

MINER YEARBOOK

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Lead¹

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GENERAL SUMMARY

AT THE beginning of 1950, lead producers, having witnessed in 1949 one of the most precipitous market price declines in the history of the industry, were gravely concerned over the lack of consumer demand and the possibility of rapidly accumulating surpluses. This anxiety was further increased several months later by rumors within the trade that Government purchases of lead for the National Strategic Stockpile were to be discontinued in July. There was little evidence that smelter and refinery stocks of lead and material in process would decline from the abnormally high levels prevailing during the first quarter of the year. On January 1, 1950, stocks were higher than at any similar date since January 1, 1939. The lack of confidence in price stability was further evidenced during the first months of 1950 by consumers' cautious buying, which caused a further depression in the market quotation from 12 cents per pound on January 1 to 10½ cents on March 14.

With the outbreak of the war in Korea in late June and the acceleration of the National Defense Program that followed immediately thereafter, industrial activity increased. Consumers recalling the difficulties experienced in obtaining full requirements of lead in World War II promptly abandoned the prudent buying practices used early in 1950. Demand increased rapidly, and lead shipments from primary refineries, which had dropped as low as 21,855 tons in February, advanced to 47,031 tons in August and to over 62,000 tons in October. Lead prices strengthened throughout the summer and early fall, reaching 17 cents per pound at the end of October.

The net effect of the abrupt mid-year change was record-breaking in several instances. Total domestic lead consumption increased 29 percent over 1949 and was the largest quantity ever recorded. Mine output increased to the highest level since 1943, and imports reached a record-shattering total of 541,864 tons, a gain of 36 percent over the record peacetime high in 1949. Recovery of lead from secondary sources, which had been decreasing since 1947, gained 17 percent in 1950 and exceeded domestic mine output for the fifth consecutive year.

Despite the unpredicted rise in demand for lead during the latter part of the year, there was no apparent stringency in lead supply until just before the year end. On December 28, 1950, the National Pro-

¹ This report deals primarily with the smelting, refining, and consuming phases of the industry. For details of mining operations, see the various State chapters of this volume.

LEAD

duction Authority issued an antihoarding order among other scarce materials, and lead was sold in quantities needed for "personal, or home consumption."

Labor difficulties during the year were not to the extent of 1948 and 1949. There were indications of a decline in the mining districts, which forecast a possible drop in domestic mine production in 1951.

TABLE 1.—Salient statistics of the lead industry, 1941-45 (average) and 1946-

	1941-45 (average)	1946-
Production of refined primary lead:		
From domestic ores and base bullion...	419,081	
From foreign ores and base bullion...	84,072	
Total.....	503,153	
Recovery of secondary lead.....	351,333	
Imports (general):		
Lead in pigs, bars, and old.....	268,009	
Lead in base bullion.....	14,042	
Lead in ores and matte.....	78,999	
Exports of refined pig lead.....	7,047	
Consumption of primary and secondary lead.....	1,076,249	
Prices (cents per pound):		
New York:		
Average for period.....	6.35	
Quotation at end of period.....	6.37	
London average for period.....	4.59	
Mine production of recoverable lead ¹	443,734	
World smelter production of lead.....	1,605,000 ¹¹	

¹ Includes Alaska.
¹¹ Revised figure.

DOMESTIC PRODUCTION

Statistics on lead output may be based on a smelter and refinery basis. Mine-production of lead, based on lead content in ores and concentrates, is a better measure of losses in smelting, are a better measure of lead output to year and are most accurate for short periods of production. Pig-lead output, as reported, presents a more precise figure of actual production, but only in a general way the source of domestic and refinery output generally differs from the lag between mine shipments and refinery output.

MINE PRODUCTION

Domestic mine output of recoverable lead in 1950 compared with 1949 and was the largest quantity produced during the first half of the year, consistently above the 1,180-ton average for the year. Production during the latter half of the year was somewhat below the annual average, and the daily output, which remained below the annual average.

Production in 11 of the 22 lead-producing States in 1950 exceeded the rates established in 1949. In California the production surpassed any other year in the State's history, and a similar record was established in Washington. Not since 1927 have Colorado mines produced as much lead as was recovered in 1950. Lead output in Idaho, Montana, and Oklahoma reached the highest point since 1942, and production from Missouri mines approached the 1946 output.

Of the total lead produced at United States mines in 1950, 69 percent came from 25 properties. Missouri continued to rank first among the States in the production of lead, and the Southeastern Missouri district continued to be the largest lead-producing area, supplying 31 percent of the total domestic output. As in previous years, the St. Joseph Lead Co. produced the bulk of the output from its Bonne Terre, Desloge, Federal, and Leadwood mine groups in St. Francois County and the Mine La Motte property in Madison County. Each mine is equipped with a mill; the five have a combined daily capacity of about 28,800 tons of ore. In Madison County the National Lead Co., St. Louis Smelting & Refining Division, operated its Madison lead-copper mine and 1,200-ton flotation mill at Fredericktown. The Catherine-Fleming mine was operated part of the year by the Fredericktown Lead Co.

The Tri-State district produced 7 percent of the total domestic lead output in 1950. Owing to low concentrate prices, production was retarded during the first quarter of the year. In the second quarter increased zinc prices stimulated ore production somewhat, but the greatest gain in output occurred in the latter half of the year when the zinc price continued to advance and the lead quotation rose sharply. The five leading Tri-State lead-producing companies in 1950, in order of output, were: Eagle-Picher Mining & Smelting Co., Nellie B. Mining Co., National Lead Co. St. Louis Smelting & Refining Division, Federal Mining & Smelting Co., and the W. M. & W. Mining Co. In December 1950 there were 16 mine mills, 1 tailings mill, and 3 clean-up mills operating, compared with 18 mine mills, 1 tailings mill, and 1 clean-up mill operating in December 1949. About 80 mines were operating in December 1950, compared with 85 in December 1949. Increased activity in open-pit operations during the year indicated the growing importance of this mode of mining in the district.

Mine production of recoverable lead in the combined Western States increased 6 percent in 1950. During the year lead mines in the region contributed nearly 60 percent of the total domestic production compared with 59 percent in 1949.

Idaho continued to be the largest producer of lead in the Western States and second only to Missouri in the United States. In 1950, 95 percent of all Idaho lead came from the Coeur d'Alene region. The Bunker Hill & Sullivan mine at Kellogg was by far the largest producer. Other large producers, all in the Coeur d'Alene region, included the Page, Star, Morning, Sherman, Dayrock, and Sidney mines. These seven properties accounted for 70 percent of the State total lead output, 78 percent of which came from zinc-lead ore and old tailings.

Lead production in Utah in 1950 declined 16 percent from the 1949 output largely as a result of a shut-down of the United States & Lark property at Bingham. The Lark mine was closed from July 16 through October 28 because of a fire in the lower levels; the United

States mine was idle 2 months owing to difficulties, which reduced lead output. In 1949, the United States & Lark property was the largest producer of lead in Utah. Productive properties, Chief Consolidated Mines Co., New Park Mining Co., Coalition Mines Co., and Hidden Valley Mines Co. supplied 95 percent of the State total lead output. 95 percent was recovered from zinc-lead ore.

Lead production from Colorado mines in 1950 exceeded the record level established in 1949 and was the largest since 1949. Producing mines, in order of rank, were: Tunnel-Black-Bear (Idarado), Smelterville, and Emperius Mining Co. group. Zinc-lead ore accounted for 95 percent of the State total lead in 1950.

The output of lead in Arizona in 1950 exceeded the record level established in 1949 owing to a substantial gain in production of zinc-lead ore from the Copper Queen mine. Lead production at the Copper Queen mine continued as the largest producer of lead, in order of output, followed by the Tiger, Iron King mine at Humboldt, and the Flux group near Patagonia, and the Emma mine at Butte. About 92 percent of the total lead production was recovered from zinc-lead ore, and the remainder from lead ore.

Montana's production of recoverable lead in 1950 increased 11 percent owing to a substantial gain in production from the Butte Hill mines and dumps of the Anaconda company-owned operations. Lead production accounted for 11 percent of the State lead; other important sources were the Emma mine at Butte, the Mike Jack mine in Sanders County, and the Jack Waite mine in Sanders County. About 87 percent of the total lead production was recovered from zinc-lead ore, and the remainder from lead ore.

The closing of the Copper Canyon mine in Esmeralda County, Nev., early in June 1950, resulted in a 11-percent decline in lead production in 1950 compared with 1949. The Pioche district, Lincoln County, was the principal source of Nevada's lead output. Lead production accounted for 11 percent of the State's total production. The leading producers were the Pioche group, including the Pioche mine; Ely Valley group, including the Copper Canyon mine; Ely Valley group, including the Bristol Silver Mines Co., Bristol mine; and the Delno mine. Nearly 73 percent of the total lead production was recovered from zinc-lead ore.

California 1950 lead production exceeded the record level established in 1949. The new record was achieved largely as a result of the development of the Darwin group by the Shoshone group, Resting Spring district. Lead production accounted for 11 percent of the State's total lead output. That adequate lead and zinc-lead ore was available for the continuity of operation at both properties was a factor in the record production.

important lead mines operated in California in 1950 included the Coronado Copper and Zinc Co., Afterthought mine; Lewis Warnken, Jr., Gold Bottom mine dump; George Lippincott, Lead King mine; and Finley and Vignich, Minnietta mine.

Lead production in Washington in 1950 increased 61 percent over 1949; this was the largest annual output of any year in the State's history. Largely responsible for the record production were substantial increases in output from the Grandview mine in Pend Oreille County and the Bonanza mine in Stevens County. Lead production declined slightly at the Deep Creek and Anderson mine in Stevens County and at the property of the Pend Oreille Mines & Metals Co. in Pend Oreille County. These properties supplied over 99 percent of the Washington lead in 1950. About 72 percent of the total output was derived from zinc-lead ore and nearly all the remainder from lead ore.

Lead production in New Mexico in 1950 declined 11 percent from the 1949 output. The principal producers during the year were the Groundhog mine in the Central district, Lynchburg property in the Magdalena district, Bayard mine in the Central district, and Portales mine in the Hansonberg district. Over 55 percent of the State total lead in 1950 was recovered from zinc ore, 25 percent from zinc-lead ore, and most of the remainder from lead ore.

TABLE 2.—Mine production of recoverable lead in the United States, 1941-45 (average) and 1946-50, by States, in short tons

State	1941-45 (average)	1946	1947	1948	1949	1950
Western States and Alaska:						
Alaska.....	206	115	264	320	51	140
Arizona.....	16,742	23,930	28,666	29,809	33,568	26,383
California.....	5,468	9,923	10,080	9,110	10,318	15,831
Colorado.....	16,106	17,036	18,696	25,143	26,853	27,007
Idaho.....	93,451	69,987	78,944	88,544	79,299	100,025
Montana.....	10,148	8,280	16,108	18,411	17,990	19,617
Nevada.....	6,534	7,175	7,161	9,777	10,626	9,408
New Mexico.....	5,985	4,890	6,383	7,653	4,652	4,150
Oregon.....	18	2	12	7	12	17
South Dakota.....	32	—	8	16	4	—
Texas.....	70	47	78	170	132	120
Utah.....	60,025	30,711	49,098	55,050	53,072	44,763
Washington.....	4,681	2,987	5,359	7,147	6,417	10,334
Wyoming.....	1	—	—	—	—	—
Total.....	225,533	165,092	221,357	252,150	243,000	257,803
West Central States:						
Arkansas.....	3	2	18	22	1	9
Kansas.....	9,087	6,445	7,286	8,580	9,772	9,487
Missouri.....	180,325	130,112	132,246	102,288	127,522	134,020
Oklahoma.....	18,834	13,697	14,289	16,018	19,858	20,724
Total.....	209,149	159,256	153,838	127,014	157,153	164,846
States east of the Mississippi River:						
Illinois.....	2,348	3,805	2,325	3,605	3,824	2,729
Kentucky.....	231	95	214	216	187	60
New York.....	1,879	1,073	1,496	1,231	1,317	1,484
Tennessee.....	103	125	22	—	257	113
Virginia.....	3,200	4,381	3,803	4,703	3,313	3,254
Wisconsin.....	1,222	1,688	1,166	681	857	532
Total.....	9,052	11,127	9,026	10,706	9,765	8,178
Grand total.....	443,734	335,475	384,221	390,476	409,908	430,827

Mine production of lead in State came from properties in Illinois, Virginia, and Wisconsin and was lead of zinc and fluorspar mining. Most of this region in 1950 can be attributed to fluorspar mines and to the closing of Illinois by the Alco Lead Corp., in latter part of 1949. Zinc-lead mine in Illinois also recorded declines in production owing to the closing on May 15 of Hyatt mine in New York. A labor shortage at the New Jersey Zinc Co. from October 1949 to January 1950 resulted in a 2-percent decrease in the output.

TABLE 3.—Mine production of recoverable lead in the United States, 1946-50, that produced 1,000 tons or more during 1946-50, in short tons

District	State
Southeastern Missouri region.....	Missouri.....
Coeur d'Alene region.....	Idaho.....
Tri-State (Joplin region).....	Kansas, southwestern Missouri, Oklahoma.....
West Mountain (Bingham).....	Utah.....
Summit Valley (Butte).....	Montana.....
Coso (Darwin).....	California.....
Warren (Blanco).....	Arizona.....
Upper San Miguel.....	Colorado.....
Park City region.....	Utah.....
Metaline.....	Washington.....
Pioche.....	Nevada.....
Tintic.....	Utah.....
California (Leadville).....	Colorado.....
Old Hat.....	Arizona.....
Big Bug.....	Arizona.....
Austinville.....	Virginia.....
Animas.....	Colorado.....
Pima (Sierritas, Papago, Twin Buttes).....	Arizona.....
Warm Springs.....	Idaho.....
Bossburg.....	Washington.....
Central.....	New Mexico.....
Red Cliff.....	Colorado.....
Harshaw.....	Arizona.....
Upper Mississippi Valley.....	Iowa, northern Illinois, Wisconsin.....
Bayhorse.....	Idaho.....
Kentucky-Southern Illinois.....	Kentucky, southern Illinois.....
Aravapo.....	Arizona.....
St. Lawrence County.....	New York.....
Creede.....	Colorado.....
Rush Valley & Smelter (Tooele County).....	Utah.....
Pioneer (Rico).....	Colorado.....
Eagle.....	Montana.....
Opbir.....	Utah.....
Heddlerton.....	Montana.....
Magdalena.....	New Mexico.....
Ten Mile.....	Colorado.....
Bnefels.....	Colorado.....
Tomichi.....	Colorado.....
Battle Mountain.....	Nevada.....
Eureka.....	Colorado.....
Northport (Aladdin).....	Washington.....
Modoc.....	California.....
Alder Creek.....	Idaho.....
Resting Springs.....	California.....

¹ Figure not shown in order to avoid disclosure of individual mine production.

² This district is not listed in order of 1950 output.

TABLE 4.—Twenty-five leading lead-producing mines in the United States in 1950, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
2	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Zinc-lead.
3	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co.	Do.
4	Leadwood	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
5	Butte Hill mines and dumps	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co.	Zinc-lead.
6	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
7	Yreka	Southeastern Missouri	Idaho	Federal Mining & Smelting Co.	Zinc-lead.
8	Bonne Terre	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
9	Darwin group	Coso	California	Anaconda Copper Mining Co.	Do.
10	Star	Hunter	Idaho	Anaconda Copper Mining Co.	Zinc-lead.
11	Copper Queen	Warren (Bisbee)	Arizona	Phoenix Copper Mining Co.	Do.
12	Shoshone group	Resting Springs	Idaho	Shoshone Copper Mining Co.	Lead.
13	Madison	Southeastern Missouri	Missouri	Federal Mining & Smelting Co.	Zinc-lead.
14	Norling	Hunter	Idaho	Combined Metals Reduction Co.	Do.
15	Combined Metals group	Pioche	Nevada	St. Joseph Lead Co.	Lead.
16	Chief of Yreka Hill	Southeastern Missouri	Missouri	Chief Consolidated Mining Co.	Zinc-lead.
17	Mammoth-Collins	Old Hat	Utah	St. Anthony Mining & Development Co.	Do.
18	Resurrection	Leadville	Colorado	Resurrection Mining Co.	Do.
19	Treasury Tunnel-Black Bear	Upper San Miguel	Colorado	Marado Mining Co.	Do.
20	Grandview	Metalline	Washington	American Zinc Lead Smelting Co.	Do.
21	Iron King	Big Bug	Arizona	Shattuck-Denn Mining Co.	Lead.
22	Sherman	Leland	Idaho	Day Mines, Inc.	Do.
23	Dayrock	Placer Center	Idaho	Day Mines, Inc.	Zinc-lead.
24	Sidney group	Yreka	Idaho	Sidney Mining Co.	Do.

Lead was also recovered in 1950 in Idaho, Montana, and Arkansas. Virtually all the lead recovered in 1950 was recovered from the mines of the Southeastern Alaska district in the Southeastern Alaska district.

The 25 leading lead-producing mines listed in table 4, yielded 69 percent of the total lead produced. The 8 leading mines produced 46 percent.

Detailed information on the lead production of the districts in the United States may be obtained from the volume dealing with the mine production of lead and zinc in the various States.

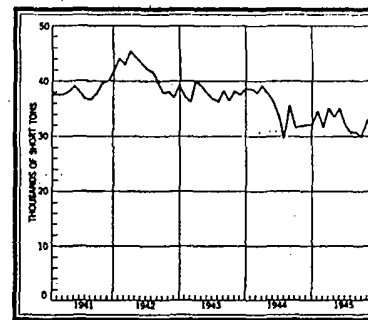


FIGURE 1.—Mine production of recoverable lead

TABLE 5.—Mine production of recoverable lead by months, 1949 and 1950

Month	1949	1950
January.....	33,203	35,684
February.....	32,687	34,716
March.....	30,910	38,960
April.....	37,215	38,432
May.....	37,006	37,906
June.....	36,278	37,439
July.....	20,836	32,037

SMELTER AND REFINERY

Pig (refined) lead produced in the United States is derived from three principal sources—domestic primary ores and base bullion, and scrap metal (mostly from primary smelters)—and is recovered at the smelter, and small quantities of that process scrap exclusively. Of the United States, 6 combine smelting and refining plants (containing approximately 50 percent of the total capacity) and 2 confine themselves to the smelting of the ores smelted, and 2 confine themselves to the refining of the lead and antimonial, or "hard," lead. The remaining 13 are primary and secondary plants. Because of the large quantities of scrap metal recovered at the smelter, the primary and secondary plants are not shown in the following table.

lead, such as battery scrap, melted at secondary smelters, the output from this type of operation is essentially antimonial lead. Statistics on the production of refined lead and alloys at secondary plants are given in the Secondary Lead section of this chapter.

Of the 13 primary smelters in operation in 1950, all but 2 consumed substantial quantities of primary materials in the form of ores and concentrates. During the year these 11 plants consumed 511,433 short tons (lead content) of this type of material, of which 17 percent was of foreign origin. In 1949, 467,128 tons of ores and concentrates were consumed, 16 percent of which was foreign.

Active Lead Smelters and Refiners.—Primary lead smelters and refineries operating in the United States in 1950 were as follows:

California: Selby—Selby plant, American Smelting & Refining Co. (smelter and refinery).
 Colorado: Leadville—Arkansas Valley plant, American Smelting & Refining Co. (smelter).
 Idaho: Bradley—Bunker Hill Smelter, Bunker Hill & Sullivan Mining & Concentrating Co. (smelter and refinery).
 Illinois: Alton—Federal plant, American Smelting & Refining Co. (smelter and refinery).
 Indiana: East Chicago—U. S. S. Lead Refinery, Inc. (refinery).
 Kansas: Galena—Galena plant, Eagle-Picher Co. (smelter and refinery).
 Missouri: Herculaneum—Herculaneum plant, St. Joseph Lead Co. (smelter and refinery).
 Montana: East Helena—East Helena plant, American Smelting & Refining Co. (smelter).
 Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (refinery).
 New Jersey: Barber—Perth Amboy plant, American Smelting & Refining Co. (smelter and refinery).
 Texas: El Paso—El Paso plant, American Smelting & Refining Co. (smelter).
 Utah:
 Midvale—Midvale plant, United States Smelting, Refining & Mining Co. (smelter).
 Tooele—Tooele plant, International Smelting & Refining Co. (smelter).

REFINED LEAD

Primary refineries in the United States in 1950 produced 513,769 short tons of refined lead, an increase of 3 percent over the 1949 output of 500,568 tons.

Of the 508,314 tons of primary refined lead produced during the year, domestic ores and base bullion were the source for 82 percent and imported ores and foreign base bullion for 18 percent. In 1949 the

TABLE 6.—Refined lead produced at primary refineries in the United States, by sources, 1946–50, in short tons

	1946	1947	1948	1949	1950
Refined lead:					
From domestic ores and base bullion	203,300	381,109	339,413	404,440	418,800
From foreign ores	44,790	50,838	60,820	71,413	80,211
From foreign base bullion	08	63	6,462	1,476	3,204
Total from primary sources	338,197	441,010	406,694	477,338	508,314
From scrap	8,013	15,092	4,952	23,230	5,455
Total refined lead	346,210	456,072	411,646	500,568	513,769
Average sales price per pound	\$0.084	\$0.143	\$0.179	\$0.158	\$0.135
Total calculated value of primary refined lead ¹	\$50,820,000	\$126,130,000	\$145,000,000	\$150,840,000	\$137,245,000

¹ Excludes value of refined lead produced from scrap at primary refineries.

origin was 85 percent domestic gives the production of refined lead by origin of the ore. Details of the are given in the Mine Production

TABLE 7.—Refined primary lead produced in the United States, by origin, 1946–50

Source	1946
Domestic ore and base bullion	293,300
Foreign ore:	
Australia	7,500
Canada	6,000
Europe	2,000
Mexico	11,300
South America	18,800
Other foreign	44,700
Total	44,700
Foreign base bullion:	
Australia	0
Mexico	0
South America	0
Other foreign	0
Total	0
Total foreign	44,800
Grand total	338,197

ANTIMONIAL LEAD

Antimonial lead output at primary refineries in the United States above the 1949 level but was well in 1948. Production increased at producing the alloy. Distribution of primary refineries in 1946–50 by source as is also the average antimony content.

Although antimonial lead is an important part of base bullion, the quantity derived from the smelting of antimonial lead is a small part of total domestic output. Production data from lead smelters exclusively are summarized in the detail in the Secondary Metals—Nonferrous.

TABLE 8.—Antimonial lead produced at primary refineries in the United States, 1946–50

Year	Production (short tons)	Antimony content	
		Short tons	Percent
1946	50,480	3,285	
1947	88,075	4,933	
1948	100,764	5,790	
1949	41,402	3,385	
1950	57,959	4,504	

SECONDARY LEAD

Some scrap lead is treated at primary smelters, but the greater part is received at a large number of plants that specialize in the treatment of secondary materials. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys.

Secondary lead recovery in 1950 was 17 percent above the 1949 figure and exceeded the domestic mine output of recoverable lead for the fifth consecutive year. Data on recovery, by type of plant, in 1946-50 are shown in table 9.

TABLE 9.—Secondary lead recovered in the United States, 1946-50, in short tons

	1946	1947	1948	1949	1950
As refined metal:					
At primary plants.....	8,013	15,662	4,052	23,230	5,455
At other plants.....	65,691	95,843	120,951	129,306	123,858
Total.....	73,704	111,505	131,903	152,626	129,313
In antimonial lead:					
At primary plants.....	33,850	56,450	49,525	32,705	38,383
At other plants.....	159,834	209,479	194,027	140,037	187,257
Total.....	193,684	265,935	243,552	172,742	225,640
In other alloys.....	125,399	134,530	124,616	80,815	127,322
Grand total:					
Short tons.....	302,787	511,970	500,071	412,183	482,275
Value.....	\$65,088,216	\$140,423,420	\$179,025,418	\$130,240,828	\$130,214,250

LEAD PIGMENTS

The principal lead pigments are litharge, white lead, red lead, sublimed lead, leaded zinc oxide, and orange mineral. These products are manufactured for the most part from metal, but some ore and concentrates are converted directly into pigments. Details of the production of lead pigments are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

CONSUMPTION AND USES

Domestic lead consumption (including lead in lead ore consumed directly in the manufacture of lead pigments and salts) totaled 1,237,981 short tons in 1950. Of the total consumed, 826,938 tons was refined soft lead, and 259,874 tons was contained in antimonial lead, 42,518 tons in unmelted white scrap, 50,311 tons in "percentage metals," 21,575 tons in copper-base scrap, 22,098 tons in drosses and residues, and 14,667 tons in lead ores used directly in the manufacture of lead compounds. During the year, 42 percent of total lead consumed was used in the manufacture of various metal products (other than storage batteries). Production of the three largest lead-consuming items—batteries, cable coverings, and tetraethyl fluid—used 52 percent of all the lead consumed in 1950. Batteries took 32 percent of the total, cable covering 11 percent, and tetraethyl fluid 9 percent.

TABLE 10.—Consumption of lead in the United States, 1949 and 1950, in short tons

	1949	1950
Metal products:		
Ammunition.....	24,111	38,438
Bearing metals.....	29,189	38,241
Brass and bronze.....	14,946	21,461
Cable covering.....	144,340	131,989
Calking lead.....	34,944	53,460
Casting metals.....	12,672	19,295
Collapsible tubes.....	8,692	13,388
Foil.....	2,503	3,941
Pipes, traps, and bonds.....	20,858	41,301
Sheet lead.....	27,144	30,778
Solder.....	62,104	94,600
Terne metal.....	3,286	3,805
Type metal.....	20,695	24,776
Total metal products.....	414,484	515,527
Storage batteries:¹		
Antimonial lead.....	175,308	212,464
Lead oxides.....	138,410	185,945
Total storage batteries.....	313,718	398,409

¹ Formerly classified under "metal products."

² Includes lead content of leaded zinc oxide products.

TABLE 11.—Consumption of lead in the United States, 1949 and 1950, by month, in short tons

Month	1949	1950
January.....	91,769	83,671
February.....	78,186	78,491
March.....	71,076	88,939
April.....	62,753	84,673
May.....	70,272	100,020
June.....	73,206	103,443
July.....	75,005	95,686

¹ Includes lead content of leaded zinc oxide products.

TABLE 12.—Lead consumption in the United States, 1949 and 1950, by type of material

	1949	1950
Metal products.....		
Storage batteries:¹		
Pigments.....		
Chemicals.....		
Miscellaneous.....		
Unclassified.....		
Total.....		

¹ Formerly classified under metal products.

² Excludes 14,667 tons of lead contained in leaded zinc

Producers' Stocks.—Lead stocks, as reported by the Bureau of Metal Statistics, are shown in table 13.

and antimonial lead include metal held by all primary refiners and by some of the refiners of secondary metal who produce soft lead. According to monthly reports released by the American Bureau of Metal Statistics, stocks of refined lead and antimonial lead increased in January, February, March, and April to reach the year's peak of 88,581 tons on April 30. Inventories declined steadily thereafter, totaling 40,910 tons on December 31, a net decrease of 42 percent from the January 1 figure of 70,424.

TABLE 13.—Lead stocks at end of year at smelters and refineries in the United States, 1946-50, in short tons

(American Bureau of Metal Statistics)

	1946	1947	1948	1949	1950
Refined pig lead.....	40,870	13,634	29,050	61,320	28,894
Antimonial lead.....	6,717	7,094	9,604	9,005	6,726
Total.....	47,587	21,328	38,654	70,424	35,619
Lead in base bullion—					
At smelters and refineries.....	8,453	7,652	6,667	16,364	11,903
In transit to refineries.....	4,911	6,447	4,101	3,690	4,959
In process at refineries.....	16,042	16,328	17,939	15,561	16,341
Total.....	29,406	29,427	31,737	35,621	32,293
Lead in ore and matte and in process at smelters.....	111,836	77,190	76,373	95,481	69,767
Grand total.....	188,829	127,954	146,754	201,520	137,669

The Bureau of Mines annual survey of primary lead smelters and refiners indicated stocks of 60,816 (revised) tons (lead content) of refined soft lead at plants on January 1, 1950, and 28,894 tons on December 31, 1950. Primary antimonial lead stocks at these same plants decreased from 8,192 short tons (lead content) at the beginning of 1950 to 6,152 tons at the end of the year. In terms of lead content, stocks of ore and concentrates at the operating primary smelters and refineries decreased 31 percent, from 61,753 (revised) tons to 42,346 tons during the same period. The inventory of base bullion at refineries that receive base bullion as a raw material and at smelters that produce base bullion for shipment to refineries totaled 7,893 tons at the beginning of January and 11,658 tons at the end of December 1950. Stocks of in-process base bullion or work lead at four combination smelter-refinery plants are not included in reports to the Bureau of Mines. No direct comparison can be made between these data and the figures of the American Bureau of Metal Statistics. Figures reported to the Bureau of Mines represent physical inventory at the plants, irrespective of ownership, and do not include material in process or in transit.

Consumers' Stocks.—Consumers' stocks of lead increased 41 percent during 1950. Stocks of lead in copper-base scrap decreased 20 percent, but there were increases in all other classes, with refined soft lead advancing 33 percent and antimonial lead 56 percent. Total inventories showed a downward trend from the 97,267 tons at the beginning of the year to a low of 86,898 tons on September 30 but gained considerably each month thereafter to total 137,147 tons on December 31.

TABLE 14.—Consumers' stocks of lead at end of year in short tons, lead

Date	Refined soft lead	Antimonial lead	Unmelted white scrap
Dec. 31, 1947.....	51,619	22,402	3,514
Dec. 31, 1948.....	62,077	35,088	4,828
Dec. 31, 1949.....	64,542	16,837	2,957
Dec. 31, 1950.....	86,101	20,252	5,720

The two major markets for lead in the United States are New York and St. Louis. Much of the lead prices normally based upon quotation of the London Metal Exchange. The London market has had no direct quotations, and the differential between St. Louis and London remained 0.2 cent a pound, an amount of charges between the two cities.

The market price for common lead, 1 at 12.00 cents per pound. Cautious decline on March 9 to 11.00 cents and Renewed consumer interest advanced prices on April 20 and to 12.00 cents thereafter resulted in a drop in the price to 11.00 cents on June 28. Developments in the metal arrested the downtrend and prices advanced to 17.00 cents per pound on October 1 and remained for the balance of the year.

TABLE 15.—Average monthly and yearly quotations for lead in New York, and London, 1948-50.

Month	1948			
	St. Louis	New York	London ¹	London ²
January.....	14.82	15.00	16.17	2.00
February.....	14.82	15.00	16.17	2.00
March.....	14.82	15.00	16.17	2.00
April.....	17.04	17.21	16.17	1.00
May.....	17.32	17.60	16.17	1.00
June.....	17.32	17.60	16.17	1.00
July.....	17.63	17.81	16.17	1.00
August.....	19.32	19.60	16.17	1.00
September.....	19.32	19.60	16.17	1.00
October.....	21.32	21.60	20.12	1.00
November.....	21.32	21.60	20.12	1.00
December.....	21.32	21.60	20.12	1.00
Average.....	17.87	18.04	17.16	1.00

¹ St. Louis: Metal Statistics, 1951, p. 511. New York: Metal and Mineral Markets.

² Conversion of English quotations into American money by Federal Reserve Board.

The official London price fixed by the Ministry of Supply for the United Kingdom was £97 per long ton (equivalent to 12.11 cents per pound computed on the basis of a \$2.7975 exchange rate) at the beginning of 1950. The price was reduced on March 10 to £88 (10.99 cents) and on March 16 to £84 (10.49 cents). It was subsequently raised on April 21 to £86 (10.74 cents), April 27 to £88, May 5 to £90 (11.24 cents), May 11 to £92 (11.49 cents), and May 12 to £96 (11.99 cents). On June 24 it was dropped to £92 (11.50 cents at the \$2.80 exchange rate established on June 1) and again on June 29 to £88 (11.00 cents). The final uptrend for the year started on July 13, when the price was raised once more to £92, followed on July 14 by an increase to £96 (12.00 cents) and other increases on August 16 to £104 (13.00 cents), August 22 to £112 (14.00 cents), September 2 to £120 (15.00 cents), September 9 to £128 (16.00 cents), and November 1 to £136 (17.00 cents), at which level it remained for the balance of the year.

FOREIGN TRADE ¹

Tariff.—The import duty set by the Tariff Act of 1930 on lead-bearing ores, flue dust, and mattes (lead content) was 1½ cents per pound and on lead bullion, pigs, bars, scrap lead, antimonial lead, type metal, babbitt metal, solder, and alloys not specially provided for, 2½ cents per pound. In accordance with the Mexican Trade Agreement of January 30, 1943, these rates were reduced to ¼ cent and 1½ cents per pound, respectively. In June 1948 these duties were suspended for 1 year by act of Congress. As the Congress took no action on a bill to extend the suspension beyond June 30, 1949, the expiration date of the original legislation, the import duty of 1½ cents a pound on pig lead and ¼ cent a pound on lead in ores and concentrates was reinstated automatically on July 1 and continued at these levels throughout 1950. The 1½ cents per pound duty on lead scrap was suspended by Congressional action for the period October 1, 1950, to June 30, 1951.

Imports.—Imports of lead in 1950 increased 36 percent over 1949 to total 541,864 tons, the largest annual quantity ever recorded. The rise was due largely to the abrogation in mid-1950 of the Mexican Trade Agreement, effective January 1, 1951, restoring as of that date the full duty established by the Tariff Act of 1930. Extraordinarily large quantities of lead were thus imported in the late months of 1950 to avoid payment of the higher tariff rates. The greater part of the lead imported in 1950 was in the form of pigs and bars, 50 percent of which came from Mexico, 24 percent from Canada, 10 percent from Yugoslavia, 7 percent from Peru, 5 percent from Australia, and 4 percent from other countries. Imports of base bullion increased 47 percent over 1949 and came principally from Australia and Japan. Ore and concentrate imports, which had gained in each of the preceding 4 years, dropped 29 percent in 1950 and were chiefly from Africa, Peru, Bolivia, Australia, and Canada.

¹ Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

LEAD

TABLE 16.—Total lead imported into the United States in 1950, in pigs, bars, and reclaimed, by country

[U. S. Department of Commerce]

Country	1950
Ore and matte:	
Africa.....	2
Argentina.....	8
Australia.....	2
Bolivia.....	23
Canada-Newfoundland-Labrador.....	1
Chile.....	5
Guatemala.....	44
Mexico.....	
Peru.....	
Other countries.....	
Total ore and matte.....	44
Base bullion:	
Australia.....	
Guatemala.....	
Japan.....	
Korea.....	
Mexico.....	
Peru.....	
Other countries.....	
Total base bullion.....	1
Pigs and bars:	
Africa.....	8
Australia.....	23
Belgium-Luxembourg.....	15
Burma.....	63
Canada-Newfoundland-Labrador.....	15
Germany.....	15
Italy.....	15
Japan.....	15
Korea.....	15
Mexico.....	15
Netherlands.....	15
Peru.....	15
Spain.....	15
Yugoslavia.....	15
Other countries.....	15
Total pigs and bars.....	115
Reclaimed, scrap, etc.:	
Africa.....	1
Australia.....	1
Belgium-Luxembourg.....	1
Canada-Newfoundland-Labrador.....	1
Canal Zone.....	1
Chile.....	1
France.....	1
Germany.....	1
Italy.....	1
Japan.....	1
Malta, Gozo, Cyprus.....	1
Mexico.....	1
Netherlands.....	1
Panama.....	1
Philippines.....	1
Yugoslavia.....	1
Other countries.....	1
Total reclaimed, scrap, etc.....	2
Grand total.....	162

¹ Data are "general imports," that is, include lead imported into the country under bond.

² Less than 0.5 ton.

TABLE 17.—Lead imported for consumption in the United States, 1946-50, by classes¹

[U. S. Department of Commerce]

Year	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1946....	28,256	\$3,042,765	20	\$2,302	104,083	\$14,816,926	24	\$10,251	\$21,517	\$18,089,893
1947....	44,442	8,561,174	1,758	416,643	168,705	38,008,443	67	42,434	10,453	50,111,298
1948....	33,932	8,350,507	10,922	3,239,135	244,692	80,922,779	181	100,519	35,664	100,968,922
1949....	121,848	34,397,028	1,133	374,954	272,437	80,148,110	178	101,084	29,830	119,054,978
1950....	95,031	21,039,227	1,134	191,879	434,366	104,323,711	207	78,111	78,090	129,697,781

¹ In addition to quantities shown (value included in total values), "reclaimed, scrap, etc.," imported as follows—1946: 2,639 tons, \$196,132; 1947: 15,963 tons, \$3,072,151; 1948: 28,897 tons, \$8,320,428; 1949: Revised figure, 14,076 tons, \$4,003,974; 1950: 22,610 tons, \$3,986,163. Figures include lead received by the Government and held in stock piles but exclude imports for manufacture in bond and export, which are classified as "imports for consumption" by the Department of Commerce.

² Revised figure.

TABLE 18.—Miscellaneous products, containing lead, imported for consumption in the United States, 1946-50

[U. S. Department of Commerce]

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1946....	157	83	\$211,122	1,740	1,494	\$220,645
1947....	264	171	208,185	2,406	2,219	753,664
1948....	257	184	213,614	14,732	13,163	5,278,080
1949....	281	127	469,236	5,861	5,207	2,258,908
1950....	4,202	2,647	2,736,350	12,408	10,481	3,596,494

¹ Revised figure.

Exports.—Total exports of pig lead (excluding reexports of foreign refined lead) increased almost threefold, from 969 tons in 1949 to 2,735 tons in 1950. Export restrictions imposed under the Export Control Act of 1940 remained in force throughout 1950.

TABLE 19.—Lead pigs, bars, and anodes exported from the United States, by destinations, 1946-50, in short tons¹

[U. S. Department of Commerce]

Destination	1946	1947	1948	1949	1950
Countries:					
Argentina.....		894	2	7	
Belgium-Luxembourg.....				76	
Brazil.....	281	63	1	126	47
Canada-Newfoundland.....	40	10	8	14	306
Canal Zone.....	6	62		15	19
Chile.....	2	62	42	40	35
China.....	9	10	21		
Colombia.....	40	12	16	60	123
Cuba.....	58	38	40	98	61
Denmark.....				131	

For footnotes, see end of table.

TABLE 19.—Lead pigs, bars, and anodes exported from the United States, by destinations, 1946-50, in short tons¹

[U. S. Department of Commerce]

Destination	
Countries—Continued	
El Salvador.....	
Honduras.....	
Hong Kong.....	
India.....	
Israel.....	
Madagascar.....	
Mexico.....	
Netherlands.....	
Netherlands Antilles.....	
Pakistan.....	
Panama.....	
Philippines.....	
Portugal.....	
Saudi Arabia.....	
Turkey.....	
United Kingdom.....	
Uruguay.....	
Venezuela.....	
Other countries.....	
Total.....	
Continents:	
North America.....	
South America.....	
Europe.....	
Asia.....	
Africa and Oceania.....	
Total: short tons.....	
value.....	\$10

¹ In addition 103 tons of foreign lead was reexported in 1946 and 53 tons in 1950.

² Revised figure.

³ Less than 0.5 ton.

WORLD RE

Lead is produced in many countries. Mexico, Australia, and Canada—have each produced one-fifth of the world output in recent years. Figures for 1944-50, which show world mine and mill production, are available in statistics for 1944-50, insofar as statistics are available.

TABLE 20.—World mine production of lead, 1944-50, in short tons

[Compiled by Viola M.]

Country ¹	1944	1945
Algeria.....	1,081	239
Argentina.....	20,000	18,528
Australia.....	192,526	167,385
Austria.....	4,782	947
Belgian Congo.....	636	715
Bolivia (exports).....	9,047	9,508
Burma.....		
Canada.....	138,155	157,393
Newfoundland.....	26,908	25,319
Chile.....		64
Czechoslovakia.....	2,177	1,100
Ecuador.....	485	160
Finland.....	237	88
France.....	4,200	4,882
French Equatorial Africa.....	3,120	3,075
French Morocco.....	9,293	11,109

For footnotes, see end of table.

with 1,970,000 tons on the same date in 1949. Other companies operating in the Broken Hill area in 1950 included the Zinc Corporation, Ltd., and the New Broken Hill Consolidated, Ltd.

The Electrolytic Zinc Co. of Australasia continued to operate its Rosebery and Hercules mines in the Read-Rosebery district of Tasmania. Despite continued labor shortages in certain skilled categories, output from these two mines for the year ending June 30, 1950, totaled 150,583 tons compared with 126,870 tons for the year ending June 30, 1949. Ore mined was milled in the Rosebery mill and 46,299 tons of zinc concentrates, 9,959 tons of lead concentrates, and 3,889 tons of copper concentrates were recovered. Ore reserves were reported at approximately 1,500,000 tons on June 30, 1950. Zinc concentrates from the Rosebery mill were smelted in the company's Risdon zinc smelter; lead concentrates and copper concentrates continued to be shipped to the United States for treatment.

Burma.—Activity at the Burma Corp., Ltd., Bawdwin mine was limited to maintenance only in 1950, although some ore was extracted during routine repair operations. Resumption of mining and smelting at the property continued to be dependent upon restoration of railroad service between Rangoon and Lashio (railhead for the Bawdwin mine). Another factor in the reopening of the property is the rehabilitation of the Gokteik viaduct between Mandalay and Lashio, which would take about 6 months. Negotiations with the Government of the Union of Burma on the Burma Corp.'s concession on the Bawdwin mines continued throughout the year. Certain provisions of the proposed concession, such as expropriation of the property, terms of compensation, and requirements on the percentage of technical and administrative employees who must be citizens of Burma, were points of disagreement.

Canada.—At Kimberley, British Columbia, the Sullivan mine of the Consolidated Mining & Smelting Co. continued to be the principal source of Canadian lead production. Ore production in 1950 totaled 2,680,962 tons compared with 2,297,672 tons in 1949. The company reports that the grade of ore was lower than in previous years due to more extensive pillar mining and the resulting dilution of ore. New mine installations scheduled for completion in 1951 included the extension of the mine conveyer system to the 2,850-foot level and a coarse crushing plant on that level. Lead concentrates from the Sullivan mine were treated at the company smelter at Trail, B. C., together with ores and concentrates from other mining properties in British Columbia and Yukon. Production of refined pig lead at the smelter totaled 170,364 tons in 1950 compared with 146,176 tons in 1949. The increase was due largely to greater receipts from custom sources, which totaled 206,942 tons in 1950 compared with 134,510 tons in 1949. Production at the smelter was retarded somewhat during the year by the National Railway strike, unusually severe weather in January and February, and by the necessity of operating the old lead smelter during construction of the new one on the same site.²

Czechoslovakia.—Lead mining in the vicinity of Przibram continued throughout 1950. Three main shafts were operating at 1,200 to 1,500

meters during the year. About 400 tons of ore with an average metal content of 2.2 percent lead and 1.5 grams of silver per ton, was mined per ton. The ore from the shafts is milled in a central flotation plant. The concentrates are shipped to the Przibram lead smelter. The company has 10 mines, and mill are owned by the Czechoslovak State. Yearly production of soft lead from the Przibram smelter is 3,000 tons.⁴

French Morocco.—The Economic Cooperation Administration announced in July an advance of approximately 10 percent of the Société des Mines de Zellidja to be used for the development of its lead-zinc mine at Bou-Beker near Oujda. The agreement provided for a period of 7 years in the form of zinc concentrates to be added to the United States Government stockpile. The output of the company's mine, after the expansion program is completed, will reach 85,000 tons of lead concentrates. During 1950 the mine produced 10,000 tons of lead concentrates.

Germany.—The equivalent of nearly \$50 million in U. S. Economic Cooperation Administration counterpart funds was made available to the Stolberger Zinc Mining & Smelting Co. for the expansion of its output of lead and zinc. Repayment of the loan is made by shipments of lead and zinc to the United States. Deliveries expected to begin in 1951. The mine is located in the southwest part of Kreis Dueren, on the northern slope of the Eifel Mountains. The ore body is estimated to be 3 percent lead and 2 percent zinc.

Greece.—Economic Cooperation Administration funds totaling approximately \$768,000 were made available to the Mediterranean Mines, Inc., for development of its mines approximately 25 miles southeast of Athens. The mines contain 300,000 tons of sulfide ore containing a minimum of 6 percent zinc, and 2½ ounces of silver per ton. The ore is treated in a flotation mill, which was completed in 1950. Operation by the end of 1951. In addition to the ore, there are 100,000 tons of tailings containing 2 to 4 percent silver which the company planned to reprocess.

Greenland.—Officials of a Danish Geological Survey party examining lead deposits on the east coast of the area around King Oscar Fjord and Disko Fjord. Operations would begin in 1951. The deposits were discovered in the summer of 1948, are reported to contain 100,000 tons of lead.

Guatemala.—Lead mining in the Department of Jalapa continued at about the same level in 1950. The mine owned by Compania Minera de Guatemala, in the Department of Alta Verapaz, was worked throughout the year. About 50 percent lead and for a part of the year, the newly constructed smelter at the mine. The company's culties smelting was suspended after a

² Consolidated Mining & Smelting Co., 1950 Annual Report to Stockholders

⁴ Jensen, C. W., Lead Smelting at Przibram: Min. Mag., vol.

production was exported in the form of ore. The ore is hauled 90 miles by truck over rough mountain roads to the town of El Rancho, in the Department of El Progreso, where it is transferred to cars of the International Railways of Central America and shipped to Puerto Barrios on the Atlantic coast.

The Santiago y Mercedes mine near Mataquesquintla, Department of Jalapa, was the only other important lead-producing mine operating in 1950. Most of the output came during the last half of the year. Activities during the first part of 1950 were directed to stope filling and construction of two bypass tunnels around a large fault encountered in the exploratory work.

Mexico.—The increase of activity at Mexican lead and zinc mines during the second half of 1950 was due largely to the impact of the Korean war upon the demand for these metals. According to the annual report to the stockholders of the San Francisco Mines of Mexico, Ltd., ore treated at the company flotation mill during the year totaled a record 623,000 tons, as compared with 580,000 tons in the preceding year. There were 51,119 tons of lead concentrates, 8,396 tons of copper concentrates, and 74,172 tons of zinc concentrates recovered from the ore milled. Ore reserves at the end of September 1950 totaled 4,164,000 tons, assaying 6.5 percent lead, 9 percent zinc, 0.6 percent copper, 0.7 gram of gold, and 155 grams of silver to the ton. This is equivalent to nearly 6 years supply of ore at the present mill capacity of 720,000 tons annually. The company reported an ample supply of labor, but its efficiency is declining.

Northern Rhodesia.—Plans for increasing lead production at Broken Hill were announced by the Rhodesia Broken Hill Development Co. during the year. The deepening of the Davis shaft was started in May 1950, and by the end of the year the shaft had been sunk 1,414 feet. The shaft is being deepened to allow the establishment of a main pumping station at the 1,585-foot level. Excavation and foundation for the new lead-smelter building were commenced during the year. The new plant has been designed to recover lead from the leach residues of the electrolytic zinc process; these residues are not amenable to treatment by the existing smelting equipment and until now have been stockpiled. According to the 1950 annual report to the stockholders, production from the mine during the year ended December 31, 1950, was 13,685 long tons of lead and 22,715 long tons of zinc. A total of 163,441 short dry tons of ore was hoisted during the year as compared with 172,576 tons in 1949. The average grade of ore treated in the concentrator was 19.8 percent lead and 30.8 percent zinc. Proved ore reserves on December 31, 1950, included 1,372,000 short tons of oxide ore and 1,064,000 short tons of sulfide ore.

Tanganyika.—Uruwira Minerals, Ltd., continued in 1950 to develop its lead deposit at Mpanda. Ore mined during development was treated in the company's 100-ton pilot plant. First shipments of lead concentrates were made early in September and were consigned to lead smelters in Antwerp, Belgium. The 131-mile Mpanda branch line of the East African Railways from Kaliua to Mpanda in the western province of Tanganyika, which has been under construction for nearly 3 years, was formally opened for all classes of traffic on August 21, 1950. The line was constructed by the Tanganyika

Government to provide a means of transporting lead concentrates from the mine to Dar es Salaam.

United Kingdom.—Lead consumption remained virtually unchanged in 1950, at 328,123 tons (328,539 in 1949), of which 24 percent was for covering; 24 percent in sheet and pipe; 16 percent for miscellaneous purposes; and 16 percent for miscellaneous purposes.

Stocks of refined lead in the United Kingdom totaled 61,687 long tons compared with 61,687 in 1949.

Lead and Zinc Pigments and Zinc Salts

By Helena M. Meyer and Alethea W. Mitchell

GENERAL SUMMARY

SHIPMENTS of lead and zinc pigments and zinc salts rebounded in 1950 from the reduced rates that accompanied the industrial recession of mid-1949. All classes covered by this report were shipped in substantially greater quantities in 1950 than in 1949, particularly after the outbreak of hostilities in Korea in June; lead pigments rose more sharply than the zinc group.

In the second half of 1950 the following gains over the first half were noted in shipments of various products: White lead (dry and in oil) 46 percent, litharge 44 percent, red lead 40 percent, zinc oxide (lead-free) 15 percent, and leaded zinc oxide 33 percent. For all of 1950 as compared with 1949, lead-pigment gains ranged from 65 percent for white lead (dry and in oil) to 41 percent for red lead. Zinc-pigment increases ranged from 74 percent for leaded zinc oxide to 35 percent for lithopone. Zinc chloride gained 17 percent and zinc sulfate 19 percent.

Industries that are large users of pigments showed marked advances in 1950. Passenger automobile production rose 30 percent over 1949 to a new all-time high; trucks gained 17 percent to a peak lower only than the record in 1948; the value of sales of paint, lacquer, and varnish materials was 20 percent greater than in 1949 and 7 percent more than the previous peak in 1948; the value of private construction gained 27 percent and public construction 11 percent; consumption of natural rubber rose 24 percent and synthetic, 28 percent as compared with 1949. Of these, the paint and construction gains, being stated in value terms, reflect in part the rising price level.

Lead and zinc, chief raw materials of the pigments industry, were available in greater quantities in 1950 than in 1949; but demand for these metals increased at a higher rate than supplies, so that pigment manufacturers could not fill total raw material needs. The price of common lead at New York was 12 cents a pound when the year began and in the first quarter continued the downtrend of the last quarter of 1949. After dropping to the lowest quotation of the year—10.50 cents a pound in March—there was some fluctuation, followed in the latter part of the year by a rise to 17 cents. The price for Prime Western slab zinc at East St. Louis dropped $\frac{1}{2}$ cent a pound in early January 1950, and thereafter every price change was upward, culminating in a peak price of 17.50 cents a pound September 7 and for the remainder of the year.

Lead- and zinc-pigment prices generally followed the pattern set by the constituent primary metals. Lead-pigment prices dropped in

LEAD AND ZINC PIGMENTS

the first half of the year and after July to the year's highest levels at the year-end, well above opening prices. Zinc-pigment prices rose steadily from the beginning to the end of the year, 10 cents a pound for most zinc classes with lead-pigment changes and carried prices never previously attained. Lead-pigment prices rose in 1948 and early 1949.

The supply-demand situation in zinc was affected by the Authority Order, M-15, effective December 1, 1949, which required a 45-day supply, or to a "practicable" supply, whichever was less. Under NPA Order M-15, producers of zinc, zinc oxide, and zinc sulfate were required to accept rated orders for shipments of 10 percent of production.

Shipments of white lead (dry) increased in 1950 over the products covered by this report.

TABLE 1.—Salient statistics of the lead and zinc pigments industry, States, 1941-45 (average)

	1941-45 (average)	1946	
Production (shipments) ¹ of principal pigments:			
White lead (dry and in oil)..... short tons..	81,940	86,501	
Red lead..... do.....	51,388	32,526	
Litharge..... do.....	120,777	133,799	
Zinc oxide..... do.....	132,108	167,851	
Leaded zinc oxide..... short tons..	57,574	67,971	
Lithopone..... do.....	145,750	147,001	
Value of products:			
All lead pigments.....	\$42,702,000	\$43,595,000	\$500,000
All zinc pigments.....	30,437,000	44,195,000	63,000
Total.....	79,139,000	87,790,000	\$154,000
Value per ton received by producers:			
White lead (dry).....	\$157	\$179	
Red lead.....	167	199	
Litharge.....	146	175	
Zinc oxide.....	135	144	
Leaded zinc oxide.....	128	143	
Lithopone.....	77	81	
Foreign trade:			
Lead pigments:			
Value of exports.....	\$1,288,000	\$851,000	\$1,000,000
Value of imports.....	7,000	13,000	
Zinc pigments:			
Value of exports.....	2,680,000	2,911,000	6,000,000
Value of imports.....	7,000	9,000	
Export balance.....	3,934,000	3,740,000	7,000

¹ Reported as sales before 1946.

² Data for basic lead sulfate in 1946 included under white lead separately.

³ Excludes value of basic lead sulfate; Bureau of Mines no.

⁴ Corrected figure.

Zinc oxide (lead-free) shipments were 46 percent over those in 1949 and equaled the previous record established in 1928 and duplicated in 1929 and 1947. The leaded variety rose 74 percent in 1950 but was little more than three-quarters of the peak in 1947. Lithopone increased 35 percent over 1949 but was well below all years from 1924-48, inclusive.

Increases in shipments of pigments to ceramics manufacturers were greater on the whole than to the larger consumers. Shipments

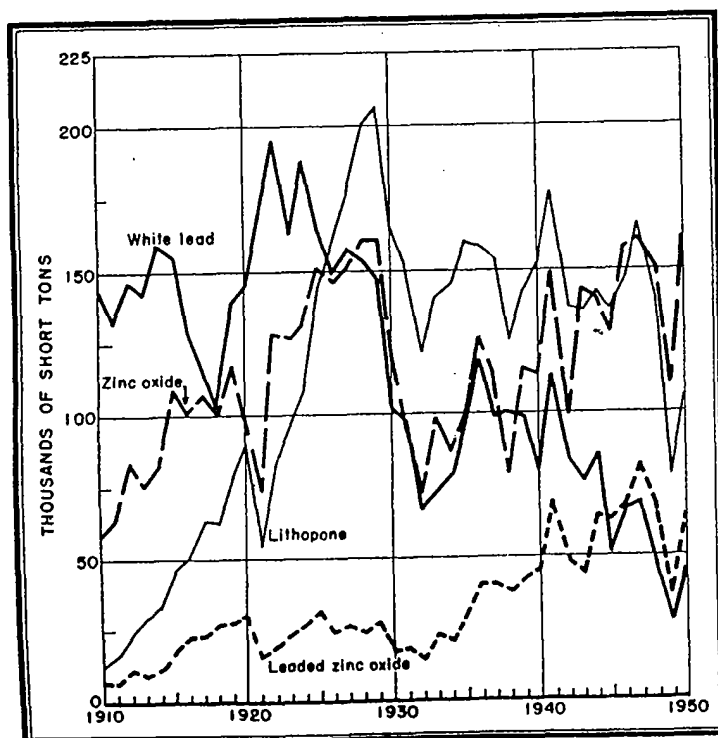


FIGURE 1.—Trends in shipments of white pigments, 1910-50.

Zinc oxide shipments to makers of red lead shot declined to levels of 1946-48 but increased less than for the rest of the whole. Litharge and lithopone shipments to makers of red lead shot contrasted with each other in gain and loss. The use of litharge for shot decreased, while lithopone, behind the over-all performance of litharge, increased. The use of red lead for the purpose fell short of the use of lithopone. More of total red-lead shipments.

Termination of the Mexican Trade Agreement had no effect on the products of zinc sulfate. The tariff on zinc sulfate from $\frac{1}{2}$ cent under the Mexican Trade

Demand for the competitive titania in 1950 despite the fact that producers had established new records. In 1948, above previous peaks in 1948, demand have been establishing new records. Pigment-plant capacity and not production and prevented even greater growth. At present, the Bureau of Census figures covering pigments of this

PRODUC

For many years, figures on sales v as a better guide than production to Beginning with 1945, the base was with data compiled on Bureau of Available information for 1945 (the difference between sales and shipment tonnages of pigments, an attempt is one of the chief problems being they are blended to make another product.

oxide, for example, are blended to make leaded zinc oxide, and in this instance the pigment weights appear in the total for the last-named class only. Pigments consumed by producing companies to make products beyond those covered by this report—that is, paints, storage batteries, and other articles—are considered as shipments.

LEAD PIGMENTS

Shipments of lead pigments rose 49 percent in quantity and 36 percent in value in 1950 compared with 1949. Average values of all items dropped in 1950, so that the greater total value is explained entirely by the substantial gains in tonnages shipped. Shipments of white lead (dry and in oil) increased 65 percent, of litharge 47 percent, and of red lead 41 percent. (Shipments of basic lead sulfate are excluded from the foregoing totals.)

Quoted prices for lead pigments dipped in the first half of 1950 and after July followed a continuous upward course, closing at the highest levels of the year. Average values reported by producers declined as follows: White lead (dry) 5 percent, white lead in oil 6 percent, red lead 6 percent, and litharge 10 percent.

White Lead.—Shipments of white lead rebounded in 1950 from the low levels of 1949, which were the lowest by far since much before the beginning of the present century; 1950 shipments were 65 percent

TABLE 2.—Production and shipments of lead pigments¹ in the United States, 1949-50

Pigment	1949				1950			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value ¹			Short tons	Value ¹	
			Total	Average			Total	Average
White lead:								
Dry.....	15,609	15,719	\$5,520,250	\$351	27,954	28,506	\$9,553,087	\$335
In oil.....	11,187	11,636	5,504,207	473	16,778	16,670	7,403,032	444
Red lead.....	26,362	24,806	8,276,801	333	34,066	35,072	11,013,908	314
Litharge.....	123,167	121,052	39,262,708	324	178,225	177,658	51,887,453	292

¹ Except for basic lead sulfate, figure for which Bureau of Mines is not at liberty to publish.
² At plant, exclusive of container. ³ Weight of white lead only, but value of paste.

TABLE 3.—Lead pigments shipped by manufacturers in the United States, 1941-45 (average) and 1946-50, in short tons

Year	White lead			Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	Total	White	Blue			
1941-45 (average)	40,785	41,155	81,940	5,642	1,270	51,388	193	120,777
1946	41,892	24,609	66,501	(1)	(1)	32,526	123	133,799
1947	39,075	29,712	68,787	(1)	(1)	36,064	—	167,080
1948	26,551	19,519	46,070	(1)	(1)	30,787	—	154,776
1949	15,719	11,036	27,355	(1)	(1)	24,860	—	121,052
1950	28,500	16,070	45,176	(1)	(1)	35,072	—	177,658

¹ Basic lead sulfate included with white lead (dry); Bureau of Mines not at liberty to publish figure.
² Bureau of Mines not at liberty to publish figure.

higher than those in 1949 but other since some years prior to 1900.

Basic Lead Sulfate.—The Bureau publishes figures on basic lead sulfate.

Red Lead.—Red-lead shipments far below World War II years and the

Orange Mineral.—No shipments 1947-50.

Litharge.—A new high record for litharge in 1950, which were 47 percent over the previous top in 1949. Production rate, with its consequent large increase, is an important factor in the establishment of the new record.

Battery manufacturers produced 1950 and 53,000 tons in 1949.

ZINC PIGMENTS

Shipments of zinc pigments rose 49 percent in value in 1950 over 1949. Average values gained; prices established all-time peaks during the year. Shipments of zinc pigments shipped likewise was high. Changes in zinc pigments were unusual, quotations of the year being those in 1949.

Percentage increases in zinc-pigment production for lithopone to 74 percent. Values received by producers rose as follows: White lead 8 percent, red lead 8 percent, zinc oxide 8 percent.

Shipments of zinc chloride and zinc oxide respectively. The tonnage for zinc oxide record established in 1946, and the tonnage for zinc chloride record below 1948, believed to be the highest.

TABLE 4.—Production and shipments of zinc pigments in the United States, 1949-50

Pigment or salt	1949		
	Production (short tons)	Shipments	
		Short tons	Value
			Total
Zinc oxide ¹	109,126	110,132	\$25,292,070
Leaded zinc oxide ²	37,040	36,722	8,874,665
Lithopone.....	72,233	78,335	8,977,178
Zinc chloride, 50° B.....	55,197	55,208	3,857,380
Zinc sulfate.....	20,952	20,065	2,365,120

¹ Value at plant, exclusive of container.
² Zinc oxide containing 5 percent or more lead is classified as leaded zinc oxide. Zinc oxide include a small quantity containing less than 5 percent lead.

TABLE 5.—Zinc pigments and salts shipped¹ by manufacturers in the United States, 1941-45 (average) and 1946-50, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1941-45 (average).....	132, 108	57, 574	145, 760	54, 964	17, 438
1946.....	157, 851	67, 971	147, 001	57, 310	24, 931
1947.....	160, 771	81, 459	165, 024	65, 521	21, 547
1948.....	150, 058	67, 441	140, 033	68, 701	21, 513
1949.....	110, 132	30, 722	78, 335	55, 208	20, 065
1950.....	160, 829	63, 973	105, 660	64, 664	23, 912

¹ Reported as sales before 1945.² 1942-45, inclusive; data for 1941 not available.

otherwise only slightly less than in one or two other high years. Average values of the two compounds increased 4 and 11 percent, respectively.

Zinc Oxide.—Zinc oxide (lead-free) shipments were 46 percent above 1949 and equaled the previous peak established in 1928 and duplicated in 1929 and 1947. The acceleration of defense mobilization after June threatened to reduce supplies of zinc metal and scrap to zinc oxide manufacturers and thus to curtail the availability of this pigment.

TABLE 6.—Production of zinc oxide (lead-free) by processes, 1945-50, as percent of total

Process	1945	1946	1947	1948	1949	1950
American process (ore and primary residues).....	77	75	73	76	71	72
French process (metal and scrap).....	15	17	17	15	17	18
Other.....	8	8	10	9	12	10
Total.....	100	100	100	100	100	100

Leaded Zinc Oxide.—Shipments of leaded zinc oxide rose 74 percent in 1950, a gain, among the products covered by this report, second only to white lead (dry). These shipments, however, were far from a record, reaching little more than three-fourths of the all-time peak of 1947.

Production of leaded zinc oxide, by grades (comparison with 1949 in parentheses) was as follows: 54,641 (31,434) tons of 35 percent lead and under and 8,553 (5,612) tons of over 35 percent lead.

Lithopone.—Lithopone shipments increased 35 percent over 1949 but fell well below all years from 1924-48, inclusive. Plant capacity for the manufacture of lithopone was reported to be 155,000 tons in 1950 compared with 157,000 in 1949.

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product. This method of publication is used to conceal the operations of one company that always dominates the output of the high-strength product and has been the only producer in some years. In 1950, as in 1947-49, this company operated two plants producing high-strength lithopone.

Consumption of ordinary lithopone in the manufacture of titanated lithopone has dropped to very small proportions. The trend has been

downward almost continuously since it reached in 1937. In 1950 the total was the first gain since 1940, but the larger than the 1937 total. The lithopone figure was 23,912 tons for ordinary lithopone in other

TABLE 7.—Titanated lithopone produced and ordinary lithopone used in its manufacture, 1941-45 (average) and 1946-50, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used
1941-45 (average).....	11, 460	9, 700
1946.....	7, 500	6, 350
1947.....	2, 600	2, 200

Zinc Sulfide.—In 1950, as in several previous years, the only company produced zinc sulfide; the company published figures for this pigment.

Zinc Chloride.—Shipments of zinc chloride were 17 percent in 1950, the smallest in the series covered by this report. The 1950 total was only 17 percent of the total for 1920, 1947, and 1949.

Zinc Sulfate.—A 19-percent increase in shipments resulted in the second-highest total in the series. 1950 shipments were only 4 percent of the total for 1920, 1947, and 1949.

RAW MATERIALS

Figures covering the raw materials for the manufacture of zinc salts in 1950 and 1949 are shown in the following table.

Lead pigments and zinc pigments are made from a variety of materials, including ore, scrap, and materials as scrap. In 1950, as in 1949, the lead in pigments was derived from primary ore. Of the lead in ore used to make pigments in 1949, 19 percent was from foreign sources, 73 (72) percent from ore, 17 (20) percent from slag zinc, and 22 (18) percent of the ore used was from the United States.

Tables 8 and 9 give the source of the raw materials for each pigment and salt. Pig lead is used directly or indirectly, in manufacturing white lead and orange mineral and is used also in the manufacture of zinc sulfate. The lead content of leaded zinc oxide, which in turn is made from leaded zinc oxide, lithopone, zinc sulfide, and zinc sulfate. A substantial proportion of the lead used in 1950 and 65 in 1949) and most of the lead used in 1950 and 1949) made in the United States.

material. For a number of years before the United States entered World War II, there had been a large increase in the quantity of secondary zinc used in manufacturing zinc oxide. The scarcity of supplies of both metal and scrap caused the proportion of the total oxide made by the French process—which uses only metal and scrap—to drop sharply in 1942 and to continue comparatively low in 1943–46, despite the fact that the total percentage from metal and scrap rose in 1943 and continued upward almost without interruption in 1944–50. The production of zinc oxide from metal and scrap accounted for the following percentages in relation to total production: 41 percent in 1939, 16 percent in 1942, 19 percent in 1943, 22 percent in 1944, 25 percent in 1945, 26 percent in 1946, 28 percent in 1947, 26 percent in 1948, 29 percent in 1949 and 29 percent in 1950.

TABLE 8.—Lead content of lead and zinc pigments¹ produced by domestic manufacturers, by sources, 1949–50, in short tons

Pigment	1949				1950			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead.....			21,504	21,504			35,897	35,897
Red lead.....			23,900	23,900			30,884	30,884
Litharge.....			114,314	114,314			165,428	165,428
Leaded zinc oxide.....	8,835	555		9,390	12,006	2,061		14,067
Total.....	8,835	555	159,718	169,108	12,006	2,061	232,209	246,876

¹ Excludes lead in basic lead sulfate, data for which Bureau of Mines not at liberty to publish.

TABLE 9.—Zinc content of zinc pigments¹ and salts produced by domestic manufacturers, by sources, 1949–50, in short tons

Pigment or salt	1949					1950				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Secondary material :		Ore		Slab zinc	Secondary material :	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide.....	48,715	13,634	10,171	14,676	87,096	69,412	22,327	16,860	19,749	128,354
Leaded zinc oxide.....	17,747	1,183	.....	.....	18,930	26,946	5,274	.....	.....	32,220
Lithopone.....	4,159	723	9	9,118	14,009	6,380	1,507	30	11,494	19,411
Total pigments..	70,621	15,440	10,180	23,794	120,035	102,738	29,108	16,896	31,243	179,985
Zinc chloride.....	.....	.....	.....	12,157	12,157	.....	.....	.....	14,346	14,346
Zinc sulfate.....	2,003	78	.....	4,404	6,464	2,127	461	.....	4,710	7,298

¹ Excludes zinc sulfide, data for which Bureau of Mines not at liberty to publish.

² These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.

CONSUMPTION

LEAD PIGMENTS

White Lead.—As usual white-lead went to the paint industry, although the color not indicated in the statistics for 1950 due to the inability of shippers to classification. It is known that some was reported under "Other", a part of the entire "Other" classification. Shipments to ceramics manufacture doubled in 1950 compared with 1941–45 level of 1941–45.

TABLE 10.—Distribution of white lead (dry) 1941–45 (average) and 1946

Industry	1941–45 (average)	1946
Paints.....	74,062	60,943
Ceramics.....	1,749	1,367
Other.....	6,129	4,191
Total.....	81,940	66,501

¹ Reported as sales before 1945.

² Data for basic lead sulfate included with white lead, separately.

³ Revised figure.

⁴ Of which 1,257 tons were for plasticizers and stabilizers.

Basic Lead Sulfate.—A distribution by uses has not been available for past short tons went to the paint industry, and 686 tons to other industries. Sulfate are also used as an intermediate product in zinc oxide. Such quantities have always been under leaded zinc oxide rather than basic lead sulfate.

Red Lead.—Shipments to storage-batteries greater than to any other class, but the color more than 50 percent of the total in 1950 and 59 percent in 1946. The paint industry total in 1950 compared with 29 percent in 1941–45. Shipments to ceramics making for most recent years except 1946 and 1947.

TABLE 11.—Distribution of red-lead shipments 1941–45 (average) and 1946–50, in short tons

Industry	1941–45 (average)	1946
Storage batteries.....	26,900	19,115
Paints.....	19,586	9,318
Ceramics.....	932	1,228
Other.....	3,970	2,805
Total.....	51,388	32,466

¹ Reported as sales before 1945.

Orange Mineral.—No shipments of orange mineral have been reported since 1946, when 78 short tons went to the ink industry, 18 tons to the color-pigment industry, and 27 tons to other industries.

Litharge.—Shipments of litharge to ceramics makers were higher by 39 percent than the previous peak in 1948. This use took 16 percent of the total in 1950, compared with 10 percent in 1941-45 and a range of 10 to 13 percent in 1946 to 1949. Only storage batteries rank above ceramics in consumption of litharge, and these took nearly four times as much as the latter in 1950. The 1950 tonnage for batteries was only 6 percent under the all-time high, in 1947, and except for that year was a record. Insecticide makers doubled their use of litharge in 1950, but this industry took much less than half of its 1944 peak quantity. Chrome-pigment tonnages were comparable to the best totals of the recent past, as were those shipped to rubber manufacturers and, except for 1 or 2 years, to oil refineries. Shipments to the varnish industry were only slightly under the 1948 high.

TABLE 12.—Distribution of litharge shipments,¹ by industries, 1941-45 (average) and 1946-50, in short tons

Industry	1941-45 (average)	1946	1947	1948	1949	1950
Storage batteries.....	60,167	75,836	111,840	100,046	77,163	105,558
Ceramics.....	12,314	13,166	18,360	19,979	13,299	27,771
Insecticides.....	19,697	14,269	7,288	6,033	5,353	10,651
Chrome pigments.....	10,050	10,877	9,228	7,456	8,657	10,017
Oil refining.....	5,758	6,682	7,688	7,248	5,720	6,488
Varnish.....	3,150	3,302	4,258	4,424	4,286	4,347
Rubber.....	3,323	2,131	2,205	2,835	1,398	3,047
Floor coverings.....	264	106	141	152	62	220
Other.....	6,061	7,440	6,042	6,004	5,214	9,559
Total.....	120,777	133,799	167,050	154,775	121,052	177,658

¹ Reported as sales before 1945.

ZINC PIGMENTS AND SALTS

Zinc Oxide.—More than half of the 1950 tonnage of the lead-free class was for the manufacture of rubber, and the quantity so used was close to the largest ever consumed for this purpose. Paint manufacture stood second as an end use of zinc oxide in 1950, taking quantities smaller only than in 2 or 3 years from 1925 to 1930. A new top was established in the use of zinc oxide in ceramics, the previous

TABLE 13.—Distribution of zinc oxide shipments,¹ by industries, 1941-45 (average) and 1946-50, in short tons

Industry	1941-45 (average)	1946	1947	1948	1949	1950
Rubber.....	66,802	83,779	82,248	82,895	58,490	82,944
Paints.....	27,086	34,785	32,867	26,779	20,205	39,699
Ceramics.....	4,694	9,056	11,350	12,327	6,982	12,679
Coated fabrics and textiles ²	8,118	10,022	9,100	9,474	5,200	6,303
Floor coverings.....	10,308	2,848	4,735	4,938	2,665	3,670
Chemical warfare.....	14,528	17,364	20,471	14,645	10,584	16,534
Other.....	132,108	157,851	160,771	150,968	110,132	160,829
Total.....	132,108	157,851	160,771	150,968	110,132	160,829

¹ Reported as sales before 1945.

² Includes the following tonnages for rayon: 1946—9,363; 1947—7,302; 1948—8,209; 1949—4,470; 1950—4,850.

LEAD AND ZINC PIGMENTS

high for 1948 being exceeded slightly. gains over a short period, the quantity greater than the average for 1941-45 in shipments for coated fabrics and these uses lagged well behind the lead.

Leaded Zinc Oxide.—Leaded zinc was reported to be for this purpose in manufacturing paint, and 98 percent were reported to be for this purpose was 20 percent below the 1947 peak and 1946. The fact that leaded zinc pigment for paint manufacture in tin such as existed during World War I war in Korea in June 1950.

TABLE 14.—Distribution of leaded zinc oxide shipments,¹ by industries, 1941-45 (average) and 1946-50, in short tons

Industry	1941-45 (average)	1946
Paints.....	55,581	64,816
Rubber.....	72	166
Other.....	1,921	2,989
Total.....	57,574	67,971

¹ Reported as sales before 1945.

Lithopone.—Paints, varnish, and three-fourths of the total lithopone sales in 1950 compares with 72 percent in 1949. tiles, second-largest use, consumed 20 percent in 1949. Rubber used 26 percent made a good showing in relation to end uses to manufacturers of floor coverings and paint, respectively, in contrast to almost this report. Both classes of users took annual quantities for 1941-45.

Zinc Chloride.—Statistics on the end use of shipments are not available.

TABLE 15.—Distribution of lithopone shipments,¹ by industries, 1941-45 (average) and 1946-50, in short tons

Industry	1941-45 (average)	1946
Paint, varnish, and lacquers ²	112,793	123,279
Coated fabrics and textiles.....	5,141	7,626
Floor coverings.....	11,550	7,541
Rubber.....	1,475	1,607
Paper.....	4,520	3,011
Printing ink.....	(³)	(³)
Other.....	10,271	3,937
Total.....	145,750	147,001

¹ Reported as sales before 1945.

² Includes a small quantity, not separable, used for printing.

³ Included in "Other" before 1950, except for those quantities.

Zinc Sulfate.—Rayon has ranked first in consumption of zinc sulfate continuously since 1946, when the agricultural use led, and in 1950 took a larger quantity than ever before, exceeding the previous peak in 1949 by 6 percent. Agriculture continued to rank second in 1950 but took a tonnage 46 percent less than in 1946 and only 52 percent of the 1950 quantity for rayon. Chemicals, in third place, have dropped in apparent importance over the years but this may be due to the fact that they overlap other uses and that producers' reports for recent years have been classified more precisely. Among other uses, the most significant detail appears to be the sharp falling off in shipments for paint and varnish processing. This use had gained in 1949 when most others declined.

TABLE 16.—Distribution of zinc sulfate shipments,¹ by industries, 1941-45 (average) and 1946-50, in short tons

Industry	1941-45 (average)	1946		1947		1948		1949		1950	
		Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
Rayon.....	5,108	7,634	5,883	8,210	6,173	9,900	7,333	10,591	7,957	11,217	8,322
Agriculture.....	4,422	10,816	8,178	7,827	6,125	5,210	4,248	4,429	3,595	5,841	4,880
Chemicals.....	2,774	2,254	1,488	2,120	1,439	1,734	1,193	1,197	851	1,879	1,377
Flotation reagents.....	862	1,084	643	1,112	717	1,632	1,366	921	767	952	727
Glue.....	628	511	335	524	444	501	402	453	370	570	464
Electroplating.....	288	488	315	233	146	319	205	217	154	324	203
Paint and varnish processing.....	1,539	174	151	61	51	121	104	603	585	189	119
Textile dyeing and printing.....	187	552	491	60	38	102	66	30	21	145	129
Other.....	1,630	1,418	943	1,300	864	1,934	1,191	1,564	979	2,786	1,820
Total.....	17,438	24,931	18,427	21,547	15,907	21,513	16,108	20,065	15,260	23,912	18,041

¹ Reported as sales before 1945.

PRICES

Total and average values received by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. Average values for all lead pigments dropped in 1950, the declines ranging from 5 percent for white lead (dry) to 10 percent for litharge. This was the second annual decrease, following establishment of successive peaks for all types in 1947 and 1948. Lead-pigment price quotations followed closely the movement of pig-lead prices. The pigment quotations dropped $\frac{3}{4}$ to $1\frac{1}{2}$ cents a pound, depending on the pigment, in the first half of the year, and after July followed a continuous upward course so that they were 4 to nearly 7 cents a pound higher at the end than at the beginning of the year. Both high and low extremes in lead-pigment price quotations in 1950 were below the respective highs and lows in 1949.

Average values received by producers for zinc pigments, unlike those for the lead group, were higher than in 1949, with rises varying from 8 percent for lithopone and leaded zinc oxide to 12 percent for zinc oxide (lead-free). Producers' average values and zinc-pigment quotations are believed to have established new all-time peaks. Zinc-pigment prices moved upward from the beginning to the end of

LEAD AND ZINC PIGMENTS

TABLE 17.—Range of quotations on lead and zinc pigments at New York (or delivered in the city) [Oil, Paint and Varnish]

Product	
White lead (basic lead carbonate), dry, carlots, barrels.....	13.
Basic lead sulfate (sublimed lead), less than carlots, barrels.....	13.
Red lead, dry, 95 percent or less, less than carlots, barrels.....	15.
Orange mineral, American, small lots, barrels.....	17.
Litharge, commercial, powdered, barrels.....	13.
Zinc oxide:	
American process, lead free, bags, carlots.....	9.
American process, 5 to 35 percent lead, barrels, carlots.....	9.
French process, red seal, bags, carlots.....	10.
French process, green seal, bags, carlots.....	10.
French process, white seal, barrels, carlots.....	11.
Lithopone, ordinary, small lots, bags.....	5.
Zinc sulfide, less than carlots, bags, barrels.....	10.
Zinc chloride, works:	
Solution, tanks.....	2.
Fused, drums.....	5.
Zinc sulfate, crystals, barrels.....	3.

¹ Quotations for bags.
² Includes granulated.

the year, most of the varieties in Lithopone gains were about 2 cents.

Average values received by producers for zinc pigments rose 4 and 11 percent, respectively, for these compounds also rose in 1950 of the year at the year end.

FOREIGN

Imports of lead and zinc pigments and domestic shipments of the various pigments, the chief lead entry, amounted to 1950 and of zinc oxide 19 percent. Even this latter was unusual gain in imports of zinc oxide in 1950 material, 2,875 tons were from Canada, Germany, and 529 from the United States also rose sharply in 1950.

Litharge is the chief lead-pigment imported; this pigment abroad were only 1 percent of producers.

Lithopone and zinc oxide are the chief of these classes dropped substantially.

¹ Figures on imports and exports compiled by M. B. from records of the U. S. Department of Commerce.

TABLE 18.—Value of foreign trade of the United States in lead and zinc pigments and salts, 1948-50

[U. S. Department of Commerce]

	Imports for consumption			Exports		
	1948	1949	1950	1948	1949	1950
Lead pigments:	\$82,538	\$73,485	\$271,035	\$204,527	\$276,888	\$243,344
White lead.....	98,506	11,848	27,114	390,222	408,491	194,939
Red lead.....	421,695	39,822	4,570	285,473	471,143	611,942
Litharge.....	32,689	17,448	40,781	(¹)	(²)	(²)
Other lead pigments.....						
Total.....	633,328	142,603	343,500	(¹)	(²)	(²)
Zinc pigments:	7,361	49,809	1,081,816	2,268,050	1,507,205	875,829
Zinc oxide.....			14,479	(²)	(¹)	(²)
Zinc sulfide.....		2,053	179,197	2,972,912	1,918,913	1,248,538
Lithopone.....						
Total.....	7,361	51,862	1,275,492	5,228,962	3,426,118	2,124,367
Lead and zinc salts:				433,779	186,991	216,034
Lead arsenate.....	448	4	1,065	(²)	(²)	(²)
Other lead compounds.....		2,650	30,447	(²)	(²)	(²)
Zinc chloride.....	10,397	6,472	11,202	(²)	(²)	(²)
Zinc sulfate.....	10,846	9,120	42,704	(²)	(²)	(²)
Total.....				(²)	(²)	(²)
Grand total.....	651,534	203,691	1,661,690	(²)	(²)	(²)

¹ Data not strictly comparable to earlier years.
² Data not available.

TABLE 19.—Lead pigments and salts imported for consumption in the United States, 1946-50

[U. S. Department of Commerce]

Year	Short tons							Total value
	White lead (basic carbonate)	Red lead	Litharge	Lead sub-oxide	Lead pigments n. s. p. f.	Lead arsenate	Other lead compounds	
1946.....	1	54	15	11	(¹)	(¹)	60	\$13,038
1947.....	1	22	416	33	30		1	171,060
1948.....	203	247	1,064	34	6		(¹)	633,778
1949.....	161	23	98	23	27		2	142,607
1950.....	944	70	12	57				344,555

¹ Less than 0.5 ton.

LEAD AND ZINC PIGMENTS

TABLE 20.—Zinc pigments and salts in the United States, 1946-50

[U. S. Department of Commerce]

Year	Sh		
	Zinc oxide		Lithopon
	Dry	In oil	
1940.....	41	-----	(1)
1947.....	117	1	(1)
1948.....	27	(1)	-----
1949.....	239	(1)	1
1950.....	5,093	2	. 1, 20

¹ Less than 0.5 ton.

TABLE 21.—Lead pigments and salts exported, 1946-50

[U. S. Department of Commerce]

Year	White lead
1946.....	916
1947.....	863
1948.....	683
1949.....	699
1950.....	814

TABLE 22.—Zinc pigments and salts exported, 1946-50

[U. S. Department of Commerce]

Year	Short tons		Total value ¹
	Zinc oxide	Lithopone	
1946.....	7,102	11,576	\$2,554,177
1947.....	10,955	9,651	2,911,457
1948.....	19,082	13,652	6,554,250

¹ Includes also in 1946: Zinc sulfide, \$25,399 (173,475 pounds); zinc sulfate, \$62,119 (1,243,826 pounds); other zinc salts, \$1,111 (1,111 pounds). Since Jan. 1, 1946, none of the foregoing classes separately reported.

WORLD PRODUCTION

Australia.—The plant of Durban at Braybrook, Victoria, for the production of other pigments for the rubber, paint, and varnish industry was mentioned in the report of the recently.²

Canada.—A report of the Dominion Bureau of Statistics published early in 1951 gave data on the production of lead and zinc pigments and varnish industry in Canada in 1949 are as follows (1948 figures in thousands of pounds):

² Chemical Engineering, vol. 58, No. 2, February 1950

Basic carbonate white lead (dry) 1,303 (2,344) short tons, basic carbonate white lead in oil 458 (717) tons, basic sulfate white lead 118 (22) tons, red lead (including orange mineral) 565 (691) tons, litharge 256 (300) tons, zinc oxide (lead-free) 2,013 (2,975) tons, loaded zinc oxide 1,071 (2,096) tons, lithopone (30 percent zinc sulfide) 5,767 (11,851) tons, titanium dioxide 5,894 (5,766) tons, extended titanium dioxide pigments 10,832 (8,791) tons, and "other white pigments" 705 (529) tons.

Canada's imports of lithopone, 8,141 and 14,787 tons, respectively, in 1949 and 1948, were large enough to more than cover use in the 2 years. Imports of zinc white (zinc oxide) were 1,094 and 1,732 tons, respectively. Imports of the other items listed in the preceding paragraph are very small except for titanium pigments. Imports of this item were not shown separately in the Canadian report, but United States records for titanium dioxide and pigments show 19,653 tons exported to Canada in 1949 and 19,787 tons in 1948. In 1950 the United States shipped 24,450 tons to Canada.

Greece.—Output of litharge was 398 tons and of red lead, 267 tons in 1950, or declines of 9 and 26 percent, respectively, from 1949.³

Italy.—According to a recent report,⁴ about 5,000 metric tons of Italy's output of lithopone is absorbed by the domestic market, and the remainder is exported. Exports in 1949 were 2,000 tons, with Austria and Australia the chief destinations. Annual production capacity is 15,000 to 17,000 tons.⁵

Japan.—A recent article⁶ described the paint industry in Japan and commented on the strong influence of United States practice in Japan. The report stated:

In pigments, our attention is especially drawn to your Rutile-non-chalking titanium dioxide and Acicular zinc oxide. In oil, our attention is drawn to the process in applying drying properties by uniting non-saturated molecules to semidrying oil, and the products obtained therefrom such as styrenated oil, and the derivation of drying oil from semidrying oil and the product itself. In synthetic resin, we are interested in silico-resin, vinyl-resin, maleic-acid resin, and others such as anti-skinning agent, wetting agent, and emulsifier.

Norway.—Norway was reported⁷ facing inadequate supplies of zinc oxide, owing to efforts of the Ministry of Commerce to increase exports of high-grade zinc. According to the report, Norway's three zinc-oxide manufacturers have a total capacity of over 7,000 tons of zinc oxide annually and produced 5,210 metric tons in 1949. Imports in 1949 were 1,774 tons. From January 1 to October 1, 1950, only about 3,300 tons of zinc oxide were produced, and imports were only 70 tons. Industrial requirements were estimated as 6,500 to 7,000 tons annually, mostly for paint manufacture.

³ Foreign Commerce Weekly, vol. 43, No. 1, Apr. 2, 1951, p. 31.

⁴ Foreign Commerce Weekly, vol. 39, No. 13, June 26, 1950, p. 31.

⁵ Foreign Commerce Weekly, vol. 39, No. 10, June 5, 1950, p. 37.

⁶ Matsumoto, Tokui, Report From Japan: Paint Ind. Mag., vol. 65, No. 11, November 1950, pp. 212-214.

⁷ U. S. Embassy, Painters and Paint Manufacturers Face Zinc Oxide Shortage: Despatch 1013, Jan. 4, 1951, Oslo, Norway.

By Oliver Bowles, F. M.

GENERAL

THE HIGH level of industrial national preparedness and half of the year was reflected in production in 1950. Sales total higher than in 1949 and 3 percent in 1948. Of the total sales, 75 percent 25 percent hydrated lime. Total increased from \$10.48 in 1949 to \$12.31 in 1949. Active plants declined from 180

TABLE 1.—Salient statistics of the States 1925-29 (average).

Active plants.....	
Sold by producers:	
By types:	
Quicklime.....	short
Hydrated.....	
Total lime:	
Short tons.....	
Value ¹	
Per ton.....	
By uses:	
Agricultural.....	short
Building.....	
Chemical and industrial.....	
Refractory (dead-burned dolomite).....	
Imports for consumption.....	
Exports.....	

¹ Selling value, f. o. b. plant, excluding cost of operations.

Lime sales are influenced more by industries. Sales of building lime of new building construction, are reasonably close. However, since output of building lime has failed of new construction. Throughout 1, sales of refractory and chemicals of industrial production.

Trends in lime sales by principal indicated in figure 2.

¹ Figures in this chapter pertain chiefly to operations.

10,585 long tons, of which 2,457 were shipped to the United States, 8,113 to Malaya, and 15 tons to Netherlands. The only mines that have not been able to produce since the end of the war were the Pinyok mine and the Talering mine. Thailand Tin Mines, Ltd., found financial and technical difficulties in finishing the Cavaet plant at the Pinyok mine, and Tonghah Harbour Tin Dredging, Ltd., had to cope with hard dredging ground and a fuel problem at Talering.¹⁵

United Kingdom.—The London Metal Exchange reopened for dealings in tin in mid-November. Starting at around £600 per ton in January, by mid-August the price had reached £847; after further upward fluctuations, £1,300 was reached in November, easing slightly to £1,290 at the end of the year. Mine production totaled 960 tons in 1950 compared with 1,212 tons in 1949. United Kingdom smelter production of tin was the third largest in the world in 1950. Output declined 4 percent compared with 1949. Year-end stocks of tin in concentrate were 2,250 tons (6,080 at beginning of year) and of metal 7,217 tons (14,682 at the beginning). Total stocks, including tin metal and concentrates afloat and visible consumers' stocks, were reported to be 12,800 tons at the end of 1950—a 45-percent decrease from 23,138 tons at the beginning of the year. Total virgin tin consumed was 22,850 tons, 10 percent above 1949. The use of tin for making tin plate, the principal finished product, was virtually unchanged from 1949. Requirements for solder were 49 percent greater than in 1949.

¹⁵ Mining World, Apr. 15, 1951, p. 45.

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Titanium

By Frank J. Cserver



GENERAL SUMMARY

DESPI¹⁶ the great interest that has been shown in titanium as a structural metal, its continued, in 1950, to be the basic element of the ilmenite production. About 99 per cent of the ilmenite produced in 1950 was in the form of titanium metal.

New records were established in production of titanium metal in 1950. This was accomplished by a production of 11,000 tons, also a new record.

Titanium metal was produced commercially for the third successive year; commercial titanium-base alloys were also available in 1950. The search on production and utilization of titanium have aroused widespread interest. In 1950, for the first time, titanium metal was used in a wide range of fabricated products, such as tubing and wire, but producers of titanium products were unable to meet the heavy demand for mental applications.

The price of titanium sponge in 1950 was the price of aluminum 60 years ago or more. It is to be expected that the price of titanium will rise, as it has for aluminum, if production rises, as it has for aluminum. The present price the use of titanium is limited to parts, aircraft structures, and ordnance because of the combination of lightness, strength, and corrosion resistance enough to justify the high cost.

Large-scale mining was started by the Allard Lake area of Quebec. The largest deposit of ilmenite in the world was discovered here. This ore were begun at Sorel; one electric furnace was started in 1950. The high-titanium slag from the furnace was sold for export, principally to the United States, and metal. Although the price of this product is higher than that of domestic and imported ores, its quality is expected to be such as to command a higher price. This source assures the United States of raw material for the industry for many years.

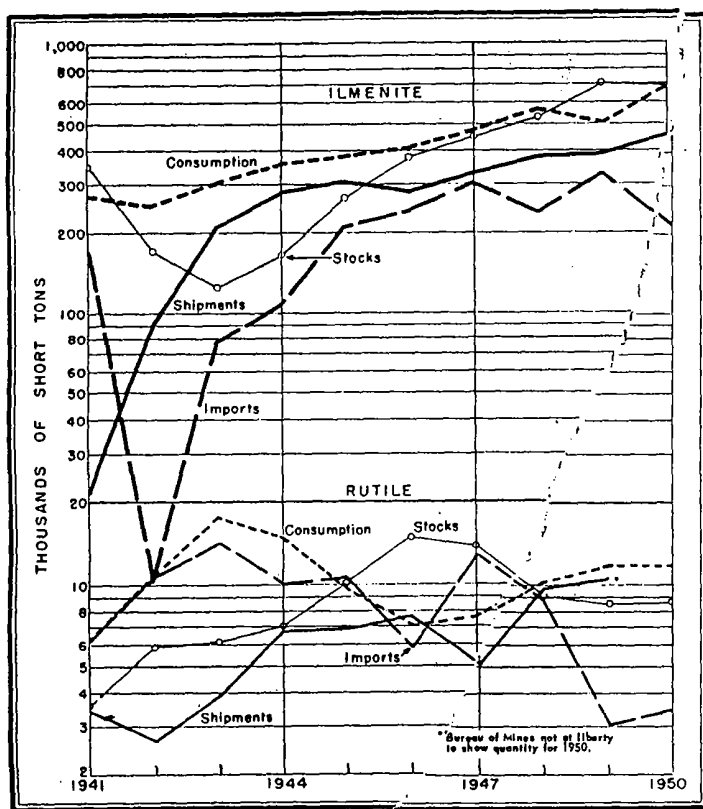


FIGURE 1.—Trends in domestic shipments, imports, consumption, and stocks of ilmenite and rutile, 1941-50

RESERVES

In his survey of the relative abundance of elements for the U. S. Geological Survey in 1924, F. W. Clarke found that titanium was the fourth most plentiful structural metal in the earth's crust, being exceeded only by iron, aluminum, and magnesium. However, only a few minerals bearing titanium are known to occur in bodies large enough to have economic importance. The principal minerals of titanium are rutile (TiO_2) and ilmenite (FeTiO_3); it also occurs as arizonite, titanite, and perovskite.

Titanium ores are found extensively throughout the United States, Canada, India, Australia, Norway, Ceylon, Brazil, Sweden, and the U. S. S. R. Large ilmenite deposits occur in Virginia and North Carolina. Extensive deposits of titaniferous iron ores occur in New York, Minnesota, Rhode Island, Wyoming, California, and New Mexico. Other occurrences of iron ores rich in titanium have been reported in North Carolina, South Carolina, Tennessee, New Jersey,

TITANIUM

Colorado, Montana, and Oklahoma. Rutile minerals are found in beach sands at many Pacific, and Gulf coasts; they have been used to some extent in Oregon. Rutile deposits are also found in Arkansas.

The more significant publications issued on occurrence, exploration, mining, and treatment were listed in a bibliography prepared by the Bureau of Mines.

The Magnet Cove rutile deposit, Hot Springs, Ark., explored by the Bureau of Mines; this was the only ore body from the previously mined Magnet Cove deposit.

Laboratory tests at the Bureau of Mines, Rolla, Mo., indicated that an ilmenite concentrate (93 percent TiO_2) and iron-ore concentrate could be recovered from the residue of the Hurricane Creek aluminum plant, Reynolds Metals Co.³

DOMESTIC PRODUCTION

Production of ilmenite in 1950 was 468,320 tons. New York supplied more than one-half, 230,826 tons, and the remainder came from North Carolina.

Both production and shipments of ilmenite in 1950 established new records for the industry. The Magnet Cove deposit, which has been mined since 1945, in 1950 includes a small quantity of altered ilmenite, leucocoxene, and rutile. The analysis of shipments of ilmenite ranged from 83 to 100 percent TiO_2 . Rutile shipments averaged 93 percent TiO_2 .

TABLE 1.—Production and mine shipments of domestic ores in the United States, 1941-45 (average) and 1950

Year	Ilmenite				Production (gross weight)
	Production (gross weight)	Shipments			
		Gross weight	TiO ₂ content	Value	
1941-45 (average)....	178,236	183,189	83,098	\$4,094,353	
1946.....	282,447	282,708	130,624	4,878,917	
1947.....	335,533	335,061	157,328	5,029,490	
1948.....	353,745	381,608	177,447	5,793,973	
1949.....	402,334	389,234	186,535	6,212,348	
1950.....	468,320	452,370	230,826	6,000,584	

¹ Includes a mixed product containing altered ilmenite, leucocoxene, and rutile.

² Bureau of Mines not at liberty to publish.

³ Carpenter, Jean Richards, and Luttrell, Gwendolyn Werth, Bituminous Coal, U. S. Geol. Survey Circ. 87, 1951, 19 pp.

⁴ Reed, Donald F., Investigation of Magnet Cove Rutile Deposits, U. S. Geol. Survey Prof. Paper 4593, 1949, 9 pp.

⁵ Calhoun, W. A., Titanium and Iron Minerals from Black Sands, U. S. Geol. Survey Prof. Paper 4621, 1950, 16 pp.

Important developments during 1950 included the formation of new titanium organizations. Rem-Cru Titanium, Inc., jointly owned by Remington Arms Co. and Crucible Steel Co. of America, was formed to make titanium and titanium-alloy products. National Lead Co. and Allegheny Ludlum Steel Corp. organized Titanium Metals Corp. of America to market and distribute titanium metal, its alloys, and various related products. Sharon Steel Corp. also announced that it was joining the ranks of steel companies going into the titanium-sheet business.

California.—A small quantity of ilmenite was produced at the property of the Ferro Titan Minerals Co., Sun Valley, Los Angeles County, Calif.

Florida.—The new operations of E. I. du Pont de Nemours & Co. at Starke, Fla., completed its first full year of operation. This property produced ilmenite and a mixed product containing altered ilmenite, leucoxene, and rutile.

Production of ilmenite and rutile in 1950 came again from the Rutile Mining Co. of Florida near Jacksonville. A small quantity of ilmenite and rutile was produced from the property of the Florida Ore Processing Co., near Melbourne, Fla., which was undergoing reorganization in 1950.

New York.—Production of ilmenite at Tahawus, Essex County, N. Y., by the National Lead Co. in 1950 was slightly below the peak production attained in 1949.

North Carolina.—The Yadkin Mica & Ilmenite Co., subsidiary of the Glidden Co., produced 26,543 tons of ilmenite (averaging 51 percent TiO_2) at Finley, Caldwell County, N. C., and shipped 25,843 tons. Production in 1950 was 15 percent under the record rate established in 1949.

Virginia.—Ilmenite was produced in 1950 at Piney River, Nelson County, Va., by the Calco Chemical Division of the American Cyanamid Co. Production at this property in 1950 increased about one-third over that in 1949.

CONSUMPTION AND USES

The consumption of ilmenite in 1950 was 33 percent higher than in 1949, establishing a new record of 679,244 tons. The manufacture of pigments again accounted for 99 percent of all ilmenite consumed. Rutile consumption in 1950 increased mainly in welding-rod coatings and alloys and carbide. Rutile consumption reported in 1949 included a mixed product containing altered ilmenite, leucoxene, and rutile; this product is included with ilmenite for 1950.

TITANIUM

TABLE 2.—Consumption of ilmenite and rutile in total, and 1948-50, by products, in a

Product	Gross weight
	Ilmenite
1942.....	257,635
1943.....	302,822
1944.....	360,941
1945.....	381,178
1946.....	404,283
1947.....	479,524
1948	
Pigments (manufactured titanium dioxide) ¹	558,448
Welding-rod coatings ²	145
Alloys and carbide.....	6,377
Ceramics.....	
Miscellaneous.....	30
Total.....	665,000
1949	
Pigments (manufactured titanium dioxide) ¹	605,432
Welding-rod coatings ²	165
Alloys and carbide.....	4,969
Ceramics.....	
Miscellaneous.....	42
Total.....	610,608
1950	
Pigments (manufactured titanium dioxide) ¹	671,335
Welding-rod coatings ²	210
Alloys and carbide.....	7,666
Ceramics.....	
Miscellaneous.....	33
Total.....	679,244

¹ "Pigments" include all manufactured titanium dioxide, consumption was 1,338 tons in 1948, 1,082 tons in 1949, and 1,439 tons in 1950.

² Included in "Miscellaneous," in order to avoid disclosure of individual companies.

³ Includes rutile used to make pigments.

⁴ Includes a mixed product containing altered ilmenite, leucoxene, and metal.

Titanium Pigments.—Production and shipments were 18 and 21 percent, respectively, in 1948. Figures in this industry are supplied infrequently are not given here. The percentage of pigment shipments, by consuming industries,

TABLE 3.—Distribution of titanium pigment shipments, by industries, 1935-45 (average) and 1946-50, in percent of total

Industry	1935-45 (average)	1946	1947	1948	1949	1950
Distribution by gross weight:						
Paints, varnishes, and lacquers.....	77.7	78.6	81.3	76.4	74.5	74.6
Floor coverings (linoleum and felt base).....	2.5	2.5	3.7	4.5	4.6	4.2
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.).....	3.0	1.8	2.1	2.1	1.6	1.5
Rubber.....	2.5	2.0	2.6	2.5	3.1	3.0
Paper.....	6.8	6.1	5.5	5.4	6.6	6.2
Printing ink.....	1.0	.9	.9	.9	.9	.9
Other.....	6.5	8.1	3.7	8.2	8.7	9.7
Total.....	100.0	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:						
Paints, varnishes, and lacquers.....	68.8	71.9	74.3	69.9	67.5	66.9
Floor coverings (linoleum and felt base).....	3.0	3.1	4.7	5.9	5.8	5.2
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.).....	3.7	2.3	2.6	2.7	2.1	2.0
Rubber.....	2.9	2.8	3.4	3.2	3.9	3.9
Paper.....	9.9	8.6	7.8	7.4	9.6	9.1
Printing ink.....	1.7	1.5	1.5	1.4	1.4	1.4
Other.....	9.1	9.8	5.7	9.5	9.7	11.5
Total.....	100.0	100.0	100.0	100.0	100.0	100.0

Metal.—Titanium metal was produced on a commercial basis for the third successive year. Pilot plants were operated in 1950 by E. I. du Pont de Nemours & Co. at Newport, Del., and by the National Lead Co. at Sayreville, N. J. The Bureau of Mines pilot plant at Boulder City, Nev., produced 13,810 pounds of titanium sponge in 1950 giving a total of 34,000 pounds of metal produced at this plant since 1945.

The nominal annual capacity of all titanium pilot plants in operation in 1950 was 300,000 pounds; however, production of metal was only about 50 percent of this amount because the pilot plants were operated experimentally and did not produce continuously at designed capacity.

At the end of 1950, E. I. du Pont de Nemours and National Lead were both considering substantial expansions. Du Pont started construction of a commercial plant with a nominal capacity of 600 tons per year and was considering additional expansion in 1951. National Lead leased several buildings at the Henderson, Nev., site of the former Basic Magnesium, Inc., plant and announced plans for expanded production of titanium, as well as the magnesium to be used as a reducing agent in titanium production.

Commercially pure titanium metal (approximately 99.5 percent Ti) was offered in limited quantities in a wide range of products, such as large sheets, strip, plate, bar, forgings, tubing, and wire. Titanium ingots weighing 500 pounds were produced during 1950, and production of larger ingots was reported at the end of the year. Producers of titanium sponge, ingot, and products could not meet the heavy demands for strategic and experimental applications.

Titanium powder, 96-98 percent Ti, was produced by Metal Hydrides Inc., Beverly, Mass. This plant also produced cast titanium suitable for addition to nonferrous alloys, titanium hydride for powder metallurgy and chemical reactions, and titanium master alloys in powder and ingot form.

The Foote Mineral Co., Philadelphia, Pa. Palmerton, Pa., produced small quantities of titanium 99.9+ percent Ti, by thermal decomposition of titanium iodides. This metal is used primarily for information on the properties of titanium of high purity metal is costly and was not available in 1950.

Welding-Rod Coatings.—Production of titanium rods was 188,000 short tons in 1950, an increase from 154,000 short tons in 1949; 188,000 tons were produced in 1947, and 481,000 tons in 1943. Of the rods produced in 1950, 32 percent were coated with natural rutile, 32 percent with titanium dioxide, 7 percent with both varieties, and 29 percent with other coatings.

Other Uses.—Ceramic titanates are finding an important place in the electronic industry. Solutions of barium and strontium titanate in organic solvents show remarkable dielectric constants and show remarkable stability. The chief advantages of titanate capacitors are compactness and high-frequency operation. They are used in pick-ups, microphones, and high-frequency oscillators. Titanate ceramic radiators for production of ultrasonic waves in application of ultrasonic radiation.

The use of titanium dioxide as the major component in enamel enamels is finding increased application. Titanium dioxide is used in enamels, signs, reflectors, architectural products, and low ware. The chief advantages of titanium dioxide are opacity or hiding power, extreme hardness, and resistance to staining.

Titanium compounds have been used extensively as agents for fabrics. A titanate complex, found to be effective in providing fire resistance, has been applied to many types of cellulose fabrics.

The alkyl titanates, derived from the acid anhydrides of titanium, were reported to be valuable as agents. These compounds can impart a water-repellent character to diverse materials as paper, cotton, wool, rayon, and wood. Potential industrial applications are being investigated for the availability of these compounds at a reasonable cost.

Clear, transparent rutile gems were available in 1950. They were produced by fusing purified titanium dioxide. Gems cut from these boules exhibit brilliant colors. Rutile gems are only seven-tenths as hard as diamond. They have an index of refraction of 2.7 compared with 2.4 for diamond, which means a higher degree of internal reflection.

The numerous uses of titanium in steel alloys are discussed in detail in a text published in 1949.⁸

⁸ Jaffe, Hans, *Titanate Ceramics for Electromechanical Purposes*, Wiley, New York, 1949, pp. 264-268.

⁹ Spencer-Strong, G. H., and Patrick, Robt. F., *Titanium in Industry*, No. 2, February 1950, pp. 253-256.

¹⁰ Panik, I. M., Sullivan, W. F., and Jacobsen, A. E., *Titanium Compounds*, American Dyestuff Reporter, vol. 39, Aug. 7, 1950, pp. 60-61.

¹¹ Speer, Robt. J., and Carmody, D. R., *Organic Compounds of Titanium*, No. 2, February 1950, pp. 251-253.

¹² Comstock, G. F., Urban, S. F., and Cohen, M., *Titanium in Steel*, No. 2, February 1950, pp. 251-253.

STOCKS

Inventories of ilmenite in 1950 decreased slightly, and those of rutile reflected little change from 1949. Year-end stocks of ilmenite and rutile (TiO₂ content basis) were sufficient to sustain industry at the 1950 rate of use for 11 months and 9 months, respectively.

TABLE 4.—Stocks of titanium concentrates in the United States at end of year, 1949–50, in short tons

Stocks	1949				1950			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content
Mine.....	10,933	7,569	2,952	2,750	32,883	15,240	3,810	3,543
Distributors ¹ ..	188	92	2,071	1,967	172	100	2,216	2,113
Consumers.....	681,767	331,483	3,691	3,355	649,203	318,862	2,653	2,466
Total.....	698,848	339,144	8,614	8,072	682,258	334,202	8,679	8,122

¹ Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

² Revised figure.

PRICES

Ore.—Quotations in E&MJ Metal and Mineral Markets covering ilmenite were unchanged in 1950. Nominal quotations for 56–59 percent TiO₂, per gross ton, f.o.b. Atlantic seaboard, according to grade and impurities, remained at \$14–\$16. Nominal quotations for rutile concentrate, guaranteed minimum 94 percent TiO₂, were 4–5 cents a pound until April 1950, when they dropped to 3½–4½ cents for the rest of the year.

Ferrotitanium.—According to the magazine Steel, quotations for ferrotitanium during the first 5 months of 1950 were as follows:

Ferrotitanium, Low-Carbon: (Ti 20–25 percent, Al 3.5 percent maximum, Si 4 percent maximum, C 0.10 percent maximum). Contract, ton lots, 2" x D, \$1.40 per pound of contained Ti; less ton \$1.45. (Ti 38–43 percent, Al 8 percent maximum, Si 4 percent maximum, C 0.10 percent maximum). Ton lot \$1.28 less ton \$1.35, f. o. b. Niagara Falls, N. Y., freight allowed to St. Louis. Spot add 5¢.

Ferrotitanium, High-Carbon: (Ti 15–18 percent, C 6–8 percent). Contract \$160 per net ton, f. o. b. Niagara Falls, N. Y., freight allowed to destination east of Mississippi River and north of Baltimore and St. Louis.

Ferrotitanium, Medium-Carbon: (Ti 17–21 percent, C 3–4.5 percent). Contract, \$175 per ton, f. o. b. Niagara Falls, N. Y., freight not exceeding St. Louis rate allowed.

TITANIUM

Quotations for low-carbon ferrotitanium continued of the year at \$1.40 and \$1.45 per pound of contained Ti for ton and less-than-ton lots. Quotations for titanium increased to \$167 per net ton in June, continued for the remainder of the year. Quotations for titanium increased to \$183 per ton in June also were reported during the remainder of 1950.

Metal.—Titanium metal, 96–98 percent, was quoted during 1950. Titanium sponge metal (titanium 90 percent iron 0.25 percent maximum, nitrogen 0.05 percent maximum) quoted by E. I. du Pont de Nemours & Co., P. D. Wilmington, Del., at \$7.50 per pound in quantities of 100 pounds and \$5 per pound in quantities of 1000 pounds f.o.b. shipping point. Titanium Metals Co., New York, N. Y., announced the following prices for commercially pure and alloy grades, in October 1950: Hot and cold-rolled sheets, \$11 per pound in lots of 10,000 pounds and over in commercial grades f.o.b. mill: Hot and cold-rolled sheets, \$11 per pound; hot-rolled sheared mill plate, \$12, Brackenridge; West Leechburg, Pa.; rolled or cold-drawn round bars, \$10, Dunkirk, N. Y.; for and round-cornered squares and rectangles, \$8, hot-rolled bars (rounds, flats, and squares), \$6.

Manufactured Titanium Dioxide.—Prices, in December 1950, for manufactured titanium dioxide (anatase) as quoted by Drug Reporter for the first 11 months of 1950 were: Ceramic, 19½ cents; chalk-resistant, 19½ cents; (rutile) nonchalking, 21½ cents. These prices were for bags, delivered. In December quotations were for grades. The ceramic and chalk-resistant grades ranged from 21–21½ cents and (rutile) nonchalking a plain grade was not shown in the December quotations. "regular" grade was added at 21–21½ cents.

FOREIGN TRADE¹

Imports.—Receipts of ilmenite in 1950 were less than the record established in 1949; the 1945. Imports from India, the dominant source, those from Norway dropped 18 percent. India and Norway, the second most important source, total.

All imports of rutile were from Australia for the year and totaled 3,427 tons, 11 percent above 1949.

¹ Figures on imports and exports compiled by M. B. Price and E. D. Price, records of the U. S. Department of Commerce.

TABLE 5.—Titanium concentrates¹ imported for consumption in the United States, 1941-45 (average) and 1946-50, by countries, in short tons

[U. S. Department of Commerce]

Country of origin	1941-45 (average)	1946	1947	1948	1949	1950
ILMENITE						
Australia ²	544		1,659	(³)		112
Brazil	4,203	2	1	8,708		
Canada	23,054	1,250	7,122	4,619	540	1,357
Ceylon	930				721	
Egypt						1
France						
India	81,592	218,623	262,503	184,309	289,739	187,834
Malaya				3,335		
Norway	1,979	21,077	30,926	41,248	33,165	27,165
Portugal	104					
Total as reported.....	112,516	240,952	301,311	242,119	324,157	216,459
Australia: In "zirconium ore" ⁴	3,120	1,388				
Grand total.....	115,642	242,340	301,311	242,119	324,157	216,459
Value of "as reported".....	\$576,793	\$1,440,112	\$1,791,020	\$1,788,848	\$2,470,071	\$1,198,545
ROUTILE						
Australia ²	1,949	4,377	7,460	8,771	3,085	3,427
Brazil	2,848	31				
French Cameroon ⁵	248		3			
India	190		113			
Norway				(³)		
Total as reported.....	5,235	4,408	7,576	8,771	3,085	3,427
Australia: In "zirconium ore"	5,120	1,456				
In "ilmenite"			5,061			
Grand total.....	10,355	5,864	12,637	8,771	3,085	3,427
Value of "as reported".....	\$424,834	\$213,795	\$468,810	\$588,713	\$179,746	\$140,733

¹ Classified as "ore" by the U. S. Department of Commerce.² Most of the imports of titanium from Australia in 1940-47 were in mixed zircon-rutile-ilmenite concentrates, which were included as ilmenite, rutile, and zirconium ore in U. S. Department of Commerce figures. The quantities reported by the U. S. Department of Commerce have been adjusted to reflect percentage content of each item based on reports to the Bureau of Mines from importers.³ Less than 0.5 ton.⁴ Includes 309 tons not recovered from mixed concentrates.⁵ Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

Exports.—Shipments of titanium pigments from the United States again established a new high level in 1950. As in previous years, titanium pigments constituted the major portion of exports of titanium materials. Canada continued to be the chief recipient with 24,450 tons, followed by Mexico with 1,579 tons, France 1,308, Brazil 1,062, Cuba 737, Belgium-Luxembourg 601. The remainder was distributed among 41 other countries. Exports of concentrates were the lowest since 1944 with Canada receiving 435 tons, Argentina 67, Netherlands 55, and eight other countries the remainder. Canada received 137 tons of the ferro-alloys exported and Belgium-Luxembourg 24; insignificant quantities went to four other countries.

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TABLE 6.—Exports of titanium products from the United States, 1941-45 (average) and 1946-50, by class

[U. S. Department of Commerce]

Year	Concentrates		Ferro-alloys	
	Short tons	Value	Short tons	Value
1943-45 (average).....	492	\$82,575	1,706	\$122,478
1946.....	1,385	200,860	550	63,723
1947.....	1,266	192,703	509	80,590
1948.....	1,454	187,225	480	82,874
1949.....	1,505	143,412	179	40,018
1950.....	600	57,753	171	42,741

¹ Includes metal and nonferrous alloys in 1943-44.² Beginning Jan. 1, 1946, not separately classified.

TECHNOLOGY

Metallic titanium owes its importance to its properties—lightness, strength, and resistance to corrosion. The density of titanium is 0.16 pound per cubic inch, compared with 0.09 for aluminum but only 56 percent as heavy as steel. Titanium alloys are much stronger than aluminum alloys, with strength and hardness approaching that of steel. The strength-to-weight ratio at ordinary temperatures is higher than either aluminum or stainless steel. Titanium has excellent resistance to fatigue and great impact strength. It is more resistant to corrosion than aluminum, especially in seawater and marine atmospheric weathering.

The chief disadvantages are high cost, and its excessive reactivity at high temperatures. The melting point of titanium—3,150° F.—is high, and it combines with oxygen and nitrogen and becomes brittle at high temperatures.

Commercial production of titanium metal has been achieved through modifications of the Kroll process developed by V. M. Kroll. Titanium tetrachloride, produced by chlorination of titanium, is reduced to the metallic state with magnesium. Magnesium chloride and excess magnesium are removed, leaving a sponge-like titanium metal by vacuum distillation. The sponge or powder is consolidated by powder pressing or melted in induction or electric-arc furnaces.

A continuous method of producing titanium metal has been developed at the Battelle Memorial Institute in 1950. In this process, titanium tetrachloride is continuously added to a titanium tetrachloride reduction chamber to produce magnesium metal. The reaction product is at 1,400°–1,600° F. The reaction product is removed from the bottom of the reduction chamber into a chamber where the titanium is melted and the magnesium is removed.

¹ Wartman, F. S., Walker, J. P., Fuller, H. C., Cook, M. A., and others. Titanium at Boulder City, Nevada: Bureau of Mines Rept. of Investigation No. 4000.

magnesium are volatilized, condensed, and removed. A continuously formed titanium ingot is withdrawn from the bottom of the furnace.¹¹

Other processes under consideration include electrolytic reduction, use of mixtures of sodium and magnesium as reducing agents, reaction of titanium tetrachloride vapors and hydrogen in an arc, and improved iodide decomposition processes.¹²

The year 1950 was notable for increased interest in titanium technology.¹³ Extensive research was in progress in 1950 on high-strength titanium-base alloys. Rem-Cru Titanium, Inc., developed and sold manganese and manganese-aluminum titanium alloys,¹⁴ and the Titanium Metals Corp. of America offered chromium titanium alloys.¹⁵ The Navy Bureau of Aeronautics reported development of a light-weight chromium-aluminum titanium alloy as strong as high-strength steel.¹⁶

A general description of the process presumably to be used on Allard Lake titaniferous ore at the Quebec Iron & Titanium Corp. smelting project at Sorel, Canada, was reported in a patent issued to that firm.¹⁷ The process marks a new approach to the smelting of titaniferous ore. Previously the titanium and iron have been separated by a combination of ore dressing and normal smelting processes. Large amounts of flux were added to produce fluid slags and permit separation from the iron. The process used by Quebec Iron & Titanium Corp. utilizes little or no flux to give a titanium-rich slag of about 70 percent TiO_2 , suitable for further processing and also a marketable iron product. A proportioned charge of ore, coal and 0 - 10 percent of lime for fluxing is smelted at 1,500° to 1,700° C. in a stationary box-shape electric furnace. Low-ash coal, ranging from 8 to 14 percent of ore weight, slightly less than stoichiometric requirements to reduce the iron oxide and to carburize the iron, is included in the charge. Ores reported to be suitable for producing titanium-slag concentrate are those with titanium dioxide content of 30 to 50 percent, iron 30 to 50 percent, and gangue up to 12 percent.

A chemical technique was devised by the Bureau of Mines for utilizing certain domestic titaniferous iron ores. Ninety percent of the iron in Tahawus magnetite was recovered experimentally as an iron powder analyzing 90 percent metallic iron and containing 2 to 3 percent TiO_2 . The titania remains in the slag, from which it may be recovered as pigment-grade TiO_2 . The main steps are (1) sintering

¹¹ Maddex, P. J., and Eastwood, L. W., Ductile Titanium: Am. Inst. Min. and Met. Eng., Jour. Metals, vol. 188, No. 4, April 1950, pp. 634-640.

¹² Gonser, Bruce W., Titanium: Am. Inst. Min. and Met. Eng., Jour. Metals, vol. 1, No. 1, sec. 1, January 1949, pp. 6-9.

¹³ Industrial and Engineering Chemistry, Titanium Symposium: Vol. 42, February 1950, pp. 214-208.

¹⁴ Analytical Chemistry, Titanium Symposium: Vol. 22, February 1950, pp. 297-303.

¹⁵ Broughton, D. B., Less Common Metals: Ind. Eng. Chem., vol. 42, No. 10, October 1950, pp. 2023-2026.

¹⁶ U. S. Research and Development Board, Symposium on Titanium: PB 103564, November 1950, 108 pp. (Available from Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.)

¹⁷ Gonser, Bruce W., Titanium Alloys: Ind. Eng. Chem., vol. 42, No. 2, February 1950, pp. 222-226.

¹⁸ Craighead, O. M., Simmons, O. W., and Eastwood, L. W., Titanium Binary Alloys, Titanium Ternary Alloys, Titanium Quaternary Alloys: Am. Inst. Min. and Met. Eng., Jour. Metals, vol. 188, No. 3, March 1950, pp. 488-552.

¹⁹ Allen, A. H., Titanium—How It Fits in Your Tomorrow: Steel, vol. 128, No. 2, Jan. 8, 1951, pp. 54-82.

²⁰ Anthony, John, Alloys Widely Used of Titanium: Iron Age, vol. 160, No. 4, July 27, 1950, pp. 60-62.

²¹ P. R. Mallory Co. (for Bureau of Aeronautics). The Manufacture of Titanium Alloys: PB 100,006, November 1940. Library of Congress, Photoduplication Service, Publications Board Project, Washington, D. C.

²² Pelros, W. M., and others, Titaniferous Material for Producing Titanium Dioxide: United States Patent 2,476,453, July 19, 1919.

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the ore at 1,050° C. with carbon and soda metal powder, retaining the titania in the powdered iron from the slag, by magnetic methods; and (3) sulfuric-acid decomposition to recover the titania.¹⁸

WORLD REVIEW

World production of ilmenite and rutile broke records in 1950. The world production of ilmenite was 511,308 metric tons, an increase of 8 percent over 1949, production, estimated at 25,600 metric tons in 1949.

The United States continued to be the world's largest producer of ilmenite, supplying about one-half of the ilmenite produced in the world.

Available data on world production of ilmenite and rutile for the years 1944-50, by countries, in metric tons, are shown in table 7.

TABLE 7.—World production of titanium concentrates, 1944-50, by countries, in metric tons

(Compiled by Pauline Robert)

Country	1944	1945	1946	1947	1948	1949	1950
ILMENITE							
Australia:							
New South Wales.....	3,600	2,485	1,630				
Queensland.....	3,697	4,180	4,268				
Tasmania.....							
Western Australia.....							
Brazil.....	3,250	5,000					
Canada.....	30,820	12,834	1,275				
Egypt.....	0	46	146				
India.....	102,412	174,848	187,993	2,000			
Malaya.....							
Norway.....	03,975	28,312	52,674				
Portugal.....		301	633				
Senegal.....		3,200	4,191				
Spain.....	648	216	128				
United States.....	252,749	279,880	256,230	3,000			
Total ilmenite.....	461,050	511,308	509,004	0			
RUTILE							
Australia:							
New South Wales.....	4,697	5,202	4,876				
Queensland.....	4,246	4,606	3,407				
Brazil.....	1,504	1,160	1,28				
French Cameroon.....	3,320	1,440	1,260				
French Equatorial Africa.....							
India.....	1,072	620	262				
Norway.....	86	76	63				
United States.....	0,279	0,513	0,761				
Total rutile.....	21,763	18,710	16,657				

¹ Excludes content of beach sand in stock dumps.

² Estimate.

³ Data not available; estimate included in total.

⁴ Exports.

⁵ Includes titanium slag containing approximately 70 percent TiO_2 .

⁶ Bureau of Mines not at liberty to publish figure.

⁷ MacMillan, Robert T., Dinnin, Joseph I., and Conley, John L., Low-Grade Titaniferous Ores: Bureau of Mines Rept. of Investiga-

Australia.—The Australian Titan Products Pty., Ltd., a subsidiary of British Titan Products Co., Ltd., operated its new titanium-pigment plant near Burnie, Tasmania, in 1950.¹⁹ This plant, with an annual capacity of 1,800 tons of titanium oxide, was completed in 1949. Plans to double plant capacity by installation of new equipment were completed in the latter part of 1950.²⁰ The titanium pigment has found a ready market in the Australian paint, enamel, rubber, soap, cosmetics, paper, and textile industries. Indian ilmenite was used as a raw material. Although Australia produces large amounts of ilmenite concentrate as a byproduct in the recovery of zircon and rutile from black sands, it is unsuitable for pigment manufacture because of its high chromite content, which ranges from 1 to 4 percent. Research on separation of chromite was in progress in 1950.

Canada.—The Allard Lake ilmenite property is being developed by the Quebec Iron & Titanium Corp., owned two-thirds by the Kennecott Copper Corp. and one-third by the New Jersey Zinc Co. The several basic operations consist of (1) mining the extensive ilmenite deposits in the Allard Lake district of the Quebec North Shore, north of Anticosti Island, (2) transportation, by company-owned railroad, to the docking and loading facilities at Havre St. Pierre, (3) pre-crushing and preparation of the ore at Havre St. Pierre, and (4) transportation by ship up the St. Lawrence to the smelter at Sorel. Mining operations eventually will center at the Lac Tio deposit, which is reported to contain more than 125 million tons and to be the largest deposit of its kind in the world. It is estimated that reserves, thus far proved, constitute 225 years' supply at the treatment rate of 1,500 tons per day. The grade of the ore is 35–36 percent TiO_2 and 40–42 percent Fe. Ore for the initial smelting operations was obtained from a small ore body near Grader Lake, 2 miles south of the main deposit, because it was near the railroad.

The mine will be operated for about 7 months, during the open shipping season. Enough ore will be mined, transported, and stockpiled during this period to feed the smelter on a year-round basis. Ore was being shipped from Grader Lake in October 1950 at the rate of three trainloads (570 tons each) daily. Approximately 100,000 tons of ore were delivered to Sorel in 1950. This will be ample for smelter operations beyond the time when navigation reopens in the spring of 1951. The railroad to Havre St. Pierre, 27 miles long, was completed near the end of 1950.

A temporary crushing plant has been built near the loading dock at Havre St. Pierre, pending construction of a permanent larger plant at Lac Tio. Loading facilities can handle from 2,000 to 2,800 tons per hour, and a 10,000-ton freighter can be loaded in 10 hours.

One 750-ton, 20,000-kw. furnace has been installed from which experimental tappings were made. Plans call for installation of four additional furnaces, starting in the spring of 1951. It is planned to

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build and maintain a stockpile of approximately of prepared ore. A contract has been negotiated with the Water & Power Co. for 165,000 hp. to be available at the rate as production gets under way.

Coproducts will be titanium dioxide slag with ultimate annual production of 250,000 tons, derived from 550,000 tons of ore. Accordingly, the company product will be competitive with the price will be higher than for other TiO₂ concentration, quality, and uniformity and the product will be able to command this price. All of the production is intended for export to the United States. The iron product, as described by the company, is low in carbon to be classed as pig iron and cannot be properly classified as steel. It has been called "specification steel," and Canadian steel interest in it as a possible source of No. 1 steel has been understood the company plans to market it domestically. No information was forthcoming for eventual production of titanium metal from both Kennecott and New Jersey Zinc at the time of the line.²¹

Dominion Magnesium is producing titanium compounds for use in high-temperature alloys at a pilot plant at Haley, Ontario. Although the grade of the ore is 98.5 to 99 percent plus was obtainable, commercial titanium metal has not yet been reported.

Ceylon.—Consideration has been given for the production of ilmenite from extensive beach deposits. It is reported that provision was made in the Ceylon Government for building an ilmenite milling plant, probably at Trincomalee on the east coast.²² According to a mineralogist, the sands contain about 70 percent rutile, and 8 percent zircon.²³ Ceylon at the time of the report was producing about 60,000 tons of ilmenite (about 54 percent rutile).

India.—Exports of ilmenite from India to the United States from 289,739 short tons in 1949 to 187,833 short tons in 1950. Production of ilmenite has been greatly hampered since the government took over the ilmenite industry.

A plant for the production of titanium metal is under construction by the Travancore Titanium Products Co. The plant will consume only about 3,600 tons of ilmenite. It appears that India will continue to be a large source of ilmenite for the 1950 shipping season, India invites foreign buyers to submit inquiries concerning the metal.²⁴

¹⁹ Chemical Engineering, vol. 57, No. 4, April 1950, p. 234.

²⁰ Chemical Engineering and Mining Review, vol. 43, No. 1, Oct. 10, 1950, p. 19.

²¹ Cross, Cecil M. F., Progress Report on the Quebec Iron & Titanium Project, American Embassy, Montreal, Canada, Oct. 25, 1950, 5 pp.

²² Canada Mining Journal, Ilmenite in Ceylon: Vol. 71, No. 3, March 1950, p. 27.

²³ Foreign Commerce Weekly, vol. 38, No. 2, Jan. 9, 1950, p. 27.

²⁴ Foreign Commerce Weekly, vol. 37, No. 10, Dec. 5, 1949, p. 1.

United Kingdom.—The National Physical Laboratory and Royal Aircraft Establishment conducted research on titanium phase diagrams, analytical methods, alloys, thermodynamics, and production processes. Reduction of titanium tetrachloride with hydrogen, electrolytic, and new electrothermic processes for producing titanium metal were under consideration.

¹⁰ The Chemical Age, Japanese Titanium Oxide: Vol. 63, No. 1628, Sept. 23, 1950, p. 441.

Tungst

By Robert W. ...



GENERAL SUM

INCREASED demand for tungsten in 1950 reversed the downward trend of both consumption and production concentrates. Later in the year, following the Korean conflict, consumption increased substantially. Demand for tungsten concentrates forced production to expand more than at any time since World War I. Class A (19 to 26 percent W) and Class B (19 to 26 percent W) concentrates increased 163 and 58 percent, respectively, in 1950 over 1949. Domestic producers of tungsten concentrates increased production at a rate that would have met the increased demand; however, domestic production was only 10 percent over 1949, and in the fourth quarter of 1950 it was over twice as high as in the corresponding quarter of 1949. In 1950, Tennessee was again the premier tungsten-producing state, followed by North Carolina and Nevada. The Pittsburgh-based Vanadium Corp. rose to first place among domestic producers of tungsten concentrates in 1950. The company, which suspended operations in 1949, resumed production from its Mill City, N. C., plant in 1950. A major factor in the increased domestic output was the expansion of the Vanadium Corp. plant at Mill City, N. C., which had been closed since 1949.

TABLE 1.—Salient statistics of tungsten or States, 1948-50, in pounds of

Year	Production	Shipments from mines	Imports for consumption	Consumption
1946.....	4,671,042	4,942,282	6,809,438	6,809,438
1947.....	3,028,470	4,044,622	6,018,008	7,848,101
1948.....	4,033,589	5,938,287	7,848,101	8,446,488
1949.....	2,806,064	2,831,406	6,374,102	6,374,102
1950.....	2,988,040	4,587,687	16,147,313	16,147,313

Imports of tungsten ores and concentrates (on a WO₃ basis), an increase from 6,592 tons in 1949 to 16,900 tons in 1950, are somewhat misleading because of large stockpiles in the United States Government warehouses by the United States Government as imports for consumption. A more accurate picture of imports is obtained from the "generalized" figures. The 8,765 tons for 1950 contrasted with 6,592 tons for 1949, based on 60-percent WO₃. In spite of the increase, tungsten supplied more of the general imports of minerals than in 1949.

Zinc¹

By Richard H. Mote and Esther B. Miller

GENERAL SUMMARY

RESPONDING to the demand generated by the outbreak of Korean hostilities and acceleration of the National Defense Program, the zinc industry produced a greater quantity of slab zinc in 1950 than in any prior year in the peacetime history of the United States. Output totaled 910,437 short tons, including 65 percent from domestic ores, 28 percent from foreign ores, and 7 percent from secondary sources. Domestic mine production of recoverable zinc rose 5 percent over 1949 to total 623,375 tons but was well below the World War II average (719,000 tons per year). Imports of zinc contained in ore and concentrates increased 13 percent to 272,538 tons and imports of slab zinc rose almost 23 percent to 155,974 tons.

Despite the record production and high level of imports the slab-zinc supply in 1950 was insufficient to fill all demands. Stocks at primary and secondary smelters were reduced 91 percent during the year to less than 9,000 tons on December 31, the smallest reserve since November 1925. Consumers' inventories were also reduced during the year and on December 31 were 26 percent under the quantity on hand on January 1.

The stringent supply situation prevalent throughout most of the year was reflected in increases in the price of slab zinc. The quotation for Prime Western grade zinc at East St. Louis ranged between 9.75 and 10.00 cents per pound during the first quarter of 1950. Beginning March 27, the price began to rise, and every change thereafter was upward until September 7, when it reached 17.50 cents, where it remained for the balance of the year.

¹ This report deals primarily with the smelter branch of the industry. Fuller details of zinc mining are given in the various State reports of this volume. As some zinc ore is used directly in the manufacture of zinc pigments, see also the chapter on Lead and Zinc Pigments and Zinc Salts.

ZINC

TABLE 1.—Salient statistics of the zinc industry (average) and 1949

	1941-45 (average)	1949
Production of primary slab zinc:		
By sources:		
From domestic ores.....short tons..	583,609	469,200
From foreign ores.....do.....	274,344	209,050
Total.....do.....	858,013	728,250
By methods:		
Electrolytic.....percent of total..	23	3
Distilled.....do.....	67	6
Production of redistilled secondary slab zinc.....short tons..	51,838	44,510
Stocks on hand at primary smelters Dec. 31.....short tons..	152,645	175,510
Price:		
Prime Western at St. Louis:		
Average for period.....cents per pound..	8.10	8.7
Highest quotation.....do.....	8.25	10.5
Lowest quotation.....do.....	7.25	8.2
Yearly average at London.....do.....	4.74	7.7
Mine production of recoverable zinc ¹ short tons..	718,869	574,830
Tri-State district (Joplin) percent of total..	28	2
Western States.....do.....	43	4
Other.....do.....	29	2
World smelter production of zinc short tons..	1,831,000	1,528,000

¹ Revised figure.
² Includes Alaska.

GOVERNMENT REGULATION

Government controls over the zinc industry began in the latter part of the year. Inventories were reduced by the Production Authority Regulation No. 1, and NPA Notice No. 1, effective December 1, 1949. Regulation No. 1, designed to prevent accumulation of materials in short supply, limited the quantity in stock to a practicable minimum working stock. Covered by this regulation included slab zinc, zinc dust, zinc oxide, and zinc and zinc-base alloys. Regulations issued to prevent hoarding of strategic materials, exceeding reasonable demand, required resale at prices over prevailing market prices for materials, including slab zinc, zinc-base alloys, as rolled and extruded shapes, wire, and base alloy scrap.

Priority ratings for defense orders were established by regulations issued by the NPA. Regulation No. 3, 1950, authorized the assignment of priority ratings to defense orders and gave priority to Order M-9, effective November 16, 1949, for producers and fabricators of zinc and zinc alloys. Under this order a producer of zinc, zinc alloys, or zinc-base alloys was required to accept rated orders for shipment in excess of 10 percent of his production capacity. No producer of zinc or zinc alloys was not required to accept rated orders exceeding 20 percent of his average monthly production during the first 8 months of 1950. Since

zinc, strip zinc, zinc wire, zinc rod, zinc shapes, and zinc plate were not required to accept orders exceeding 15 percent of the average monthly shipments of such products during the first 8 months of 1950. A dealer was not required to accept rated orders for shipment in any one month of a total tonnage that exceeded 15 percent of the total quantity available to him during the month. The order further stipulated that producers and fabricators were not required to accept rated orders received less than 30 days before the first day of the month in which shipment was requested.

NPA Order M-15, restricting civilian use of zinc metal and zinc metal products, was issued effective December 1, 1950, and limited civilian consumers of zinc metal and zinc-metal products during 1951 to an average quarterly rate of 80 percent of the use during the first 6 months of 1950. The order further specified that inventories were to be held to a 45-day supply or a "practicable minimum working inventory," whichever was less.

DOMESTIC PRODUCTION

Statistics on zinc production are compiled both on a mine basis and on a smelter basis. The mine-output data, based upon the zinc content of ores and concentrates produced (adjusted to account for average smelting losses), form an accurate measure of domestic zinc output from year to year. Smelter production of slab zinc from domestic ores represents a more accurate figure of actual zinc recovery but usually differs from the mine figure owing to a time-lag between mine or mill shipments and smelter production. Over a period of years, these variations tend to balance out within the limits of statistical error.

MINE PRODUCTION

Zinc mining in the United States is centered largely in five areas—the Tri-State area of southeastern Kansas, southwestern Missouri, and northeastern Oklahoma; Tennessee-Virginia; Sussex County, N. J.; St. Lawrence County, N. Y.; and the Western States (principally Idaho, Montana, Arizona, Colorado, Utah, New Mexico, Nevada, and Washington, in descending order of production in 1950).

Mine production in the combined Western States increased 3 percent in 1950 compared with 1949. Almost 59 percent of the total domestic output of zinc in 1950 (60 percent in 1949) was produced in the Western States.

Idaho continued to be the largest producer of zinc in the United States, about 98 percent of the State total in 1950 coming from the Coeur d'Alene region and most of the remainder from the Warm Springs district. Zinc-lead ore and old tailings concentrated yielded 91 percent of the State total zinc; old zinc slag smelted and fumed, 5 percent; and zinc ore concentrated and lead ore concentrated, 3 percent. The Star mine near Burke in the Coeur d'Alene region remained the largest Idaho zinc producer; it was followed by the Page, Morning, Bunker Hill and Sullivan, Sidney, Frisco, Bunker Hill slag dump, Spokane-Idaho, and Tamarack. These nine properties supplied 83 percent of Idaho's total zinc in 1950.

Owing to a record high output at the Butte Hill mines and dumps of the Anaconda Copper Mining Co., Montana zinc production

advanced 25 percent in 1950 to 67,678 tons, second among the zinc-producing States, a 1920. During 1950 Anaconda company-owned properties supplied 79 percent of the State's zinc output. Zinc producers during the year were the Kootenai old slag dump, the Travona mine in Silver Lake, and Mike Horse property at Flesher in Lewis and Clark. Five operations produced nearly 99 percent of the output. Of Montana zinc in 1950, 96 percent came from lead ore, nearly 4 percent from zinc ore and the remainder from gold, silver, lead, and copper.

Arizona zinc output in 1950 declined 14 percent from 1949 owing largely to a small output from the Copper Queen mine at Bisbee. Output at the Copper Queen mine dropped 41 percent from 1949. The largest producer in Arizona. Other important producers in order of output, were the Iron King mine near Verde branch of the Phelps Dodge Corp. at Sahuarita, St. Anthony property at Patagonia, Magma mine in Pinal County, and the mine at Dragoon (Coronado Copper & Zinc) property at Bagdad. More than 77 percent of the output came from zinc-lead ore and most of the remainder from copper, and zinc-lead-copper ores.

TABLE 2.—Mine production of recoverable zinc in the United States (average) and 1946-50, by States.

State	1941-45 (average)	1946
Western States and Alaska:		
Alaska.....		
Arizona.....	24,799	43,665
California.....	4,267	6,877
Colorado.....	33,562	36,147
Idaho.....	86,577	71,507
Montana.....	41,312	16,770
Nevada.....	16,226	22,649
New Mexico.....	46,974	36,103
Oregon.....		
South Dakota.....	43	44
Texas.....	41,422	28,292
Utah.....	12,004	11,320
Washington.....		
Total.....	307,066	273,383
West Central States:		
Arkansas.....	161	85
Kansas.....	59,294	47,703
Missouri.....	29,608	22,234
Oklahoma.....	117,589	69,562
Total.....	206,652	139,574
States east of the Mississippi River:		
Illinois.....	8,002	8,798
Kentucky.....	458	314
New Jersey.....	88,473	64,454
New York.....	38,164	32,616
Tennessee.....	39,312	24,614
Virginia.....	18,660	16,906
Wisconsin.....	12,232	14,276
Total.....	208,281	161,876
Grand total.....	718,869	574,833

TABLE 3.—Mine production of recoverable zinc in the United States,¹ 1949-50, by months, in short tons

Month	1949	1950	Month	1949	1950
January.....	51,966	43,808	August.....	45,289	55,487
February.....	53,235	46,327	September.....	42,268	54,858
March.....	62,395	51,999	October.....	39,219	55,937
April.....	59,571	49,319	November.....	42,447	55,432
May.....	50,304	52,160	December.....	40,019	57,493
June.....	54,557	50,874	Total.....	593,203	623,376
July.....	39,933	48,675			

¹ Includes Alaska.

Zinc production in Colorado declined slightly in 1950 after 4 years of successive increases. In Summit County at Kokomo, depletion of ore reserves in the Victory-Lucky Strike-Wilson-McKinley group of mines caused this large producer to close April 19. The subsequent decrease in Summit County's zinc output was partly offset by expanded production in Eagle, San Miguel, and Lake Counties and reopening in July of the Rico Argentine mine in Dolores County, closed since May 1949. The leading zinc producers, in order of rank, were the Eagle mine, Eagle County; Treasury Tunnel-Black Bear (Idarado) group, San Miguel County; Resurrection group, Lake County; Victory (American Smelting & Refining Co. Kokomo unit), Summit County; and Smuggler Union-Montana group, San Miguel County. Zinc, zinc-lead, and zinc-lead-copper ores yielded 93 percent of the Colorado total zinc in 1950.

Utah zinc output in 1950 decreased 22 percent from that in 1949 and was the smallest since 1946. This loss resulted mainly from the closing during part of the year of the United States & Lark property at Bingham and from reduced zinc output of mines in the Park City, Ophir, and Rush Valley (Stockton) districts. The Lark mine was shut from July 16 through October 28 because of a fire in the lower levels; the United States mine was idle 2 months owing to a labor strike. Despite the fire and labor difficulties that lowered zinc output in 1950 about 27 percent under 1949, the United States & Lark property remained by far the largest producer of zinc in Utah.

It was followed by the properties of the Chief Consolidated Mining Co., Park Utah Consolidated Mines Co., New Park Mining Co., Butterfield group, and Honorine, Cardiff, Hidden Treasure, and Calumet mines. These nine properties supplied 97 percent of the Utah total zinc in 1950. Over 97 percent of the State total zinc was recovered from zinc-lead ore.

Most New Mexico mines that had closed in 1949 as a result of the decline in the price of zinc metal reopened in 1950. In the Central district, the New Mexico Consolidated Mines Co. Kearney mine resumed operations February 27; the Kennecott Copper Corp. Oswaldo mine, the American Smelting & Refining Co. Ground Hog, and the United States Smelting, Refining & Mining Co. Bayard group reopened in June; and the Peru Mining Co. Pewabic mine reopened October 16. The Hanover mine and mill of the New Jersey Zinc Co., Empire Zinc Division, which had operated throughout 1949, were closed by a work stoppage October 17, 1950, and remained idle the balance of the year. The principal New Mexico producers of zinc in 1950, in order of output, were the Kearney, Hanover (Empire Zinc), Ground Hog, Oswaldo, and Bayard groups. Nearly 94 percent of the State total zinc in 1950 was recovered from zinc ore.

Nevada zinc production in 1950 was 6. Most of the output was centered in Esmeralda County, where zinc and zinc-lead ores are the source of 91 percent of the State total. In 1950, especially after midyear, made possible by a slag-fuming plant of notable tonnages from mines in Clark, Eureka, and White Pine Counties. The former Metals Reserve Co. World War ore at Jean, Nev. Leading Nevada producers were the Combined Metals Reduction Co. Pioche Mines, Inc., Ely Valley mine, both in Esmeralda County; the Copper Canyon Mining Co. Battle Mountain district, Lander County; and the Yellow Pine mine, Yellow Pine district. Zinc-lead ore accounted for 91 percent of the Nevada total zinc in 1950, and most of the remainder from zinc-lead-copper ore.

Recoverable zinc production in Washington was at its highest level on record, owing mainly to the reopening of zinc-lead ore milled at the Grandview mine, which replaced the Pend Oreille mine as the leading producer; it was followed by the Holden and the Grandview mines. These properties supplied nearly 90 percent of the State total zinc. Zinc-lead ore supplied over 74 percent of the total, zinc-copper ore 16 percent, and zinc ore 10 percent.

California zinc production in 1950 was 1.5 million short tons, a yield by a small margin. The Anaconda group of mines dominated the State output, accounting for 60 percent of the total, place, by the Coronado Copper & Zinc Co. in San Diego County, which resumed operation in August 1949 after a period of inactivity. In addition, the Anaconda group, the Penn Chemical Co. Penn Calaveras County; and the J. Q. Little Ivanpah district, San Bernardino County. The Anaconda group oxidized zinc ore to a slag-fuming plant—recoverable zinc. Over 65 percent of the total was derived from zinc-lead ore, 23 percent from zinc-copper ore, and the remainder from lead ore.

In Oregon a small tonnage of zinc was produced in the Bohemia district, Lane County.

Zinc production in the Tri-State district, which has been active since 1942, advanced slightly in 1950 as a result of higher lead concentrate prices during the latter part of the year, when during the first quarter of the year, when prices remained low, causing district output to decline. In the second quarter zinc prices improved, and prices remained low, causing district output to decline. Continued advances in prices for zinc-lead ore resulted in a 31-percent increase in mine output of the year compared with the first half. The leading producers in the Tri-State district in 1950 were the Eagle-Picher Mining & Smelting Co. (Oklahoma); B. Mining Co. (Oklahoma); National Lead Refining Division (Kansas); Federal Mining Co. (Missouri and Missouri); and Dale Mining Co. (Missouri).

Zinc production from mines in the St. Louis River increased 12 percent over 1949 in 1950.

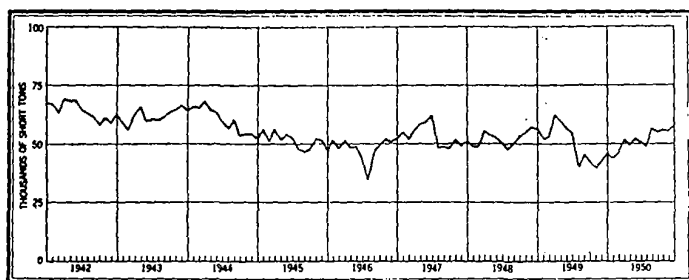


FIGURE 1.—Mine production of recoverable zinc in the United States, 1942-50, by months, in short tons.

ported in Illinois, Kentucky, New Jersey, New York, Tennessee, Virginia, and Wisconsin. The principal producer was again the New Jersey Zinc Co., operating the Franklin and Sterling Hill mines in New Jersey and the Austinville mine in Virginia. In Kentucky and Southern Illinois, zinc is produced chiefly as a byproduct or coproduct with fluorspar. The principal producers in this area were the Ozark-Mahoning Co. and the Minerva Oil Co. During the latter part of the year the Alcoa Mining Co. began producing and concentrating zinc ore from its newly developed Hutson mine in Kentucky. Output from the Kentucky-Southern Illinois area was 2 percent greater in 1950 than in 1949. New Jersey production was 8 percent greater than in 1949. Franklin and Sterling Hill, the two producing mines, operated continuously after resumption of work with the ending of a labor strike at the Palmerton, Pa., zinc smelter January 26. New York mines produced about the same quantity of zinc as in 1949, despite closing of the Universal Exploration Co. Hyatt mine on May 15. Other producers in New York during 1950 were the Balmat and Edwards mines, operated by the St. Joseph Lead Co. In Tennessee, zinc output increased 19 percent over 1949. The leading producers were: The American Zinc Co. of Tennessee, operating the Athletic, Grasselli, Jarnagin, and the Mascot No. 2 mines; the Universal Exploration Co.; and the Tennessee Copper Co. Production of zinc in 1950 in Virginia declined 6 percent compared with 1949, chiefly due to a labor strike from October 9 to November 23 at the Austinville mine of the New Jersey Zinc Co. The Wisconsin and Northern Illinois region reported a 50-percent increase in zinc output in 1950, most of which can be attributed to new operations of Calumet & Hecla Consolidated Copper Co. near Shullsburg, Wis., and the Eagle-Picher Mining & Smelting Co. near Galena, Ill. Other producers in the area include the Dodgeville Mining Co., Dodgeville, Wis. (operations resumed in July); the Vinegar Hill Zinc Co. near Shullsburg; and the Tri-State Zinc, Inc., in Illinois.

The 25 leading zinc-producing mines in the United States in 1950, listed in table 4, yielded 61 percent of the total domestic zinc output; the 3 leading mines produced over 21 percent and the 6 leading mines nearly 32 percent.

Detailed information on the production of mines and mining districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

Table 4.—Twenty-five leading zinc-producing mines in the United States in 1950, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Franklin & Sterling Hill	New Jersey	New Jersey	New Jersey Zinc Co.	Zinc.
2	Butte Hill mines & dump	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co.	Zinc-lead.
3	Balmat	St. Lawrence County	New York	St. Joseph Lead Co.	Do.
4	Star	Hunter	Idaho	Sullivan Mining Co.	Do.
5	Copper Queen	Warren (Blisbee)	Arizona	Phelps Dodge Corp.	Do.
6	Copper King Group	West (Magma)	Colorado	Empire Zinc Division, New Jersey Zinc Co.	Zinc.
7	United States & Mt.	West (Magma)	Colorado	C. S. Smelting, Mining & Smelting Co.	Zinc-lead.
8	Plocha Group	Plocha (Highland)	Nebraska	Nebraska Lead Co.	Do.
9	Mascot No. 2	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
10	Austinville	Austinville	Virginia	New Jersey Zinc Co.	Zinc-lead.
11	Edwards	St. Lawrence County	New York	St. Joseph Lead Co.	Zinc.
12	Iron King	Bleu	Idaho	Shattuck Denn Mining Corp.	Zinc-lead.
13	Pago Group	Yreka	Idaho	Federal Mining & Smelting Co.	Do.
14	Davis-Bible Group	Eastern Tennessee	Tennessee	Universal Exploration Co.	Zinc.
15	Gruma	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co.	Zinc-lead.
16	Griffin	Northern Illinois	Illinois	Eagle Picher Mining & Smelting Co.	Zinc.
17	Baerbach	Northern Illinois	Illinois	Phelps Dodge Corp.	Zinc-lead.
18	United Verde	Verde (Jerome)	Arizona	Phelps Dodge Corp.	Zinc-lead.
19	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Zinc-lead.
20	Kearney	Central	New Mexico	Parr Mining Co.	Zinc.
21	Sidney Group	Yreka	Idaho	Sidney Mining Co.	Zinc-lead.
22	Butte	Tri-State	Oklahoma	Nelle B. Mining Co.	Do.
23	Grasselli	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Do.
24	Grandview	Metalline	Washington	American Zinc Lead Smelting Co.	Do.

TABLE 5.—Mine production of recoverable zinc in the United States by districts that produced 1,000 tons or more during any year, 1941-45 (average) and 1946-50, in short tons

District	State	1941-45 (average)	1946	1947	1948	1949	1950
Coeur d'Alene region.....	Idaho.....	77,905	67,429	79,251	83,801	74,370	84,103
Tri-State (Joplin region).....	Kansas, Southwestern Missouri, Oklahoma.....	205,366	139,038	109,338	84,839	78,628	80,558
Summit Valley (Butte).....	Montana.....	18,300	7,108	40,712	52,625	47,982	63,511
New Jersey.....	New Jersey.....	88,473	64,454	76,871	76,332	50,984	55,029
St. Lawrence County.....	New York.....	38,154	32,515	34,116	34,566	37,973	38,321
Eastern Tennessee.....	Tennessee.....	39,312	24,614	31,212	29,524	29,788	35,328
Central.....	New Mexico.....	42,028	32,279	38,155	35,140	26,376	26,897
Upper Mississippi Valley.....	Northern Illinois, Iowa,* Wisconsin.....	14,236	18,344	17,077	14,061	17,846	28,793
Warren (Bisbee).....	Arizona.....	6,142	22,374	32,546	27,669	35,393	20,707
Red Cliff.....	Colorado.....	19,782	16,437	17,375	16,355	17,450	19,956
Pioche.....	Nevada.....	13,979	15,764	14,362	18,612	18,651	19,655
West Mountain (Bingham).....	Utah.....	20,071	7,593	20,446	22,077	22,311	16,120
Austinville.....	Virginia.....	18,020	16,905	16,788	15,882	13,166	12,396
Metalline.....	Washington.....	10,829	7,685	9,754	5,985	6,496	11,032
Big Bug.....	Arizona.....	5,234	5,234	4,991	5,832	8,798	10,416
Upper San Miguel.....	Colorado.....	778	1,963	2,067	3,486	6,004	8,881
Verde (Jerome).....	Arizona.....				459	4,350	7,800
Park City region.....	Utah.....	11,536	8,876	10,956	10,320	8,359	7,425
California (Leadville).....	Colorado.....	4,861	5,996	4,809	5,726	6,455	7,392
Kentucky-Southern Illinois.....	Kentucky, Southern Illinois.....	6,456	5,044	5,728	7,422	6,541	6,642
Tintic.....	Utah.....	2,243	3,710	3,969	3,680	6,082	5,985
Pima (Sierritas, Papago, Twin Buttes).....	Arizona.....	2,051	3,948	4,727	5,758	7,177	5,802
Coso.....	California.....	364	854	603	4,497	4,062	5,237
Old Hat (Oracle).....	Arizona.....	2,060	4,235	3,427	3,796	5,195	4,603
Harshaw.....	do.....	3,094	1,128	2,006	2,875	2,947	4,193
Ten Mile.....	Colorado.....	1,062	2,490	4,587	10,338	9,716	2,825
Pioneer (Superior).....	Arizona.....	3,648					2,695
Chelan Lake.....	Washington.....	1,085	1,730	1,000	3,289	2,724	2,430
Smelter (Lewis and Clark County).....	Montana.....	17,193	4,995	748	3,417	1,463	2,358
Magdalena.....	New Mexico.....	3,715	3,474	5,013	4,856	2,263	1,677
Eureka (Bagdad).....	Arizona.....	275	325	257	2,321	2,304	1,478
Pioneer (Rico).....	Colorado.....	3,580	3,435	3,433	3,180	1,354	1,365
Northport.....	Washington.....	910	1,790	2,788	3,271	1,412	1,304
Warm Springs.....	Idaho.....	5,266	2,161	2,791	1,545	1,635	1,236
Rush Valley and Smelter (Tooele County).....	Utah.....	6,835	6,365	5,642	3,552	2,188	1,219
Cochise.....	Arizona.....	326	2,877	3,143	2,875	1,760	1,025
Tomichi.....	Colorado.....	255	440	1,684	1,983	1,456	963
Animas.....	do.....	611	1,590	1,310	748	1,029	961
Aravaipa.....	Arizona.....	135	152	20	1,098	783	921

Hedderston.....	Montana.....	1,235	1,516	1,482	1,437	2,026	892
Snodgrass.....	Colorado.....	297	(¹)	(¹)	815	1,053	810
Brackenridge.....	do.....	258	1,110	1,279	171	2,2	427
Ophir.....	Utah.....	124	294	987	786	1,004	374
Campo Seco.....	California.....	569	3,301	2,350		363	326
Eureka (Lone Mountain).....	Nevada.....	289	3,705	897	19	108	321
Pinos Altos.....	New Mexico.....	412	81	724	1,056	243	144
Cow Creek.....	California.....	36			(¹)	(¹)	(¹)
Flat Creek.....	do.....	695	1,926	1,707			
Smelter (Cascade County).....	Montana.....					1,278	

¹ Includes very small quantity produced elsewhere in State.

² No production in Iowa since 1917.

³ Includes Peshastin Creek and Wenatchee River districts.

⁴ Quantity withheld to avoid disclosure of individual company operations.

⁵ This district is not listed in order of 1950 output.

SMELTER PRODUCTION

During 1950, 18 primary zinc-reduction plants were in operation; 9 operated with horizontal retorts exclusively, 4 with vertical retorts exclusively (1 electrothermic), and 5 with electrolytic methods.

Horizontal-Retort Plants.—The total number of retorts reported at horizontal-retort primary plants in 1950 was 54,624, a 2-percent reduction from the 55,584 retorts on December 31, 1949, at plants that operated during that year. Of the total retorts reported, 52,484 (96 percent) were in use at the close of 1950 compared with 51,652 (93 percent) in operation at the end of 1949.

Vertical-Retort Plants.—Four vertical retort continuous distilling plants operated during 1950. The total number of vertical retorts increased from 79 on December 31, 1949, to 88 at the end of 1950. At the close of the year 82 vertical retorts were in operation.

Electrolytic Plants.—Five electrolytic zinc reduction plants were in operation during 1950. There was a total of 3,360 cells at the plants on December 31, 1950, of which 3,322 (99 percent) were in operation. The number of cells at the end of 1949 was 3,370, of which 3,235 (96 percent) were operating.

Smelting Capacity.—Irrespective of additions or subtractions of smelter recovery units, statistics on domestic smelting capacity vary from year to year, owing to changes in metallurgical practices among the various plants. According to reports to the Bureau of Mines, the zinc-reduction plants in the United States on December 31, 1950, had a stated annual capacity of 1,044,000 tons of slab zinc under normal operating conditions, allowing for necessary shut-downs for repairs. This figure, which compares with a 1,035,000-ton reported capacity at the end of 1949, indicates that 1950 output was 87 percent of capacity. Horizontal- and vertical-retort plants operated at 86 percent of a stated 619,000-ton capacity (82 percent of a 621,000-ton capacity in 1949), electrolytic plants at 93 percent of a 369,000-ton capacity (90 percent of 362,500-ton capacity in 1949), and secondary smelters at 69 percent of a 56,000-ton capacity (62 percent of a 52,000-ton capacity in 1949).

Waelz Kilns.—The following companies operated Waelz kilns in 1950:

Arkansas: Fort Smith—The Residue Co.
Illinois:

Danville—The Hegeler Zinc Co.
Fairmont City—American Zinc Co. of Illinois.
La Salle—Matthiessen & Hegeler Zinc Co.

Kansas: Cherryvale—National Zinc Co., Inc.
Oklahoma: Henryetta—Eagle-Picher Mining & Smelting Co.
Pennsylvania:

Donora—American Steel & Wire Co.
Palmerton—New Jersey Zinc Co.

Slag-Fuming Plants.—The following companies operated slag-fuming plants in 1950 and produced impure zinc oxide, which was further treated to recover slab zinc:

Idaho: Bradley—Bunker Hill & Sullivan Mining & Concentrating Co.
Montana: East Helena—Anaconda Copper Mining Co.
Texas: El Paso—American Smelting & Refining Co.
Utah: Tooele—International Smelting & Refining Co.

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During 1950 these four plants treated 652 tons of slag, which yielded 102,826 tons of oxide and 1,028 tons of recoverable zinc. Corresponding figures for 1949 were 613,615, 98,263, and 65,263 tons.

Active Zinc-Reduction Plants.—Modernization of existing zinc smelters and the adoption of new techniques were important features of the zinc industry in 1950. The last of the old horizontal retorts with which the Palmerton, Pa., smelter was originally equipped was retired. At the end of September the company put into operation 43 vertical retorts, bringing the total to 43. The new retorts, which are equipped with splash cooling, have resulted in improved zinc recovery per retort.

Tests to establish the advantage of mechanical stirring at horizontal retort smelters continued at the Refining Co. plant in Amarillo, Tex. A mechanical stirrer was used during the year on all but two blast furnaces. As a result of tests on sintering raw concentrate in Oklahoma, smelter, the American Metal Co. began operation of a plant with one large machine 168 feet long and 10 feet high, the largest ever constructed, will produce 1,000 tons of raw concentrate per day and is expected to reduce operating cost, greater elimination of cadmium and desirable sinter than have heretofore been achieved by standard-size sintering machines.

A list of zinc-reduction plants operating in 1950 follows:

Primary zinc distillers

Horizontal-retort plants

Arkansas: Fort Smith—Athletic Mining & Smelting Co.
Illinois:

Fairmont City—American Zinc Co. of Illinois.
La Salle—Matthiessen & Hegeler Zinc Co.

Oklahoma:

Bartlesville—National Zinc Co., Inc.
Blackwell—Blackwell Zinc Co.

Henryetta—Eagle-Picher Mining & Smelting Co.
Pennsylvania: Donora—American Steel & Wire Co.
Texas:

Amarillo—American Smelting & Refining Co.
Dumas—American Zinc Co. of Illinois.

Vertical-retort plants

Illinois: Depue—The New Jersey Zinc Co.
Pennsylvania:

Josephstown—St. Joseph Lead Co.

Palmerton—The New Jersey Zinc Co. of Pennsylvania
West Virginia: Meadowbrook—E. I. du Pont de Nemours & Co.

Electrolytic plants

Idaho: Kellogg—Sullivan Mining Co.
Illinois: Monsanto—American Zinc Co. of Illinois.
Montana:

Anaconda—Anaconda Copper Mining Co.
Great Falls—Anaconda Copper Mining Co.

Texas: Corpus Christi—American Smelting & Refining Co.

Secondary zinc distillers

Alabama: Fairfield—W. J. Bullock, Inc.

California:

Los Angeles—American Smelting & Refining Co., Federated Metals Division.
Torrance—Pacific Smelting Co.

Illinois:

Beckemeyer—American Smelting & Refining Co., Federated Metals Division.
Hillsboro—American Zinc, Lead & Smelting Co.

Sandoval—Sandoval Zinc Co.

New Jersey: Trenton—American Smelting & Refining Co., Federated Metals Division.

New York: Tottenville—Nassau Smelting & Refining Co.

Oklahoma: Sand Springs—American Smelting & Refining Co., Federated Metals Division.

Pennsylvania:

Bristol—Superior Zinc Corp.

Philadelphia—General Smelting Co.

West Virginia: Wheeling—Wheeling Steel Corp.

SLAB ZINC

The output of primary slab zinc in 1950 advanced 4 percent over 1949 production. Output from domestic concentrates fell 1 percent. Production from foreign concentrates, however, rose 14 percent.

Production of redistilled slab zinc rose 22 percent from 1949 and was the highest on record. Of the 66,970 tons of redistilled secondary slab zinc produced in 1950, 28,411 tons (42 percent) were derived from primary smelters, and 38,559 tons (58 percent) were produced at secondary plants.

Data on output of remelted secondary slab zinc are not included with those for redistilled metal. In 1950 the production of slab zinc recovered by remelting purchased scrap was 7,243 tons (6,045 tons in 1949). Zinc rolling mills and other substantial consumers of slab zinc recovered large quantities of zinc from their own plant scrap; but such metal is not measured statistically, for it seldom enters the market as scrap.

In addition to redistilled and remelted unalloyed secondary zinc, a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Additional information on secondary zinc is given in the Secondary Metals—Nonferrous chapter of this volume.

TABLE 6.—Primary and redistilled secondary slab zinc produced in the United States, 1941-45 (average) and 1946-50, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	From domestic ores	From foreign ores	Total		
1941-45 (average).....	583,609	274,344	858,013	51,338	909,851
1946.....	469,205	269,057	738,262	44,518	772,778
1947.....	510,058	292,437	802,495	59,542	862,037
1948.....	537,990	249,798	787,764	62,320	850,084
1949.....	591,454	223,328	814,782	55,041	869,823
1950.....	588,201	255,176	843,407	66,070	910,437

¹ Includes a small tonnage of foreign slab zinc further refined into high-grade metal in the United States.

Labor strikes continued in 1950 to hamper zinc, but not to the extent of 1948 and 1949. A retort smelter at Palmerton, Pa., which started in 1949, was not settled until January 26, 1950. A smelter at Henryetta, Okla., was strike-bound October 7. The coal shortage during the winter resulted in a reduction in availability of electricity for production at the Josephstown, Pa., smelter in March.

Of the 1950 output of primary zinc, 59 percent was produced electrolytically.

Production of Special High Grade, Selected Grade, and Brass Special rose 18, 57, and 6 percent, respectively, in 1950. High Grade and Brass Special declined 7 and 10 percent. Production of Intermediate Grade and Unalloyed Grade rose 10 percent in 1950 output (comparable 1949 figures in 1949). (40 percent) was Prime Western, 30 percent High Grade, 21 percent (24 percent) Regular Grade, 6 percent Brass Special, 2 percent (3 percent) Selected.

TABLE 7.—Distilled and electrolytic zinc, primary and secondary, United States, 1941-45 (average) and 1946-50

CLASSIFIED ACCORDING TO METHOD

Year	Electrolytic primary	Distilled
1941-45 (average).....	278,903	579,110
1946.....	281,295	446,967
1947.....	295,620	506,975
1948.....	312,477	476,287
1949.....	328,152	488,630
1950.....	342,085	501,382

CLASSIFIED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D (Brass Special)
	Special High Grade (99.99% Zn)	Regular High Grade (Ordinary)		
1941-45 (average).....	239,814	234,988	64,012	74,472
1946.....	235,184	180,366	32,204	76,280
1947.....	239,274	190,429	36,812	61,104
1948.....	248,346	196,482	38,892	45,946
1949.....	230,576	206,651	21,513	55,388
1950.....	271,678	192,075	21,571	46,730

¹ For total production of secondary zinc see chapter on Secondary Zinc.

Montana continued to be the leading producer of zinc in 1950; Pennsylvania and Oklahoma were next, respectively. Of the States for which data may be shown separately, Illinois, Idaho, and Montana were next three positions. As usual, in Montana

produced by electrolytic methods only. In Illinois and Texas both electrolytic and distilled zinc metal were recovered, whereas in other States zinc was recovered by distillation alone.

TABLE 8.—Primary slab zinc produced in the United States, by States where smelted, 1941-45 (average) and 1946-50, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Texas and West Virginia ¹	Total	
								Short tons	Value
1941-45 (average).....	35,428	38,000	150,804	202,224	98,760	215,780	109,945	858,013	\$144,317,898
1946.....	18,720	34,832	104,002	180,662	104,125	178,811	101,110	726,262	129,630,636
1947.....	17,188	41,801	113,192	197,453	128,398	193,524	110,909	802,406	171,894,429
1948.....	16,686	42,004	93,229	207,717	137,844	171,276	120,048	787,764	208,890,330
1949.....	17,116	41,854	86,823	216,578	157,650	155,620	137,841	814,782	202,391,849
1950.....	20,688	53,922	108,301	216,104	145,117	162,539	136,790	843,467	240,050,708

¹ Includes Missouri, 1943-44 and 1947-50.

² Corrected figure.

BYPRODUCT SULFURIC ACID

Sulfuric acid made from sulfur dioxide gases produced in roasting zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consumed large quantities of native sulfur. Combined production of sulfuric acid from both sources (see table 9) increased 40 percent in 1950.

TABLE 9.—Sulfuric acid (basis, 100 percent) made at zinc-blende roasting plants in the United States, 1946-50

Year	Made from zinc-blende ¹		Made from native sulfur		Total ²		
	Short tons	Value ³	Short tons	Value ³	Short tons	Value ³	
						Total	Average per ton
1946.....	544,529	\$6,842,541	160,886	\$2,021,606	705,415	\$8,864,237	\$9.76
1947.....	598,703	8,001,205	260,104	3,550,281	858,807	11,557,486	10.38
1948.....	629,478	7,478,271	233,090	3,292,261	762,577	10,770,532	10.97
1949.....	476,932	7,276,481	130,692	1,992,423	607,624	9,268,904	11.85
1950.....	609,671	8,829,236	243,743	3,530,464	853,414	12,359,700	11.25

¹ Includes acid from foreign blende.

² At average of sales of 60° B. acid.

ZINC DUST

Production of zinc dust in 1950 totaled 28,922 tons, a 27-percent increase over 1949 output. Zinc powder and blue powder are not included in the Bureau of Mines production totals; the zinc dust statistically reported is restricted to commercial grades that comply with close specifications as to percentage of unoxidized metal, evenness of grading, and fineness of particles. The zinc content of the dust produced in 1950 ranged from 92.86 to 99.72 percent and averaged 97.87 percent. Shipments of zinc dust, which totaled 26,518 tons—441 tons of which went to foreign countries—were slightly

ZINC

lower than production. The quantity consumed by plants (9 percent of output) was greater than production and shipments, with the result that the stock decreased from 1,310 tons at the beginning of the year.

The average price of zinc dust shipped to 1950 was 16.6 cents a pound compared with 1949. The raw materials used to manufacture zinc dust are secondary Metals—Nonferrous chapter of this production is from zinc scrap (principally some is recovered from zinc ore, slab zinc, and refining.

TABLE 10.—Zinc dust¹ produced in the United States, 1946-50

Year	Short tons	Value		Year
		Total	Average per pound	
1941-45 (average).....	25,122	\$5,063,202	\$0.101	1948.....
1946.....	28,574	6,067,688	.106	1949.....
1947.....	30,602	7,589,296	.124	1950.....

¹ All produced by distillation.

² Revised figure.

ZINC PIGMENTS AND SALTS

The principal zinc pigments are zinc oxide and the principal salts are the chloride and sulfate. They are manufactured from various zinc-bearing materials, scrap, and residues. Details of the production of these salts are given in the Lead and Zinc Pigments chapter of this volume.

CONSUMPTION AND STOCKS

According to reports from 588 plants, 96 percent of the quantity so consumed during the year was put into process in 1950, a 36-percent increase over the level and the largest quantity on record. The quantity of plants in 1950 were 946,091 tons. Comparison of figure of slab zinc available to consumers and consumption since 1943 indicates that coverage survey was approximately 96 percent.

Galvanizing continued to be the largest field for the quantity so consumed during the year was the previous annual record established in 1948. Zinc die castings, continued to be the second-largest use of zinc, establishing a new high 23 percent over 1949 to the highest point since 1943. The average of the immediate pre-World War level of slab zinc consumption in brass in the postwar period is due to the abnormal flow of brass scrap to the

TABLE 11.—Consumption of slab zinc in the United States, 1946-50, by industries, in short tons ¹

Industry and product	1946	1947	1948	1949	1950
Galvanizing: ²					
Sheet and strip.....	113,816	115,147	120,360	146,923	188,406
Wire and wire rope.....	43,667	49,728	40,900	39,231	47,317
Tubes and pipe.....	62,400	77,238	81,874	78,030	91,877
Fittings.....	10,593	10,467	14,037	11,487	15,948
Other.....	89,223	108,740	104,792	75,209	99,138
Total galvanizing.....	310,769	361,327	370,960	350,880	441,686
Brass products:					
Sheet, strip, and plate.....	66,125	60,212	51,813	43,157	68,737
Rod and wire.....	55,387	34,653	32,076	23,651	43,413
Tube.....	19,173	15,488	16,890	12,816	17,385
Castings and billets.....	4,776	3,155	4,228	2,620	4,170
Copper-base ingots.....	4,370	7,299	3,546	2,701	4,081
Other copper-base products.....	1,262	1,540	1,587	589	1,587
Total brass products.....	149,102	112,347	109,140	85,534	139,373
Zinc-base alloy:					
Die castings.....	206,237	210,214	230,995	190,665	285,022
Alloy dies and rod.....	6,313	3,802	3,171	2,024	2,020
Slush and sand castings.....	601	453	462	492	1,576
Total zinc-base alloy.....	212,211	214,469	234,628	202,181	289,527
Rolled zinc.....	92,397	70,680	76,672	55,200	68,444
Zinc oxide.....	19,170	18,376	15,657	10,292	18,187
Other uses:					
Wet batteries.....	1,635	1,462	1,368	1,350	1,527
Desilverizing lead.....	1,781	2,687	2,654	2,448	2,947
Light-metal alloys.....	615	607	1,125	1,060	1,356
Other ³	4,642	4,405	5,522	2,887	4,087
Total other uses.....	8,603	9,161	10,660	7,754	9,917
Total consumption ⁴	801,242	786,300	817,735	711,841	967,134

¹ Excludes some small consumers.² Includes zinc used in electrogalvanizing and electroplating, but excludes sherardizing.³ Includes zinc used in making zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.⁴ Includes 3,912 tons of remelt zinc in 1946, 3,577 tons in 1947, 3,141 tons in 1948, 2,394 tons in 1949, and 3,035 tons in 1950.

The quantity of slab zinc consumed for rolled products in 1950 increased 24 percent from the 1949 figure. In addition to slab zinc, the rolling mills remelt and reroll the metallic scrap produced from their fabricating operations. The scrap so treated in 1950 amounted to 13,841 tons, an increase of 54 percent above the 8,977 tons processed in 1949. Purchased zinc scrap, in the form of zinc clippings, old zinc scrap, and engravers' plates, totaling 4,516 tons was melted and rolled in 1950 (3,802 tons in 1949). Production of rolled zinc from both slab zinc and purchased scrap was 70,075 tons, an increase of 21 percent over the 1949 total. Inventories of rolled zinc were 1,420 tons on December 31, 1950, compared with 2,076 tons (revised figure) on the same date in 1949. In addition to the actual shipments of 56,253 tons of rolled zinc in 1950, the rolling mills processed 28,127 tons of rolled zinc (including that which was remelted and rerolled) in manufacturing 14,568 tons of semifabricated and finished products.

TABLE 12.—Rolled zinc produced and quantity available in the United States, 1949-50

	1949		
	Short tons	Value	Avail. for consumption
Production:			
Sheet zinc not over 0.1 inch thick.....	14,710	\$5,642,609	\$
Boiler plate and sheets over 0.1 inch thick.....	757	257,855	
Strip and ribbon zinc ¹	41,354	13,691,412	
Foil, rod, and wire.....	1,166	552,546	
Total rolled zinc.....	57,987	20,144,422	
Imports.....	32	8,144	
Exports.....	6,147	2,858,566	
Available for consumption.....	51,872		
Value of slab zinc (all grades).....			
Value added by rolling.....			

¹ Figures represent net production. In addition 8,977 tons of strip zinc in 1950 were rerolled from scrap originating in fabricating plants.² Revised figure.

Table 13 shows the six commercial grades purchased remelt spelter consumed by the industry. Of the 967,134 tons of domestic and foreign zinc, 34 percent was Prime Western, 34 percent Special High Grade, 14 percent Regular High Grade, compared with 45, 33, and 14 percent, respectively, in 1949. All grades of zinc were used in 1950. Prime Western was the principal grade used in 1949, higher grades being used chiefly for electrogalvanizing and in brass manufacture necessitating high purity metal, 76 percent of the total used in this industry in the highest grades.

TABLE 13.—Consumption of slab zinc in the United States, by industry, in short tons ¹

Industry	Special High Grade	Regular High Grade	Intermediate	Brass Special
Galvanizers.....	14,892	17,549	9,842	8,475
Brass products.....	24,040	81,667	2,369	10,750
Zinc-base alloy.....	278,824	10,375	65	
Rolled zinc.....	7,087	21,583	19,583	18,035
Zinc oxide.....	1,632	2,987		656
Other.....	1,549	2,108	1,243	217
Total.....	328,024	136,274	33,102	38,183

¹ Excludes some small consumers. For other qualifications, see footnotes.

CONSUMPTION OF SLAB ZINC BY GEOGRAPHIC AREA

The geography of slab zinc consumption has changed only since 1940. During the 11-year period the

¹ This section is based partly on a detailed study by Ransome, *Aluminum in the United States* by Industries, Grades, and Geographic Divisions, 1940, 1948, 30 pp.

shifts are observable, largely the result of conversion to war production in 1940-41 and reconversion to peacetime consumption in 1945-46. The distribution of slab zinc consumption by geographic divisions and States, both total and for individual uses, is shown in tables 14-20.

Consumption of Slab Zinc for All Uses.—During the period 1940-50 Illinois ranked first among the 42 zinc-consuming States and the District of Columbia, with an annual average of 136,978 short tons. Since 1945 Ohio has been in second place. Connecticut, which averaged second during the war period owing to the large quantities of zinc consumed in the brass plants of that State, has since dropped to fourth place. Since 1940 Pennsylvania has held either second or third place. The greatest concentration of slab-zinc consumption is in the region comprising Illinois, Indiana, Michigan, Ohio, and Wisconsin. This area, which has consistently ranked first in zinc consumption since 1940, uses nearly half the total quantity of slab zinc consumed annually in the United States. The region of least consumption is the Mountain States, including Arizona, Colorado, Idaho, Nevada, New Mexico, and Utah, which have accounted for less than 0.3 percent of the total.

TABLE 14.—Consumption of slab zinc in the United States, 1943-47 (average) and 1948-50, by geographic divisions and States¹

Geographic division and State	1943-47 (average)		1948		1949		1950	
	Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
I. New England:								
Connecticut.....	104,652	4	57,001	5	40,948	5	70,115	4
Massachusetts.....	13,907	14	10,476	15	7,454	16	9,507	16
Maine.....	724	25	78	31	67	31	97	31
New Hampshire.....	245	30	(?)	35	(?)	34	(?)	36
Rhode Island.....	174	32	(?)	29	(?)	30	(?)	28
Total.....	119,602	3	67,891	3	48,650	4	80,014	3
II. Middle Atlantic:								
New Jersey.....	22,604	11	20,944	12	19,084	12	23,231	12
New York.....	44,836	6	47,262	6	39,619	6	55,070	7
Pennsylvania.....	117,295	3	130,912	3	105,308	3	139,400	3
Total.....	184,735	2	199,118	2	164,011	2	217,701	2
III. South Atlantic:								
District of Columbia.....	125	35	(?)	33	21	32	(?)	34
Florida.....	144	33	2,738	19	1,703	20	2,164	21
Georgia.....	1,607	20	24,906	9	26,625	9	36,649	10
Maryland.....	24,724	9	(?)	32	(?)	(?)	(?)	33
South Carolina.....	139	34	(?)	28	267	27	267	20
Virginia.....	501	27	(?)	27	267	27	267	20
West Virginia.....	21,164	12	23,781	10	25,694	11	29,736	11
Total.....	48,554	4	51,939	4	54,210	3	68,825	4
IV. East North Central:								
Illinois.....	137,272	1	152,050	1	131,619	1	183,957	1
Indiana.....	64,658	5	61,350	4	52,837	4	67,449	5
Michigan.....	44,328	7	41,887	7	32,265	7	57,017	6
Ohio.....	119,337	2	132,044	2	123,903	2	152,008	2
Wisconsin.....	27,394	8	11,888	14	9,162	15	13,752	14
Total.....	393,189	1	399,325	1	349,776	1	474,183	1

For footnotes, see end of table.

TABLE 14.—Consumption of slab zinc in the United States, 1943-47 (average) and 1948-50, by geographic divisions and States¹

Geographic division and State	1943-47 (average)		Rank	Short tons
	Short tons	Rank		
V. East South Central:				
Alabama.....	16,708	13	22	16,708
Kentucky.....	6,350	10	10	6,350
Tennessee.....	1,013	24	1	1,013
Total.....	24,071	6	32	24,071
VI. West North Central:				
Iowa.....	6,331	17	7	6,331
Kansas.....	91	30	1	91
Minnesota.....	2,701	18	4	2,701
Missouri.....	13,678	15	17	13,678
Nebraska.....	1,116	23	1	1,116
Total.....	23,817	7	30	23,817
VII. West South Central:				
Louisiana.....	292	29	1	292
Oklahoma.....	638	26	1	638
Texas.....	2,334	19	1	2,334
Total.....	3,264	8	2	3,264
VIII. Mountain:				
Arizona.....	19	39	1	19
Colorado.....	1,429	21	1	1,429
Idaho.....	197	31	1	197
Nevada.....	54	37	1	54
Utah.....	38	38	1	38
Total.....	1,737	9	2	1,737
IX. Pacific:				
California.....	24,247	10	26	24,247
Oregon.....	555	28	1	555
Washington.....	1,306	22	1	1,306
Total.....	26,108	5	28	26,108
Grand total ¹	825,147		814	825,147

¹ Excludes remelt zinc and some small consumers of slab zinc.
² Nominal quantity consumed included with subtotal for division.

Consumption of Slab Zinc for Galvanizing.—The galvanizing industry is the largest consumer of slab zinc. It is used for galvanizing or rustproofing sheets, wire, tube, pole-line hardware, railway-signal equipment, and a multitude of other items. The producing States are thus also the principal consumers of zinc. From 1940 through 1943, among the 34 States that consumed zinc, Ohio displaced Pennsylvania and retained the lead in succeeding years through 1950. The greatest consumption for galvanizing is the region comprising Ohio, and Pennsylvania, which accounted for an average annual domestic consumption for the period 1940-50 of 45 percent but declined to 63 percent in 1949, and 59 percent in 1950.

TABLE 15.—Consumption of slab zinc for galvanizing in the United States, 1943-47 (average) and 1948-50, by States¹

State	Geo-graphic division	1943-47 (average)		1948		1949		1950	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama.....	V	16,640	7	(²)	7	25,918	5	36,520	4
California.....	IX	13,534	8	16,046	8	13,493	8	21,208	8
Colorado.....	VIII	1,381	20	(²)	19	(²)	20	(²)	19
Connecticut.....	I	3,594	15	3,752	15	1,843	16	3,003	17
Florida.....	III	142	31	(²)	(²)	(²)	18	(²)	20
Georgia.....	III	1,662	18	(²)	17	(²)	18	(²)	20
Illinois.....	IV	33,757	3	47,660	3	43,430	3	55,276	3
Indiana.....	IV	22,544	4	20,458	4	25,113	6	35,375	6
Iowa.....	VI	153	30	(²)	31	(²)	30	89	30
Kentucky.....	V	6,320	11	(²)	9	(²)	9	(²)	9
Louisiana.....	VII	283	27	(²)	28	(²)	26	722	24
Maine.....	I	682	23	(²)	29	(²)	29	(²)	29
Maryland.....	III	17,688	6	24,422	5	26,105	4	36,136	5
Massachusetts.....	I	6,889	9	6,005	10	4,188	12	5,460	11
Michigan.....	IV	4,396	13	3,513	16	2,598	15	4,446	13
Minnesota.....	VI	2,097	16	4,062	14	(²)	14	4,250	14
Missouri.....	VI	3,710	14	4,453	13	3,472	13	4,067	15
Nebraska.....	VI	202	28	(²)	27	(²)	27	(²)	27
New Hampshire.....	I	73	33	(²)	(²)	(²)	(²)	(²)	(²)
New Jersey.....	II	6,414	10	5,104	12	4,608	10	4,546	12
New York.....	II	5,629	12	5,906	11	4,382	11	6,031	10
Ohio.....	IV	71,815	1	82,622	1	78,663	1	88,629	1
Oklahoma.....	VII	623	24	(²)	21	(²)	21	1,201	21
Oregon.....	IX	555	25	(²)	24	(²)	25	229	26
Pennsylvania.....	II	67,344	2	73,806	2	67,230	2	79,344	2
Rhode Island.....	I	162	29	(²)	25	(²)	28	(²)	25
South Carolina.....	III	117	32	(²)	30	(²)	(²)	(²)	31
Tennessee.....	V	811	22	(²)	22	(²)	23	(²)	22
Texas.....	VII	1,384	19	(²)	20	(²)	19	3,251	16
Utah.....	VIII	33	34	(²)	(²)	(²)	24	(²)	(²)
Virginia.....	III	461	26	(²)	26	(²)	(²)	185	28
Washington.....	IX	1,126	21	(²)	23	(²)	22	1,041	23
West Virginia.....	III	19,513	5	(²)	6	(²)	7	29,187	7
Wisconsin.....	IV	2,613	17	2,560	18	1,806	17	2,505	18
Total ¹		314,947		368,796		348,983		439,368	

¹ Excludes remelt zinc. Includes zinc used in electrogalvanizing and electroplating but excludes sherardizing.

² Quantity withheld to avoid disclosure of individual company operations.

³ Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Brass Products.—From 1940 through 1950 Connecticut has ranked first among the States consuming slab zinc for brass products; but, owing to the wartime demand for brass and the construction of new plant facilities, there has been some change in the rank of the other leading States. In 1940 Michigan was in second place, followed by New York, Illinois, Ohio, and Pennsylvania among the top six, whereas in 1950 Illinois ranked second, with Michigan in third place, followed by Ohio, New York, and Wisconsin.

TABLE 16.—Consumption of slab zinc for brass in the United States, 1943-47 (average) and 1948-50, by States¹

State	Geo-graphic division	1943-47 (average)		1948	1949	1950
		Short tons	Rank			
Alabama.....	V	68	17	(²)	(²)	(²)
California.....	IX	2,054	12	(²)	(²)	(²)
Colorado.....	VIII	37	20	(²)	(²)	(²)
Connecticut.....	I	95,648	1	(²)	(²)	(²)
Delaware.....	III	125	16	(²)	(²)	(²)
District of Columbia.....	III	1	32	(²)	(²)	(²)
Florida.....	III	5	27	(²)	(²)	(²)
Georgia.....	III	29,137	2	(²)	(²)	(²)
Illinois.....	IV	12,485	7	(²)	(²)	(²)
Indiana.....	IV	2	30	(²)	(²)	(²)
Iowa.....	VI	51	19	(²)	(²)	(²)
Kansas.....	V	26	21	(²)	(²)	(²)
Kentucky.....	VI	5	28	(²)	(²)	(²)
Maine.....	I	6,978	10	(²)	(²)	(²)
Maryland.....	III	5,517	11	(²)	(²)	(²)
Massachusetts.....	I	24,735	3	(²)	(²)	(²)
Michigan.....	IV	304	13	(²)	(²)	(²)
Minnesota.....	VI	6	26	(²)	(²)	(²)
Missouri.....	VI	162	15	(²)	(²)	(²)
Nebraska.....	VI	9,903	9	(²)	(²)	(²)
New Hampshire.....	I	18,804	6	(²)	(²)	(²)
New Jersey.....	II	22,652	5	(²)	(²)	(²)
New York.....	II	10	25	(²)	(²)	(²)
Ohio.....	IV	11,877	8	(²)	(²)	(²)
Oregon.....	IX	11	24	(²)	(²)	(²)
Pennsylvania.....	II	22	22	(²)	(²)	(²)
Rhode Island.....	I	15	23	(²)	(²)	(²)
South Carolina.....	III	2	31	(²)	(²)	(²)
Texas.....	VII	65	18	(²)	(²)	(²)
Utah.....	VIII	164	14	(²)	(²)	(²)
Virginia.....	III	22,879	4	(²)	(²)	(²)
Washington.....	IX			(²)	(²)	(²)
West Virginia.....	III			(²)	(²)	(²)
Wisconsin.....	IV			(²)	(²)	(²)
Total ¹		253,652		108,421		

¹ Excludes remelt zinc.

² Quantity withheld to avoid disclosure of individual company operations.

³ Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Zinc-Bearing Products.—The zinc-base alloy industry is the largest user of zinc-base alloy products and assemblies, such as fuel pumps, windshield wipers, and a wide variety of hardware. Thus the region embracing Ohio, and Wisconsin, in which the automotive industry is the area of greatest concentration of zinc-base alloys. Nearly 63 percent of the other zinc-base alloy uses in 1950 was consumed in the automotive industry.

TABLE 17.—Consumption of slab zinc for zinc-base alloys in the United States, 1943-47 (average) and 1948-50, by States¹

State	Geo-graphic division	1943-47 (average)		1948		1949		1950	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Alabama.....	V	8,139	8	10,775	8	12,901	7	(²)	12
California.....	IX	3,423	10	(²)	10	3,460	10	5,535	10
Connecticut.....	I	1	20						
Florida.....	III	35,424	1	54,602	1	48,772	1	75,739	1
Illinois.....	IV	0,127	7	14,958	6	13,082	6	16,677	6
Indiana.....	IV	29	14						
Kansas.....	VI	13	17						
Maine.....	I	68	13						
Maryland.....	III	23	15	(²)	14			(²)	14
Massachusetts.....	I	14,853	4	(²)	4	(²)	4	37,302	3
Michigan.....	IV	9,284	6	12,724	7	(²)	8	11,944	9
Missouri.....	VI	4,336	9	8,266	9	9,324	8	12,694	8
New Jersey.....	II	16,973	3	28,312	3	23,220	3	33,356	4
New York.....	II	24,251	2	42,092	2	39,292	2	52,051	2
Ohio.....	IV	16	16						
Oklahoma.....	VII	14,667	5	26,429	5	18,601	5	25,600	5
Pennsylvania.....	II	828	12	(²)	12	(²)	12	(²)	13
Texas.....	VII	2	19	(²)	13	(²)	13	(²)	15
Virginia.....	III	8	18						
Washington.....	IX	2,096	11	(²)	11	(²)	11	(²)	11
Wisconsin.....	IV								
Total ¹		143,581		234,612		202,163		289,511	

¹ Excludes remelt zinc.² Quantity withheld to avoid disclosure of individual company operations.³ Includes States not individually shown (footnote reference 2).

Consumption of Slab Zinc for Rolled Zinc.—During the period 1940-50, although the quantity of slab zinc consumed for rolled zinc changed widely, the geographic pattern of consumption and rank of the consuming States varied little. Illinois and Indiana ranked first and second, respectively, and accounted for the greater part of slab zinc consumed for rolling in the United States. Pennsylvania held third place through 1946 but was displaced in 1947 and 1948 by Iowa, which moved up from fourth position. In 1949 New York ranked third, but in 1950, it was displaced by Pennsylvania, which moved up to third place again.

Consumption of Slab Zinc for Zinc Oxide.—Because of the small number of companies consuming slab zinc in the manufacture of zinc

TABLE 18.—Consumption of slab zinc for rolled zinc in the United States, 1943-47 (average) and 1948-50, by States

State	Geo-graphic division	1943-47 (average)		1948		1949		1950	
		Short tons	Rank	Short tons	Rank	Short tons	Rank	Short tons	Rank
Connecticut.....	I	1,630	6	(²)	8	(²)	7	(²)	6
Illinois.....	IV	36,910	1	35,064	1	26,538	1	35,134	1
Indiana.....	IV	19,062	2	(²)	2	(²)	2	(²)	2
Iowa.....	VI	6,177	4	(²)	3	(²)	4	(²)	3
Massachusetts.....	I	1,444	8	(²)	7	(²)	6	(²)	7
Maine.....	I	3,181	5	(²)	5	(²)	3	(²)	4
New York.....	II	7,072	3	(²)	4	(²)	5	(²)	5
Pennsylvania.....	II	1,622	7	(²)	6	(²)	8	(²)	8
West Virginia.....	III								
Total.....		77,128		76,672		55,200		68,444	

¹ Quantity withheld to avoid disclosure of individual company operations.

oxide and because individual company it is not possible to show specific quantity. Table 19, however, gives the relative rank for each year.

TABLE 19.—Consumption of slab zinc for zinc-base alloys in the United States, 1943-47 (average) and 1948-50, by States

State	Geo-graphic division	1943-47 (average)		1948	1949	1950
		Short tons	Rank			
Illinois.....	IV	1,925	2	(²)	(²)	(²)
Indiana.....	IV	1,151	3	(²)	(²)	(²)
Pennsylvania.....	II	14,124	1			
Total.....		17,200				15,

¹ Quantity withheld to avoid disclosure of individual company operations.

Consumption of Slab Zinc for Other States of the quantity of zinc consumed for castings, wet batteries, desilverizing lead (than zinc-base alloys), zinc dust, surface powder is shown in table 20.

TABLE 20.—Consumption of slab zinc for other uses in the United States, 1943-47 (average) and 1948-50, by States

State	Geo-graphic division	1943-47 (average)		1948	1949	1950
		Short tons	Rank			
Alabama.....	V					
Arizona.....	VIII	19	20			
California.....	IX	820	5			
Colorado.....	VIII	10	22			
Connecticut.....	I	258	10			
Idaho.....	VIII	197	12			
Illinois.....	IV	90	14			
Indiana.....	IV	259	9			
Iowa.....	VI					
Kansas.....	VI	12	21			
Kentucky.....	V	6	26			
Louisiana.....	VII	9	24			
Maine.....	I	24	19			
Massachusetts.....	I	34	17			
Michigan.....	IV	344	6			
Minnesota.....	VI	1	29			
Missouri.....	VI	280	7			
Nebraska.....	VI	907	3			
Nevada.....	VIII	54	16			
New Hampshire.....	I	10	23			
New Jersey.....	II	2,011	2			
New York.....	II	278	8			
Ohio.....	IV	719	4			
Pennsylvania.....	II	2,181	1			
Tennessee.....	V	202	11			
Texas.....	VII	107	13			
Utah.....	VIII	3	28			
Virginia.....	III	63	15			
Washington.....	IX	7	25			
West Virginia.....	III	29	18			
Wisconsin.....	IV	5	27			
Total.....		8,639				10,428

¹ Excludes remelt zinc.² Quantity withheld to avoid disclosure of individual company operations.³ Includes States not individually shown (footnote reference 2).

STOCKS

Producers' Stocks.—Inventories of slab zinc at producers' plants declined steadily throughout 1950. By the year end they were reduced to 8,884 tons, the lowest level for any year end since 1925.

TABLE 21.—Stocks of zinc at zinc-reduction plants in the United States at end of year, 1946-50, in short tons

	1946	1947	1948	1949	1950
At primary reduction plants.....	175,513	67,046	19,179	190,710	7,920
At secondary distilling plants.....	766	1,601	1,600	3,511	964
Total.....	176,269	68,647	20,848	94,221	8,884

¹ Revised figure.

Consumers' Stocks.—On December 31, 1950, consumers' stocks of slab zinc were 60,349 tons compared with 81,801 tons at the beginning of the year. At the average monthly rate of consumption in 1950, consumers' stocks on hand were approximately 22 days' requirements.

TABLE 22.—Consumers' stocks of slab zinc at plants at the beginning and end of 1950, by industries, in short tons

Date	Galvanizers	Brass mills ¹	Die casters ²	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31—							
1949.....	45,000	10,307	18,833	5,262	803	996	81,801
1950.....	34,191	8,549	13,051	3,190	390	978	60,349

¹ Includes brass mills, brass ingot makers, and brass product producers.

² Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.

³ Revised figure.

⁴ Stocks on Dec. 31, 1949 and 1950, exclude 103 (revised figure) and 512 tons, respectively, of remelt spelter.

PRICES

The market price for Prime Western grade slab zinc at East St. Louis opened in 1950 at 9.87½ cents per pound, then dropped to 9.75 cents on January 17. On March 14 the quotation advanced to 10.00 cents and thereafter continued to rise in ¼- and ½-cent intervals until May 29, when it stood at 13.00 cents. On June 2 a midwestern producer raised its quotation to 14.50 cents; other sellers followed on June 5. On June 12 the price advanced to 15.00 cents and was unchanged until September 7. On that date the quotation was established at 17.50 cents per pound, where it remained the rest of the year.

On December 30, 1949, the British Ministry of Supply established the price of zinc at London at £87 10s. per long ton (equivalent to 10.93 cents per pound computed on the basis of £ equals \$2.7975). This price continued until January 25, when it was reduced to £85 10s. (10.68 cents). The uninterrupted uptrend in prices that characterized the remaining months of 1950 began on March 15. On that day the quotation was advanced to £87 10s. (10.93 cents). It was subsequently increased on March 28 to £89 10s. (11.18 cents), April 4 to £91 10s. (11.43 cents), April 20 to £95 10s. (11.93 cents), May 2 to £97 10s. (12.18 cents), May 5 to £99 10s. (12.43 cents), May 10 to

TABLE 23.—Price of zinc concentrates

Joplin 60-percent zinc concentrates: ¹	
Price per short ton.....	dollars
Average price common zinc at—	
St. Louis (spot) ¹	cents per pound
New York ¹	do.
London ¹	do.
Price indexes (1925-29 average=100):	
Zinc (New York).....	
Lead (New York).....	
Copper (New York).....	
Nonferrous metals ²	
All commodities ³	

¹ Metal Statistics, 1951.

² E&M Metal and Mineral Markets English quotations converted at average rates of exchange recorded by Federal Reserve Board.

³ Based upon price indexes of U. S. Department of Labor.

TABLE 24.—Average monthly quoted prices of Joplin, and of common zinc (prompt delivery) 1949-50¹

Month	1949		
	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)	
		St. Louis	London
January.....	110.00	17.50	19.00
February.....	110.00	17.50	19.00
March.....	108.61	17.06	19.00
April.....	91.70	14.06	18.00
May.....	75.83	11.88	16.00
June.....	56.63	9.36	14.00
July.....	61.00	9.85	14.00
August.....	57.00	10.00	11.00
September.....	57.69	10.05	11.00
October.....	52.54	9.32	10.00
November.....	55.62	9.77	10.00
December.....	55.30	9.77	10.00
Average for year.....	72.28	12.15	14.00

¹ Joplin: Metal Statistics, 1951, p. 568. St. Louis: Metal Statistics and Mineral Markets.

² Conversion of English quotations into American money based Federal Reserve Board.

³ Represents average price realized on total shipments for year.

TABLE 25.—Average price received by producers cents per pound¹

Grade	
Grade A:	
Special High Grade.....	
Regular High Grade.....	
Grade B: Intermediate.....	
Grades C and D:	
Brass Special.....	
Selected.....	
Grade E: Prime Western.....	
All grades.....	
Prime Western, spot quotation at St. Louis ²	

¹ Does not include overquota premium payments made by Office of Metal Statistics, 1951, p. 565.

£103 10s. (12.93 cents), May 25 to £107 10s. (13.43 cents), and May 30 to £111 10s. (13.93 cents). On June 5 the price was raised to £123 10s. (15.44 cents per pound on the new basis of £ equals \$2.80, established on June 1). Further increases took place on June 16, with the new price at £127 10s. (15.94 cents), and September 8, when the price was placed at £147 10s. (18.44 cents). The final official London price, fixed on October 4, was £151 (18.88 cents).

FOREIGN TRADE ³

Imports.—Total imports (general imports) of zinc in ores and concentrates in 1950 increased 13 percent over 1949. Of the 272,538 tons of contained zinc imported, 55 percent came from Mexico, 29 percent from Canada, 7 percent from Spain, and 6 percent from Peru. The remaining 3 percent was largely from the Union of South Africa, Australia, and Bolivia.

Slab-zinc imports totaled 155,974 tons, an increase of 23 percent over the quantity imported in 1949. Canada supplied 70 percent, Mexico 17 percent, Norway 5 percent, Belgium-Luxembourg 2 percent, and Italy 2 percent. The remaining 4 percent came principally from the Netherlands, Germany and Peru.

TABLE 26.—Zinc imported into the United States, in ores, blocks, pigs, or slabs, by countries, 1948–50, in short tons ¹

[U. S. Department of Commerce]			
Country	1948	1949	1950
Ores (zinc content):			
Argentina.....	77	—	8
Australia.....	495	4,956	2,377
Bolivia.....	4,515	3,526	2,195
Canada-Newfoundland-Labrador.....	65,124	61,314	77,585
Guatemala.....	—	—	473
Italy.....	11,288	—	—
Japan.....	5,018	—	—
Korea.....	1,002	168	(²)
Mexico.....	142,134	144,101	180,412
Peru.....	22,475	14,001	17,314
Spain.....	9,101	4,880	17,738
Union of South Africa.....	2,035	6,568	3,794
Other countries.....	39	765	641
Total ores.....	264,203	241,170	272,538
Blocks, pigs, or slabs:			
Australia.....	75	103	—
Belgium-Luxembourg.....	1,145	1,933	3,617
Canada-Newfoundland-Labrador.....	77,690	100,705	108,037
Germany.....	—	—	1,637
Italy.....	1,570	—	2,070
Japan.....	4,680	1	—
Mexico.....	5,737	14,101	20,293
Netherlands.....	—	—	2,005
Norway.....	2,240	960	7,939
Peru.....	—	—	1,305
Poland-Danzig.....	110	—	358
United Kingdom.....	—	—	493
Yugoslavia.....	—	20	264
Other countries.....	—	—	—
Total blocks, pigs, or slabs.....	93,232	126,025	155,974

¹ Data are general imports which comprise zinc imported for immediate consumption plus material entering country under bond.

² Less than 0.5 ton.

³ Revised figure.

⁴ Figures on imports and exports compiled by M. B. Price and E. D. Page, of the Bureau of Mines, from records of the U. S. Department of Commerce.

ZINC

TABLE 27.—Zinc imported for consumption in the classes ¹

[U. S. Department of Commerce]							
Year	Ores (zinc content)		Blocks, pigs, slabs		Sheets		Old stock
	Short tons	Value	Short tons	Value	Short tons	Value	
1946.....	106,885	\$3,122,471	104,005	\$16,481,904	(²)	\$10	4.0
1947.....	194,822	12,165,163	72,063	14,822,407	1	457	6.1
1948.....	133,814	11,737,624	92,495	24,911,454	120	32,871	10.2
1949.....	109,535	11,748,199	125,564	20,340,620	32	8,144	3.7
1950.....	237,081	23,743,502	155,304	38,741,797	211	92,862	2.8

¹ Excludes imports for manufacture in bond and export, which are reported by the U. S. Department of Commerce.

² Includes dross and skimmings as follows: 1946—2,801 tons, \$181,911; 1947—2,608 tons, \$335,283; 1950—1,229 tons, \$186,748.

³ In addition, manufactures of zinc were imported as follows: 1946—\$2,883; 1950—\$142,369.

⁴ Less than 0.5 ton.

Exports.—The value of exports of zinc in manufactured articles containing zinc of foreign origin (excluding galvanized products, alloys, and other items) in 1950 compared with \$23,159,200 in 1949 to the items shown in tables 28 and 29, consists of each year in brass, pigments, chemicals, and other items. Export data on zinc pigments and chemicals are given in Zinc Pigments and Zinc Salts chapter of this yearbook.

Exports of slab zinc in 1950 totaled 12,917 tons, under the quantity exported in 1949. India (10 percent of the total) and the United Kingdom (9 percent) the major importers. Table 29 contains data on slab and sheet.

TABLE 28.—Zinc ore and manufactures of zinc exported, 1946–50

[U. S. Department of Commerce]						
Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, pigs, or blocks		Sheets, plates, strips, or other forms, n. e. s.	
	Short tons	Value	Short tons	Value	Short tons	Value
1946.....	89	\$15,440	47,224	\$8,222,940	13,846	\$4,408,320
1947.....	1,404	215,123	108,069	22,817,004	10,893	4,234,300
1948.....	3,547	422,314	55,537	15,852,819	7,344	3,290,410
1949.....	2,925	1,477,718	58,706	18,599,597	7,456	3,496,160
1950.....	1,140	\$264,907	12,917	3,967,055	4,810	2,327,150

¹ Not separately classified before Jan. 1, 1949; formerly included with "scrap."

² Effective Jan. 1, 1949 "dross" included with "scrap."

TABLE 29.—Slab and sheet zinc exported from the United States, by destinations, 1947-50,¹ in short tons

[U. S. Department of Commerce]

Destination	Slabs, pigs, and blocks ¹				Sheets, plates, strips, or other forms, n. e. s.			
	1947	1948	1949	1950	1947	1948	1949	1950
Country:								
Argentina.....	5,809	741			890	478		
Austria.....		213	1,172			1	9	
Belgium-Luxembourg.....	7,071	5,132	1,081	67	13	17	10	21
Brazil.....	1,735	1,270	2,280	830	628	106	85	74
Canada-Newfoundland-Labrador.....	3	504	10	24	2,670	3,584	2,058	2,778
Chile.....	600	980	425	190	201	182	90	18
China.....	611	44	30		431	106	12	12
Colombia.....		3	40	3	143	134	214	322
Cuba.....	182	303	116	274	91	103	71	131
Czechoslovakia.....	3,347				720			
Denmark.....			2,794	641				
Finland.....	2,330		112		19		3	
France.....	5,253	2,205	4,840			0	(¹)	(¹)
Germany.....	392	3,473	4,293				49	
India-Pakistan.....	10,748	11,550	12,608	4,588	753	548	1,743	420
Indonesia.....		1	2		140	242	50	9
Israel.....		58	19	105	7		64	70
Italy.....	903	112	319	224				
Malaya.....					7	137	375	
Mexico.....	54	61	131	349	628	668	778	878
Netherlands.....	2,509	280	4,028		398	74	230	1
Philippines.....	1	2	3	4	36	42	63	54
Portugal.....	260				339	243		
Sweden.....	2,454				379	8	25	10
Switzerland.....	1,492	1,273	1,432	112	241	38	90	11
Turkey.....		6			119			
Tunisia.....	333				210	22	2	4
Union of South Africa.....					93	80	76	37
United Kingdom.....	50,289	37,269	22,811	4,941	95	109	40	98
Other countries.....	384	48	157	565	1,030	540	413	165
Total.....	100,609	65,537	58,709	12,917	10,898	7,344	7,456	4,810
Continent:								
North America.....	262	872	267	652	3,441	4,374	3,858	3,544
South America.....	8,153	3,034	2,760	1,026	2,194	1,032	505	481
Europe.....	86,561	49,069	42,994	6,035	2,333	577	515	184
Asia.....	11,603	11,062	12,687	5,204	2,131	1,266	2,465	591
Africa.....			1		440	94	104	40
Oceania.....					353	1	9	

¹ Changes in 1946 data (Minerals Yearbook, 1949, p. 1291): Slabs, pigs, and blocks—France, 112 tons; other countries, 92 tons.² Less than 0.5 ton.

Tariff.—The import duty on zinc-bearing ores in 1950 remained at $\frac{1}{2}$ cent per pound (zinc content) and on zinc in blocks, pigs, slabs, and dust at $\frac{1}{2}$ cent per pound. Congressional action (H. R. 5327) during the latter part of the year suspended the $\frac{1}{2}$ cent per pound duty on zinc scrap from October 2 until June 30, 1951.

WORLD PRODUCTION

World mine and smelter production of zinc in recent years, insofar as data are available, are shown in tables 30 and 31.

TABLE 30.—World mine production of zinc, 1944-50, in metric tons

[Compiled by Viola M.]

Country ¹	1944	1945	1946
Algeria.....	1,010	1,906	
Argentina.....	18,945	13,134	
Australia.....	177,166	182,726	
Austria.....	3,991	1,071	
Belgian Congo.....	16,405	24,848	
Bolivia (exports).....	16,319	20,075	
Canada.....	249,848	234,603	
Newfoundland.....	53,952	51,400	
Finland.....	2,900	1,500	
France.....	2,535	3,345	
French Equatorial Africa.....	500	621	
French Indochina.....	1,405	380	
French Morocco.....	1,170	980	
Germany:			
Federal Republic.....	250,000	24,385	
Soviet Zone.....		(¹)	
Greece.....	585	747	
Italy.....	21,284	10,267	
Japan.....	74,268	22,680	
Korea, South.....	8,195	2,880	
Mexico.....	218,965	209,940	
Nigeria.....			
Northern Rhodesia.....	14,712	15,485	
Norway.....	5,054	1,835	
Peru.....	56,781	61,164	
Poland.....	(¹)	36,385	
South-West Africa.....			
Spain.....	34,000	31,000	
Sweden.....	32,909	33,600	
Switzerland.....	742	767	
Tunisia.....			
U. S. S. R. ²	84,000	89,000	
United Kingdom.....	8,802	3,619	
United States.....	651,938	557,333	
Yugoslavia.....	16,257	7,711	
Total (estimate)³.....	2,060,000	1,816,000	1,580,000

¹ Data derived from the United Nations Statistical Yearbook, 1949, and other sources.² In addition to the countries listed, Czechoslovakia, Norway, and the Netherlands produced zinc, but no estimates for them are included in the totals.³ Estimate.⁴ Data not yet available; estimate by author of chapter 1.⁵ Smelter production.⁶ Zinc content of lead-copper ore sorted from dumps, plus

TABLE 31.—World smelter production of zinc, by countries, 1944-50, in metric tons

[Compiled by Viola May Haslacker]

Country ¹	1944	1945	1946	1947	1948	1949	1950
Argentina.....	976	983	1,814	2,631	1,602	2,648	* 7,530
Australia.....	79,979	85,118	77,541	70,535	82,617	82,255	85,146
Belgium.....	8,600	11,712	79,325	* 133,011	* 153,928	* 176,565	* 177,326
Canada.....	152,876	166,302	168,448	161,367	178,329	186,920	185,935
China.....	331	328	(²)	320	330	(³)	(³)
Czechoslovakia.....	(⁴)	3,300	(⁵)	1,964	(⁶)	(⁶)	(⁶)
France.....	8,793	8,414	31,014	46,007	66,067	60,697	71,531
Germany: ⁷							
Federal Republic.....	259,000	(⁸)	{* 114,855	{* 20,723	{* 41,352	{* 66,916	112,791
Soviet Zone.....			(⁹)	(⁹)	(⁹)	(⁹)	(⁹)
Indochina.....	* 622						
Italy.....	6,100	1,517	15,706	22,849	26,397	26,612	38,119
Japan.....	* 60,850	* 30,000	11,253	14,849	21,200	32,318	49,008
Mexico.....	49,248	48,985	41,982	66,749	48,323	53,496	53,492
Netherlands.....	2,105		2,011	9,532	13,588	15,614	19,762
Northern Rhodesia.....	14,712	15,485	17,466	21,476	22,626	23,217	23,080
Norway.....	11,777	9,228	30,210	34,580	42,000	41,040	44,000
Peru.....	1,447	1,583	936	1,013	1,464	1,261	1,262
Poland.....	(¹⁰)	30,385	56,614	71,756	87,089	(¹¹)	(¹²)
Spain.....	18,054	17,310	17,568	19,825	21,203	19,551	21,264
Sweden.....	1,790	2,929					
U. S. S. R. ¹³	84,000	89,000	90,000	106,000	110,000	110,000	128,700
United Kingdom.....	72,192	63,024	66,569	60,392	73,138	65,124	71,418
United States.....	788,613	693,594	660,665	728,007	714,644	739,184	765,176
Total (estimate).....	1,622,000	1,302,000	1,386,000	1,595,000	1,698,000	1,811,000	1,943,000

¹ In addition to the countries listed, Rumania and Yugoslavia produce zinc, but no estimates for them are included in the totals. Rumania produced about 2,300 metric tons in 1947, and Yugoslavia about 5,000 tons annually prewar.

² Estimated.

³ Includes production from reclaimed scrap.

⁴ Data not available; estimate by senior author of chapter included in total.

⁵ Data for Austria, Czechoslovakia and Poland in 1944 included with Germany.

⁶ American and British zones only.

⁷ Yearbook of American Bureau of Metal Statistics, 1950.

Minor M

By Jack W

BARIUM AND

DOMESTIC producers of barium getter-alloys during 1950 were & Carbon Corp., Cleveland, O. Syracuse, N. Y. Production of barium is about 100,000 pounds annually; strontium output is about 100,000 pounds and strontium minerals and chemicals are produced in small quantities. Barite and Minor Nonmetals chapter.

Uses.—Barium and, occasionally, strontium are used exclusively in getter-alloys used in vacuum tubes or other devices requiring vacuum. Barium is unstable, hence is ordinarily alloyed with strontium, the former giving a lower flashing temperature and stability. A composition common in tube production contains the aforementioned elements in a weight ratio of 1Ba:1Al:2Sr, having the highest practical barium content. Barium getter-alloys, may range up to 90% barium. Types may contain other elements such as copper, iron, nickel, calcium, and beryllium.

Prices.—During 1949 and 1950 a pound of barium at \$6 per pound in lots of more than 100 pounds, at \$10 in 500-pound lots. The foregoing prices are with extruded rods \$1 per pound higher.

Technology.—Procedures were published for the production of its alloys ¹ and for vaporizing the element ².

Canada.—Dominion Magnesium, Ltd., Sarnia, Ontario, reported production of 10,652 pounds of barium which compared with 10,652 pounds of strontium was produced in 1949. The production of barium and strontium are not reported. The U. S. Associates, Cleveland, Ohio, distributes barium and strontium in the United States.

¹ Deceased. Figures on imports and exports compiled from records of the U. S. Department of Commerce, closed in parentheses are translations from the language of the country of origin.

² Compagnie de Produits et Electrometallurgiques A. S. French Patent 935,324, June 16, 1949.

³ N. V. Philips Gloeilampenfabrieken (Coating of Vacuum Tubes), Eindhoven, Holland, Patent 63,639, May 16, 1949.

⁴ Jenkins, R. O., and Newton, R. H. O., Elemental Barium, Apr. 9, 1949, p. 572.