches England from the Malay Peninsula and Burma
These countries continue to produce considerable quantities of or
because it is obtained mixed with cassiterite, which commanded
fairly good price during 1923, though probably not what would be
a normal price if Europe were back to a peace-time business basis.

Owing to the disturbed conditions the European demand for
tungsten was poor during 1923, so that the very cheap and good
Chinese ore seeking a market, in connection with the large stocks
of tungsten ores, ferrotungsten, tungsten powder, scrap alloy steel

id scale held in the United States, kept price
han $3 above the duty.

Prices in the United States ranged from $7.
olframite and $8 for scheelite at the beginnin
, depending on quality, for Chinese wolframi
e at the end of the year. The price of ferro
93 per cent of tungsten ranged from 88 to 9
ontained tungsten; some was forced on the m
923 at 75 to 80 cents a pound.

Prices in England for wolframite carrying
ent of tungsten trioxide were, at the beginnin
8s. 6d. per long-ton unit (22.4 pounds WO_3)
errotungsten carrying 80 to 85 per cent of tu
bout 1s. 5d. throughout the year, and tungste
the beginning of the year and 1s. 9d. at the
ould probably have been shaded had there be
usiness.

Never since tungsten became an article of tr
f tungsten used and the quantity in stock been
ew among those most familiar with the trade
stimates of either quantity. Throughout 1923
ar apart, and a canvass of the industry was th
ircular letters, which were sent to every per
have tungsten in any form at any time afte
hen the new duty went into effect. The inqu
n November 1, 1923, because the first letters
date. Some firms, however, did not find it c
the figures at once, and for some other reason
bling the statistics occupied an unexpectedly
onse to the rather tedious inquiries was grat
ery few found it inexpedient to give the data
Although the tungsten used in making in
ments, contact points, and chemicals has a
comparison with equal quantities used in steel
teel put in hairsprings is not to be compared in
sed in rails, the quantities used for these purp
hey affect the general market very little, so t
f tungsten is fixed by its use in steel.

In the following table all items are reduce
n short tons (2,000 pounds) of ore carrying 60
trioxide. Ore "used" means ore put in a fi
tool steel, lamp filaments, or chemicals. Ferrot
powder are regarded as intermediate products
the ore for use. Stocks "on hand" include all
producers, investors, and users and in warehous
In estimating the quantity of ore represented
f tungsten powder or ferrotungsten the tungs
has been multiplied by 2.5 on the supposition th
metallurgical practice about 800 pounds of t
from a short ton of ore carrying 60 per cent
Some will probably disagree with this estimat
mployed is stated, corrections can be made as d