

DEPARTMENT OF THE INTERIOR  
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY  
GEORGE OTIS SMITH, Director

# MINERAL RESOURCES OF THE UNITED STATES

1920

G. F. LOUGHLIN  
Geologist in Charge, Division of Mineral Resources

PART I—METALS  
G. F. LOUGHLIN, Geologist in Charge



WASHINGTON  
GOVERNMENT PRINTING OFFICE

1922  
H. F. G.

N49748

*Antimony ore produced in Algeria, 1912-1919, in metric tons.*

| Year.                   | Ore.   | Metric tons. |
|-------------------------|--------|--------------|
| 1912.....               | 4,061  | 11           |
| 1913.....               | 582    | 1            |
| 1914 <sup>a</sup> ..... | 1,100  | 3            |
| 1915 <sup>a</sup> ..... | 9,022  | 25           |
| 1916 <sup>a</sup> ..... | 28,473 | 11           |
| 1917.....               | 16,248 | 11           |
| 1918.....               | 7,920  | 12           |
| 1919.....               | 2,160  | 11           |

<sup>a</sup> Exports, metal content approximate only.

#### BRITISH SOUTH AFRICA.

The most promising antimony deposits in British South Africa appear to be those of the Murchison Range,<sup>15</sup> in northern Transvaal. The principal mine of the range is the United Jack. In 1913-1919 there was shipped from Transvaal 1,610 metric tons of concentrates and crude antimony. In 1920 72 tons of regulus is reported to have been produced. Deposits occur also in the Steynsdorp district in the Forbes Reef district, in Swaziland, and over a considerable portion of southern Rhodesia.<sup>16</sup>

#### AUSTRALIA.<sup>17</sup>

The only important antimony-producing district in Australia is the Costerfield district of Victoria. The antimony concentrates average about 48 per cent of antimony and also contain about 2½ ounces of gold to the ton. The output in 1913-1919 was 16,406 long tons.

The Hillgrove district in New South Wales was formerly a considerable producer, the highest annual output being 2,450 tons of ore in 1906. The antimony metal and ore produced in New South Wales in 1912-1919 amounted to 2,110 long tons.

Imports of antimony ore into Great Britain from Australia in 1919 amounted to 3,854 long tons, valued at \$471,700.

<sup>15</sup> Hall, A. L., *Geology of the Murchison Range: South Africa Geol. Survey Mem. 6, 1912.* Union of South Africa, Reports Govt. Mining Engineer, 1914-1917.

<sup>16</sup> *South African Min. Jour.*, vol. 25, p. 485, Aug. 19, 1916; vol. 25, pt. 2, p. 479, Aug. 26, 1916. Molengraaf, G. A. F., *Géologie de la République sud-africaine: Soc. géol. France Bull.*, 4th ser., vol. 1, p. 28, 1901.

<sup>17</sup> Official statistics, Victoria and New South Wales. *Imp. Inst. Bull.*, vol. 14, pp. 405-408, 1916. Carr, J. E., *The antimony mining industry in New South Wales: New South Wales Dept. Mines, Min. B.* 16, 1912. Victoria *Sec. Mines Ann. Rept.*, 1918, p. 5. *Chem. Eng. and Min. Rev.*, vol. 12, No. 141, p. 22, 1920. *The mineral industry of the British Empire and foreign countries: Antimony (1913-1919).*

## LEAD.

By C. E. SIEBENTHAL and A. STOL.

### SUMMARY.

The following tabular statement gives the general summary of domestic production and consumption of refined lead compiled by the United States Geological Survey:

*Summary of statistics of refined lead, 1919-20, in short tons.*

| PRODUCTION.                                                   |         |
|---------------------------------------------------------------|---------|
| Domestic desilverized lead.....                               | 476,849 |
| Domestic soft lead.....                                       | 1,100   |
| Domestic desilverized soft lead.....                          | 9,022   |
| Foreign desilverized lead.....                                | 28,473  |
| Total refined primary <sup>a</sup> lead.....                  | 515,444 |
| Antimonial lead.....                                          | 16,248  |
| Secondary <sup>a</sup> lead.....                              | 7,920   |
| CONSUMPTION. <sup>b</sup>                                     |         |
| Apparent consumption of primary lead, stocks disregarded..... | 476,849 |

<sup>a</sup> "Primary lead," which is produced directly from ore, is here distinguished from secondary lead, which is obtained by refining skimmings, drosses, and old metals. The statistics given on p. 89. Wherever in this report the word "lead" is used without qualification, it is understood to mean primary lead.

<sup>b</sup> For method of calculating consumption see p. 93.

The output of refined lead in the United States in 1920 was 476,849 short tons, valued at \$10,000,000. The average selling price of pig lead in New York, as compared with 1919, of 12 per cent in quantity and of 70 per cent in value.

### PRODUCTION.

#### QUANTITY AND VALUE.

The refined lead produced in the United States in 1920 was 476,849 short tons, valued at \$10,000,000. The average selling price of pig lead in New York, as compared with 1919, of 12 per cent in quantity and of 70 per cent in value. The refined lead produced in the United States from domestic ores and from foreign ores and the value at the average price in New York are shown in chapter on lead in Mineral Resources for 1919. The years are shown in the table on page 86.

Production, price per pound, and value of refined lead in the United States, 1720-1920.

| Year.          | Desilverized lead. <sup>a,b</sup> | Soft lead. <sup>c</sup> | Total production. <sup>b</sup> | From domestic ores and base bullion. <sup>b</sup> | From foreign ores.    | From foreign base bullion. | Price per pound at New York. <sup>d</sup> | Value.        |
|----------------|-----------------------------------|-------------------------|--------------------------------|---------------------------------------------------|-----------------------|----------------------------|-------------------------------------------|---------------|
| 1720-1913..... | Short tons. 7,834,081             | Short tons. 3,061,047   | Short tons. 10,895,128         | Short tons. 8,937,261                             | Short tons. 1,957,867 | Short tons. 21,089         | .....                                     | .....         |
| 1914.....      | 383,903                           | 158,219                 | 542,122                        | 512,794                                           | 7,639                 | 21,089                     | \$0.039                                   | \$905,296,000 |
| 1915.....      | 388,504                           | 161,461                 | 550,055                        | 507,026                                           | 9,581                 | 33,448                     | .047                                      | 42,286,000    |
| 1916.....      | 403,619                           | 167,515                 | 571,134                        | 552,228                                           | 6,095                 | 12,821                     | .069                                      | 51,705,000    |
| 1917.....      | 422,266                           | 188,503                 | 610,769                        | 548,450                                           | 15,872                | 40,447                     | .086                                      | 78,817,000    |
| 1918.....      | 429,732                           | 210,463                 | 640,195                        | 539,905                                           | 15,331                | 81,050                     | .071                                      | 105,052,000   |
| 1919.....      | 334,476                           | 147,744                 | 482,220                        | 424,433                                           | 7,056                 | 50,131                     | .053                                      | 90,908,000    |
| 1920.....      | 339,803                           | 189,854                 | 529,657                        | 476,849                                           | 8,414                 | 44,394                     | .08                                       | 61,115,000    |
|                | 10,536,474                        | 4,284,806               | 14,821,280                     | 12,518,940                                        | 2,302,334             |                            |                                           | 84,745,000    |
|                |                                   |                         |                                |                                                   |                       |                            |                                           | 1,469,924,000 |

<sup>a</sup> Desilverized soft lead is included; for quantity see page 87.

<sup>b</sup> Antimonial lead is excluded; for quantity see page 88.

<sup>c</sup> Desilverized soft lead is excluded.

<sup>d</sup> For 1917-1920, average sales price.

#### PRODUCTION BY STATES.

In addition to the domestic lead ores smelted in this country, small quantities of domestic lead ore have been exported to smelters in Canada. In 1912 soft lead amounting to 63 tons was smelted from Wisconsin ores at Canadian smelters, and in 1913 soft lead amounting to 37 tons from Wisconsin ores and desilverized lead amounting to 98 tons from Idaho and Washington ores were smelted at Canadian smelters. The desilverized lead smelted in Canada from Washington ores amounted to 31 tons in 1914, to 137 tons in 1915, and to 2,001 tons in 1916. In 1917 silver-lead ores from Idaho and Montana smelted in Canada produced 4,570 tons of lead. Ores from Washington yielded 1,388 tons of lead at Canadian smelters in 1918 and 3 tons in 1919, but no lead ore from the United States was treated in Canada in 1920.

Primary lead smelted or refined in the United States, 1914-1920, by

| Source of ore.               | 1914           | 1915           | 1916           | 1917           |
|------------------------------|----------------|----------------|----------------|----------------|
| <b>Domestic ore:</b>         |                |                |                |                |
| Alaska.....                  | 5,601          | 6,953          | 15,328         | 7,456          |
| Arizona.....                 | 52             | 51             | 170            | 300            |
| Arkansas.....                | 3,698          | 5,600          | 3,633          | 11,471         |
| California.....              | 41,198         | 32,352         | 33,046         | 29,327         |
| Colorado.....                | 177,827        | 160,680        | 170,059        | 174,045        |
| Idaho.....                   | 427            | 910            | 670            | 867            |
| Illinois.....                | 34             |                |                |                |
| Iowa.....                    | 1,043          | 1,320          | 1,737          | 2,063          |
| Kansas.....                  | 16             | 95             | 37             | 21             |
| Kentucky.....                | 194,275        | 195,634        | 218,253        | 218,197        |
| Missouri.....                | 4,386          | 4,853          | 4,961          | 5,933          |
| Montana.....                 | 5,996          | 7,664          | 11,868         | 12,334         |
| Nevada.....                  |                | 3              | 46             |                |
| New Hampshire.....           | 741            | 2,157          | 3,290          | 3,428          |
| New Mexico.....              |                |                |                |                |
| New York.....                | 8,916          | 4,340          | 10,969         | 19,646         |
| Oklahoma.....                | 17             | 11             | 9              |                |
| Oregon.....                  | 2              | 5              | 12             | 34             |
| South Dakota.....            |                | 8              |                |                |
| Tennessee.....               | 89             | 111            | 26             | 68             |
| Texas.....                   | 88,970         | 100,105        | 111,799        | 82,081         |
| Utah.....                    | 143            | 467            | 740            | 1,417          |
| Virginia.....                | 2              | 11             | 217            | 929            |
| Washington.....              | 1,819          | 2,632          | 3,121          | 2,930          |
| Wisconsin.....               | 99             | 128            | 113            | 145            |
| Undistributed.....           | 4,125          | 4,562          | 5,478          | 6,489          |
| Zinc residues.....           | 534,482        | 537,012        | 596,221        | 579,385        |
| <b>Foreign ore:</b>          |                |                |                |                |
| Africa.....                  | 2,942          |                | 328            | 1,738          |
| Australia.....               | 2              | 1,174          | 1,231          | 1,100          |
| Canada.....                  |                | 1              | 7              |                |
| Central America.....         | 2,386          | 5,437          | 1,917          | 7,607          |
| Mexico.....                  | 1,821          | 2,829          | 2,366          | 1,633          |
| South America.....           | 488            | 140            | 236            | 3,894          |
| Other foreign.....           |                |                |                |                |
| <b>Foreign base bullion:</b> |                |                |                |                |
| Canada.....                  | 21,689         | 33,173         | 11,698         | 39,608         |
| Mexico.....                  |                | 275            | 151            | 189            |
| South America.....           |                |                |                |                |
|                              | 29,328         | 43,029         | 18,906         | 62,319         |
| <b>Grand total.....</b>      | <b>563,810</b> | <b>580,041</b> | <b>615,127</b> | <b>641,704</b> |

\* The lead produced by these States is nonargenterous or soft lead.

#### SOFT LEAD.

The lead ores of the Mississippi Valley are almost all soft lead, and the lead produced from them is known as soft lead.

Soft lead produced in the United States, 1914-1920.

| Year.     | Soft pig lead.  |               |                      | Soft lead recovered in pigments. |
|-----------|-----------------|---------------|----------------------|----------------------------------|
|           | Undesilverized. | Desilverized. | Total soft pig lead. |                                  |
| 1914..... | 158,219         | 43,506        | 201,725              | 11,914                           |
| 1915..... | 161,461         | 44,001        | 205,462              | 12,782                           |
| 1916..... | 167,515         | 68,244        | 235,759              | 13,252                           |
| 1917..... | 188,503         | 56,268        | 244,771              | 12,870                           |
| 1918..... | 210,463         | 47,418        | 257,881              | 13,093                           |
| 1919..... | 147,744         | 67,938        | 215,682              | 11,470                           |
| 1920..... | 189,854         | 66,688        | 256,542              | 15,960                           |

\* Includes domestic refined lead, domestic lead in antimonial lead, and

## ANTIMONIAL LEAD.

The production of by-product antimonial lead from argentiferous lead ores derived from all sources, as reported by all lead refineries operating in this country, is shown for the period 1871-1914 (the quantity for years prior to 1891 being estimated from the output of desilverized lead) in a table in the chapter on lead in Mineral Resources, 1914. The figures for later years are given below.

*By-product antimonial lead produced in the United States, 1914-1920.*

| Year.        | Total lead refined from base bullion (short tons). | Per-centage of by-product antimonial lead. | Antimonial lead.                |                                |                        |             |                   |              |                                           |
|--------------|----------------------------------------------------|--------------------------------------------|---------------------------------|--------------------------------|------------------------|-------------|-------------------|--------------|-------------------------------------------|
|              |                                                    |                                            | From domestic ore (short tons). | From foreign ore (short tons). | Total.                 |             |                   |              | Lead content, by difference (short tons). |
|              |                                                    |                                            |                                 |                                | Quantity (short tons). | Value.      | Antimony content. |              |                                           |
|              |                                                    |                                            |                                 |                                |                        |             | Short tons.       | Per-centage. |                                           |
| 1914.....    | 340,397                                            | 4.9                                        | 15,475                          | 1,102                          | 16,667                 | \$1,572,167 | 2,693             | 16.2         | 13,974                                    |
| 1915.....    | 344,583                                            | 6.7                                        | 19,371                          | 3,853                          | 23,224                 | 3,855,736   | 3,425             | 14.8         | 19,799                                    |
| 1916.....    | 335,375                                            | 7.2                                        | 17,246                          | 6,782                          | 24,038                 | 4,493,582   | 3,496             | 14.5         | 20,542                                    |
| 1917.....    | 365,998                                            | 5.1                                        | 15,279                          | 3,367                          | 18,646                 | 3,781,660   | 2,759             | 14.8         | 15,887                                    |
| 1918.....    | 382,314                                            | 4.9                                        | 10,777                          | 7,703                          | 18,570                 | 2,820,350   | 2,566             | 13.8         | 16,004                                    |
| 1919.....    | 266,538                                            | 5.2                                        | 9,674                           | 4,200                          | 13,874                 | 1,513,900   | 1,943             | 14.0         | 11,931                                    |
| 1920.....    | 273,135                                            | 4.6                                        | 9,604                           | 2,931                          | 12,535                 | 1,963,255   | 2,033             | 16.2         | 10,502                                    |
| Average..... |                                                    | 5.52                                       |                                 |                                |                        |             |                   | 14.8         |                                           |

Details of the production and consumption of antimony in the United States are given in the chapter on antimony in Mineral Resources, 1920.

## LEAD PIGMENTS.

Leaded zinc oxide, zinc-lead oxide, sublimed white lead, and sublimed blue lead are made directly from ore. Each of these pigments is discussed and the output given elsewhere in this volume in the chapter on lead and zinc pigments and salts. The lead content of pigments smelted directly from ore is given in the fourth column of the table on page 87. The pigments manufactured from pig lead (white lead, red lead, orange mineral, and litharge) are also discussed and the output given in the chapter on lead and zinc pigments.

## SECONDARY LEAD.

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

## LEAD.

*Secondary lead recovered in the United States, 1914-1920, in short tons.*

| Year.     | Pig lead. | Lead in alloys. |
|-----------|-----------|-----------------|
| 1914..... | 29,337    | 31,771          |
| 1915..... | 36,400    | 42,500          |
| 1916..... | 56,700    | 39,600          |
| 1917..... | 45,100    | 48,400          |
| 1918..... | 41,146    | 55,900          |
| 1919..... | 55,684    | 66,400          |
| 1920..... | 56,350    | 68,300          |

## MINE PRODUCTION.

The preceding tables give the quantity of lead recovered and refining operations either as metallic lead, antimonial lead, or as lead in pigments. The original figures are much more accurately shown by the mines reports, which necessarily treat mixtures of ores, sometimes long known, but which have not been received, so that the actual output of metal correspond at all closely to the product of the mine.

The following table gives the mine output of lead in the United States for 1907-1918, inclusive. See page 946 of the chapter on lead in Mineral Resources, 1920.

*Mine production of lead by States, 1914-1920, in short tons.*

| State.              | 1914    | 1915    | 1916    | 1917    |
|---------------------|---------|---------|---------|---------|
| Alaska.....         | 28      | 437     | 820     | 852     |
| Arizona.....        | 7,502   | 10,659  | 13,531  | 11,733  |
| Arkansas.....       | 41      | 63      | 272     | 362     |
| California.....     | 2,126   | 2,290   | 6,204   | 10,934  |
| Colorado.....       | 37,106  | 34,405  | 35,457  | 33,966  |
| Georgia.....        |         |         |         | 196,780 |
| Idaho.....          | 174,263 | 173,000 | 187,641 | 149,780 |
| Illinois.....       | 717     | 954     | 1,072   | 1,429   |
| Iowa.....           |         |         | 14      | 34      |
| Kansas.....         | 1,409   | 1,212   | 1,648   | 3,025   |
| Kentucky.....       | 16      | 261     | 153     | 123     |
| Maine.....          |         |         |         |         |
| Massachusetts.....  |         |         |         | 234,150 |
| Missouri.....       | 192,612 | 210,440 | 233,088 | 10,976  |
| Montana.....        | 4,928   | 6,878   | 6,798   | 13,889  |
| Nevada.....         | 6,408   | 8,319   | 12,819  | 48      |
| New Hampshire.....  |         | 3       | 47      | 4,564   |
| New Mexico.....     | 882     | 2,271   | 4,107   |         |
| North Carolina..... |         |         |         | 20,358  |
| Oklahoma.....       | 7,556   | 7,308   | 12,115  | 14      |
| Oregon.....         | 8       | 31      |         |         |
| Pennsylvania.....   |         | 2       | 18      | 84      |
| South Dakota.....   | 2       | 1       | 16      | 2,531   |
| Tennessee.....      |         |         |         |         |
| Texas.....          | 75      | 110     | 25      | 89,201  |
| Utah.....           | 85,662  | 99,984  | 100,745 | 859     |
| Virginia.....       | 127     | 339     | 728     | 4,895   |
| Washington.....     | 33      | 148     | 2,700   | 4,130   |
| Wisconsin.....      | 1,404   | 2,322   | 3,043   |         |
| Total.....          | 522,892 | 561,641 | 622,975 | 650,949 |

## COMPARISON OF TOTALS BASED ON SMELTER RETURNS AND ON MINE RETURNS.

The statistics of lead actually recovered by the smelters as refined pig lead, as antimonial lead, and in pigments, and the statistics of mine production (in large part expressed as lead content of ores produced) are compared over a period of years in the following table:

*Domestic lead recovered and lead mined in the United States, 1907-1920, in short tons.*

| Year.          | From smelter reports. | From mine reports. | Smelter excess. | Mine excess. |
|----------------|-----------------------|--------------------|-----------------|--------------|
| 1907-1913..... | 2,704,368             | 2,903,479          |                 | 199,111      |
| 1914.....      | 537,676               | 522,892            | 14,784          |              |
| 1915.....      | 536,312               | 561,641            |                 | 25,329       |
| 1916.....      | 580,225               | 622,975            |                 | 42,750       |
| 1917.....      | 574,338               | 650,949            |                 | 76,611       |
| 1918.....      | 502,218               | 581,654            |                 | 79,436       |
| 1919.....      | 444,250               | 443,694            | 556             |              |
| 1920.....      | 600,841               | 513,533            |                 | 86,308       |
|                | 6,440,228             | 6,800,817          |                 | 360,589      |

## TRADE CONDITIONS.

## WORLD'S PRODUCTION.

*World's production of work lead, 1913-1920.*

[By countries where smelted but not necessarily refined, in metric tons.]

| Country.                          | 1913      | 1914      | 1915      | 1916      | 1917      | 1918      | 1919    | 1920    |
|-----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|---------|---------|
| Australia.....                    | 110,444   | 101,788   | 102,721   | 184,072   | 144,950   | 163,308   | 83,408  | 7,802   |
| Africa:                           |           |           |           |           |           |           |         |         |
| Rhodesia.....                     | 296       | 186       | 25        |           | 5,028     | 8,311     | 10,172  | 13,247  |
| Tunis.....                        | (a)       | (a)       | (a)       | (a)       | (a)       | 16,638    | (a)     | (a)     |
| Austria-Hungary.....              | 24,000    | 32,000    | 34,500    | 38,500    | 34,400    | 33,000    | (a)     | (a)     |
| Belgium.....                      | 103,480   | 70,980    | 16,770    | 15,560    | 22,745    | 20,630    | 58,500  | 16,040  |
| Canada.....                       | 17,202    | 16,531    | 19,740    | 19,879    | 20,709    | 17,005    | 16,143  | 13,788  |
| France.....                       | 28,817    | 20,001    | 14,509    | 24,276    | 21,285    | 12,778    | 10,928  | (a)     |
| Germany:                          |           |           |           |           |           |           |         |         |
| Upper Silesia.....                | 41,300    | 38,950    | 28,750    | 41,820    | 32,860    | 23,960    | 18,580  | d 8,579 |
| Other Germany.....                | 147,000   | 143,000   | 93,000    | 65,000    | 55,000    | 46,000    | 33,000  | (a)     |
| Great Britain.....                | 30,990    | 20,000    | 10,020    | 12,980    | 11,614    | 11,269    | 11,458  | (a)     |
| Greece.....                       | 18,309    | 20,684    | 11,595    | 9,424     | 1,422     | 4,093     | 3,841   | 4,815   |
| India (Burma).....                | 5,961     | 10,717    | 13,738    | 11,011    | 17,238    | 19,880    | 19,806  | 24,198  |
| Italy.....                        | 21,674    | 20,164    | 21,812    | 24,362    | 16,287    | 18,832    | 18,590  | (a)     |
| Japan.....                        | 3,777     | 4,662     | 4,704     | 11,371    | 15,807    | 10,684    | 5,771   | (a)     |
| Mexico.....                       | 62,000    | 23,598    | 31,384    | 19,966    | 46,612    | 88,503    | 78,645  | 84,200  |
| Russia.....                       | 1,523     | 1,080     | 935       | 540       | (a)       | (a)       | (a)     | (a)     |
| South America.....                | 2,729     | 3,145     | 4,667     | 4,267     | 4,571     | 5,208     | 7,234   | 6,510   |
| Spain.....                        | 198,829   | 148,624   | 174,474   | 147,407   | 176,809   | 169,709   | 126,721 | (a)     |
| Sweden.....                       | 1,235     | 1,396     | 1,917     | 2,076     | 8,174     | 2,241     | 827     | 800     |
| Turkey.....                       | 13,900    | 1,100     | 1,100     | 1,100     | 3,000     | 3,300     | 1,000   | 1,000   |
| United States (refined lead)..... | 385,643   | 472,126   | 468,656   | 506,490   | 511,042   | 503,702   | 391,982 | 440,221 |
| Known output.....                 | 1,219,000 | 1,153,000 | 1,058,000 | 1,091,000 | 1,143,000 | 1,178,000 | 888,000 | 620,000 |

<sup>a</sup> Statistics not available.

<sup>b</sup> Metallgesellschaft (statistical publication), 21st vol., 1921.

<sup>c</sup> Upper Silesian Mining and Smelting Syndicate.

<sup>d</sup> January to June only.

<sup>e</sup> Amer. Bur. Metal Statistics Year Book, 1920.

## LEAD.

The foregoing statistics of the world's production are incomplete, give some idea of the foreign production. The figures in black-faced type are taken from the countries named; those in ordinary type are from statistical handbooks, consular reports, market letters. There is always a possibility of duplication of production, for some countries send "work" to other countries for refining. Furthermore, some lead are included in the figures showing that to put the United States on an equal footing would be necessary to include in its production of secondary lead and antimonial lead. The United States represent refined lead that was smelted over the source of the ore.

## IMPORTS AND EXPORTS.

The following tables are taken from the Foreign and Domestic Commerce.

## WAREHOUSE TRANSACTIONS.

*Lead remaining in warehouse in the United States, December 31, 1920.*

| Year.     | Form in which lead was entered for warehouse. |                      | New York.  | Chicago. |
|-----------|-----------------------------------------------|----------------------|------------|----------|
|           | Lead in ore and base bullion.                 | Pigs, bars, and old. |            |          |
| 1914..... | 15,333,064                                    | 3,837                | 10,309,592 | 94,165   |
| 1915..... | 24,338,633                                    |                      | 8,401,728  | 185,732  |
| 1916..... | 23,667,358                                    | 1,070,268            | 8,576,115  | 4,732    |
| 1917..... | 47,853,945                                    | 5,370,445            | 19,016,511 | 4,757    |
| 1918..... | 33,997,822                                    | 944,483              | (a)        | (a)      |
| 1919..... | 90,952,684                                    | 408,154              | (a)        | (a)      |
| 1920..... | 102,440,326                                   | 2,044,576            | (a)        | (a)      |

<sup>a</sup> Not available.

## IMPORTS.

*Lead imported and entered for consumption in the United States, 1914-1920.*

| Year.     | Lead in ore.       |           | Base bullion.      |           | Pigs, bars, and old. |           |
|-----------|--------------------|-----------|--------------------|-----------|----------------------|-----------|
|           | Quantity (pounds). | Value.    | Quantity (pounds). | Value.    | Quantity (pounds).   | Value.    |
| 1914..... | 5,459,961          | \$188,749 | 8,904,649          | \$301,195 | 575,290              | \$12,382  |
| 1915..... | 2,865,792          | 96,010    | 15,496,230         | 519,355   | 997,388              | 32,732    |
| 1916..... | 10,125,983         | 368,824   | 5,242,171          | 208,277   | 6,388,097            | 331,732   |
| 1917..... | 5,438,931          | 207,370   | 6,965,849          | 470,639   | 1,756,223            | 85,732    |
| 1918..... | 6,064,902          | 344,080   | 3,559,071          | 180,070   | 1,139,950            | 56,732    |
| 1919..... | 4,100,823          | 190,303   | 31,796,693         | 1,130,937 | 10,174,115           | 415,732   |
| 1920..... | 13,700,499         | 908,619   | 66,816,820         | 3,340,600 | 68,901,959           | 3,887,732 |

Type metal imported and entered for consumption in the United States, 1914-1920.

| Year.                                | Type metal.            |           | Lead content.      |             |
|--------------------------------------|------------------------|-----------|--------------------|-------------|
|                                      | Gross weight (pounds). | Value.    | Quantity (pounds). | Percentage. |
| 1914.....                            | 1,509,538              | \$45,373  | 1,322,188          | 87.6        |
| 1915.....                            | 2,708,261              | 107,607   | 2,424,300          | 87.6        |
| 1916.....                            | 1,162,580              | 83,810    | 923,473            | 79.4        |
| 1917.....                            | 551,794                | 35,938    | 513,106            | 93.0        |
| 1918.....                            | 13,394,803             | 818,642   | 11,000,498         | 82.1        |
| 1919.....                            | 20,887,353             | 1,349,495 | 25,761,543         | 86.2        |
| 1920.....                            |                        |           |                    |             |
| Average lead content, 1914-1920..... |                        |           |                    | 86.1        |

General imports of lead into the United States, in ore, base bullion, and refined, 1914-1920, by sources, in pounds.

| Year.     | Canada.    | Mexico.     | South America. | Europe.    | Other countries. | Total imports. |
|-----------|------------|-------------|----------------|------------|------------------|----------------|
| 1914..... | 384,007    | 46,282,207  | 2,417,744      | 4,888,552  | 2,894,283        | 56,876,803     |
| 1915..... | 2,303,170  | 94,247,384  | 5,420,567      | 217,773    | 802,516          | 102,991,410    |
| 1916..... | 12,600,216 | 48,395,670  | 6,235,753      | 575,759    | 2,845,949        | 70,659,352     |
| 1917..... | 11,738,379 | 123,782,759 | 4,550,460      | 8,945,899  | 5,520,323        | 158,543,820    |
| 1918..... | 28,225,878 | 102,259,199 | 1,962,124      | 62,510     | 4,705,049        | 197,214,760    |
| 1919..... | 10,391,115 | 125,541,614 | 5,591,416      | 89,840     | 289,142          | 141,813,127    |
| 1920..... | 8,199,234  | 131,815,278 | 7,085,351      | 38,760,504 | 11,163,160       | 197,029,527    |

General imports of lead into the United States, 1914-1920, by classes, in pounds.

| Year.     | Lead in ore (lead content). | Base bullion. |               | Pigs, bars, sheets, and old. | Total lead content. |
|-----------|-----------------------------|---------------|---------------|------------------------------|---------------------|
|           |                             | Gross weight. | Lead content. |                              |                     |
| 1914..... | 23,649,637                  | 33,444,503    | 32,730,320    | 296,846                      | 56,876,803          |
| 1915..... | 18,185,140                  | 86,247,995    | 83,086,988    | 819,222                      | 102,991,410         |
| 1916..... | 35,086,100                  | 24,943,660    | 24,262,435    | 11,310,817                   | 70,659,352          |
| 1917..... | 41,292,876                  | 100,279,997   | 103,064,970   | 11,685,974                   | 158,543,820         |
| 1918..... | 37,070,340                  | 155,810,063   | 149,603,880   | 10,480,631                   | 197,214,760         |
| 1919..... | 19,573,850                  | 115,317,190   | 112,024,518   | 10,214,753                   | 141,813,127         |
| 1920..... | 29,488,810                  | 101,476,550   | 96,103,603    | 71,437,108                   | 197,029,527         |

#### EXPORTS.

##### DOMESTIC EXPORTS.

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

Refined lead made from domestic ores and exported from the United States, 1914-1920.

| Year.     | Quantity (short tons). | Value.      |
|-----------|------------------------|-------------|
| 1914..... | 58,722                 | \$4,501,674 |
| 1915..... | 88,306                 | 7,028,518   |
| 1916..... | 100,500                | 13,494,065  |
| 1917..... | 53,688                 | 9,560,698   |
| 1918..... | 41,831                 | 5,889,381   |
| 1919..... | 10,510                 | 1,471,256   |
| 1920..... | 2,730                  | 462,223     |

#### LEAD.

##### FOREIGN EXPORTS.

By foreign lead exports are meant the export of lead which has been smelted, refined, or manufactured in this country and then shipped abroad.

Foreign lead exported from the United States

| Year.     | Exported from warehouse. |           |                               |           |                      |           |
|-----------|--------------------------|-----------|-------------------------------|-----------|----------------------|-----------|
|           | Lead content of ore.     |           | Lead content of base bullion. |           | Pigs, bars, and old. |           |
|           | Quantity (pounds).       | Value.    | Quantity (pounds).            | Value.    | Quantity (pounds).   | Value.    |
| 1914..... | 6,724,525                | \$245,205 | 10,944,350                    | \$378,286 | 25,421,500           | \$913,111 |
| 1915..... | (a)                      |           | (a)                           |           | 17,226,803           | 2,738,500 |
| 1916..... | (a)                      |           | (a)                           |           | 19,780,086           | 1,111,111 |
| 1917..... | (a)                      |           | (a)                           |           | 75,304,480           | 9,550,000 |
| 1918..... | (a)                      |           | (a)                           |           | 118,832,344          | 8,300,000 |
| 1919..... | (a)                      |           | (a)                           |           | 81,951,396           | 4,630,000 |
| 1920..... | (a)                      |           | (a)                           |           | 34,725,501           | 2,570,000 |

<sup>a</sup> Since July 1, 1915, the Bureau of Foreign and Domestic Commerce has reported "domestic exports, of pigs, bars, etc., produced from foreign."

#### CONSUMPTION.

Apparent consumption of refined primary lead in the United States, guarded, in short tons, 1914-1920.

|                                                | 1914    | 1915    | 1916    | 1917    |
|------------------------------------------------|---------|---------|---------|---------|
| Supply:                                        |         |         |         |         |
| Stock in bonded warehouses, Jan. 1.....        |         | 2       |         |         |
| Imports of pigs, bars, and old.....            | 148     | 410     | 5,655   | 5,610   |
| Production.....                                | 542,122 | 550,055 | 571,134 | 617,111 |
|                                                | 542,270 | 550,467 | 576,789 | 617,111 |
| Withdrawn:                                     |         |         |         |         |
| Exports of foreign lead—                       |         |         |         |         |
| From warehouse.....                            | 21,545  | 38,618  | 9,880   | 37,111  |
| In manufactures, with benefit of drawback..... | 9,489   | 3,983   | 5,171   | 7,111   |
| Exports of domestic lead.....                  | 58,722  | 88,306  | 100,600 | 53,111  |
| Stock in bonded warehouses, Dec. 31.....       | 2       |         | 535     | 2,111   |
|                                                | 89,758  | 130,907 | 116,086 | 101,111 |
| Apparent consumption.....                      | 452,512 | 419,560 | 460,703 | 516,000 |

## PRICES AND VALUE.

At the beginning of 1920 lead for immediate delivery was quoted at 7.75 cents a pound in the open market at New York, but by

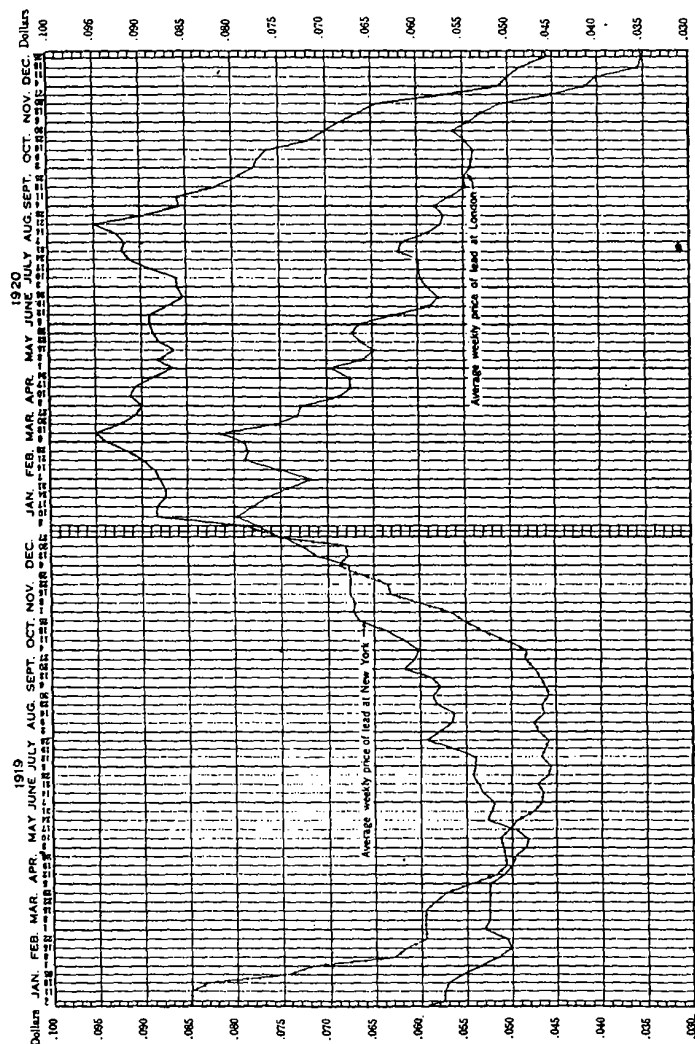


FIGURE 5.—Average weekly price of lead at New York and London, 1919-1920.

January 6 it had risen to 8.875 cents and by March 8 to 9.5 cents. After a decline of nearly a cent a pound it rose again to 9.5 cents on August 16. Later there was a sharp and continuous decline (coin-

## LEAD.

cident with large receipts of foreign lead at New York on December 21, though the price rose to 4.7 cents by year.

The average quoted price of lead for prompt delivery at New York for the year was 8.2 cents a pound, as compared with 5.8 cents in 1919. As a matter of fact, for the first 10 months of 1920 the price averaged almost 9 cents a pound, as figured from the total sales during the year. These are the figures used in calculating the value of lead produced from domestic ores in the United States in the

Prices quoted on lead by the American Smelting & Refining Co. in 1919

|              |       |               |       |
|--------------|-------|---------------|-------|
| Jan. 2.....  | 7.75  | Aug. 12.....  | 8.00  |
| Jan. 3.....  | 8.00  | Sept. 13..... | 8.25  |
| Jan. 12..... | 8.25  | Sept. 23..... | 8.50  |
| Jan. 14..... | 8.50  | Sept. 29..... | 8.75  |
| Feb. 7.....  | 8.75  | Oct. 15.....  | 9.00  |
| Feb. 24..... | 9.00  | Nov. 8.....   | 9.25  |
| Mar. 5.....  | 9.25  | Nov. 15.....  | 9.50  |
| May 7.....   | 9.50  | Nov. 22.....  | 9.75  |
| June 15..... | 9.75  | Nov. 30.....  | 10.00 |
| June 16..... | 10.00 | Dec. 3.....   | 10.25 |
| July 21..... | 10.50 | Dec. 20.....  | 10.75 |

The London price of lead started the year at £4 7s. 6d. (7.75 cents a pound, exchange rate taken into account) and increased on March 1 to £4 10s. a ton (which was nevertheless only 7.06 cents a pound), and increased on March 8 to £4 10s. a ton (8.25 cents a pound). From this point the London price was generally downward. In August, a break in New York prices, the spread between the London prices was nearly 4 cents a pound. The London price began to break rapidly in the later part of October, year at £23 10s. a ton (3.7 cents a pound). The average price for the year is given as £38 4s. 7d. a long ton (at the exchange 6.15 cents a pound), as compared to £23 10s. a ton in 1919 (5.63 cents a pound at the average rate).

The fluctuations in the price of lead at New York are graphically shown in figure 5, which gives curves of the weekly price of lead in those markets for the years

As stated on page 85, the value of the output of lead in the United States from domestic ores in 1920 was \$7,000,000, based on the average price of refined lead, as compared with \$6,000,000 based on the average price in 1919, a gain of 70 per

## Zinc dust produced in the United States, 1914-1920.

| Year.     | Prepared "blue powder." |                     |                                  | Zinc dust "atomized."  |                     |                                  |
|-----------|-------------------------|---------------------|----------------------------------|------------------------|---------------------|----------------------------------|
|           | Quantity (short tons).  | Value. <sup>a</sup> | Average selling price per pound. | Quantity (short tons). | Value. <sup>a</sup> | Average selling price per pound. |
| 1914..... | 1,004                   | \$184,736           | \$0.092                          |                        |                     |                                  |
| 1915..... | 1,755                   | 940,680             | .268                             |                        |                     |                                  |
| 1916..... | 2,548                   | 1,097,397           | .215                             | 61                     | \$28,230            | \$.215                           |
| 1917..... | 3,080                   | 1,322,106           | .160                             | 1,024                  | 642,782             | .167                             |
| 1918..... | 4,016                   | 877,171             | .100                             | 2,070                  | 773,740             | .120                             |
| 1919..... | 4,083                   | 801,366             | .098                             | 2,515                  | 624,694             | .104                             |
| 1920..... | 6,066                   | 2,009,117           | .111                             | 2,273                  | 612,633             | .112                             |

<sup>a</sup> Value is calculated from the total value of material sold during year.  
<sup>b</sup> Of the total output of zinc dust in 1919, 385 tons of "blue powder" and 676 tons of "atomized" zinc dust was made from secondary zinc materials. In 1920, 1,179 tons of zinc dust was made from secondary materials.

## ZINC PIGMENTS.

Zinc forms the base, either in whole or in part, of four white pigments—zinc oxide, leaded zinc oxide, zinc-lead oxide, and lithopone.

Details of the production of zinc pigments and of market conditions are given in the chapter on lead and zinc pigments and salts.

The zinc content of the pigments made in the United States from ore, both domestic and foreign, for the period 1914-1920 is given in the table below. Statistics of the secondary zinc recovered in the form of pigments are given under the next heading.

Primary zinc content of zinc pigments made in the United States, 1914-1920, in short tons.

|           |        |           |         |
|-----------|--------|-----------|---------|
| 1914..... | 70,619 | 1918..... | 102,778 |
| 1915..... | 79,572 | 1919..... | 96,817  |
| 1916..... | 90,276 | 1920..... | 110,695 |
| 1917..... | 97,573 |           |         |

## SECONDARY ZINC.

In the table below the secondary zinc<sup>1</sup> recovered by redistillation is separated from that recovered by remelting. The canvass of secondary smelters was made by J. P. Dunlop, of the United States Geological Survey.

Secondary zinc produced in the United States, 1915-1920, in short tons.

|                                                             | 1915    | 1916    | 1917    | 1918    | 1919    | 1920    |
|-------------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Secondary zinc, redistilled.....                            | 29,764  | 28,776  | 10,835  | 9,918   | 19,748  | 21,371  |
| Secondary zinc, remelted.....                               | 23,136  | 21,037  | 14,565  | 17,190  | 20,162  | 21,479  |
| Recovered zinc in alloys, excluding old brass remelted..... | 5,300   | 2,600   | 4,800   | 11,082  | 6,062   | 7,650   |
| Recovered zinc in remelted brass.....                       | 34,375  | 61,700  | 80,000  | 82,400  | 62,400  | 65,000  |
| Secondary zinc recovered as metal.....                      | 92,575  | 114,100 | 116,200 | 120,600 | 108,400 | 115,600 |
| Secondary zinc recovered in zinc dust.....                  | 8,323   | 8,740   | 9,204   | 8,675   | 955     | 1,061   |
| Secondary zinc recovered in pigments.....                   | 7,860   | 6,319   | 6,248   | 7,348   | 10,702  | 12,870  |
| Secondary zinc recovered in zinc chloride.....              |         |         |         |         | 10,273  | 11,646  |
| Total secondary zinc.....                                   | 108,758 | 129,200 | 132,000 | 137,000 | 130,300 | 141,000 |

<sup>a</sup> These figures include only the quantity of zinc chloride used in wood preservation and were furnished by courtesy of the Forest Service, Department of Agriculture. They may include some imported zinc chloride. In the last few years some zinc chloride has been made from primary material. (See chapter on lead and zinc pigments and salts.)

<sup>1</sup> See page 221 for definition of secondary zinc.

## BY-PRODUCT SULPHURIC ACID.

An important by-product of zinc-smelting is sulphuric acid made from the sulphur gases evolved from sulphide ores preparatory to their distillation as oxide or to zinc salts. Sulphur gases from zinc smelting are utilized by Matthiessen & Hegeler, at La Salle, Ill. There are 20 acid plants using these gases. They are located at zinc smelters, at roasting and magnesia at the mines, or nearer the acid markets, the acid being shipped to the smelters or to other zinc plants. Of this by-product acid have been collected by the Bureau of years, but in 1918 it was found that some other agencies were collecting figures for it, and it was stopped doing so in order to relieve producers of making reports. This decision is to be regretted, as the continuity of the record and left only an estimate available for 1918. Figures for 1919 were obtained from the Bureau, but the Survey again undertook their collection. In the last two or three years the demand for acid has been stronger than that for zinc, so that considerable quantities of sulphur have been burned in order to utilize the acid plants. This acid made from sulphur has been included in the table of output given below.

By-product sulphuric acid made from zinc-bearing ores.

| Year.                   | Number of companies operating. | Number of acid plants operated. | Acid produced, 50°-66° Baumé.                  |             |                        |
|-------------------------|--------------------------------|---------------------------------|------------------------------------------------|-------------|------------------------|
|                         |                                |                                 | Equivalent quantity in 60° Baumé (short tons). | Value.      | Average price per ton. |
| 1914.....               | 11                             | 15                              | 411,911                                        | \$2,974,603 | \$7.22                 |
| 1915.....               | 12                             | 16                              | 484,942                                        | 4,292,493   | 8.85                   |
| 1916.....               | 11                             | 17                              | 671,585                                        | 8,169,651   | 12.16                  |
| 1917.....               | 15                             | 21                              | 908,563                                        | 11,261,142  | 12.39                  |
| 1918.....               | (b)                            | (b)                             | 900,000                                        | (b)         | (b)                    |
| 1919 <sup>a</sup> ..... | 10                             | 14                              | 517,922                                        | \$6,380,879 | \$12.28                |
| 1920.....               | 13                             | 20                              | 790,510                                        | 10,674,481  | 13.60                  |

<sup>a</sup> Reported as 50°, 60°, and 66° Baumé and higher strengths, the three being converted to 60° Baumé on the basis of H<sub>2</sub>SO<sub>4</sub> content; 50° Baumé equals 78.04 per cent H<sub>2</sub>SO<sub>4</sub>; and 66° Baumé equals 86 per cent H<sub>2</sub>SO<sub>4</sub>.

<sup>b</sup> Not available.

<sup>c</sup> Estimated by H. L. Lewenberg (Price of mineral acids; War Industries Administration).

<sup>d</sup> As reported by the Bureau of the Census. Acid of "higher strength" than 60° Baumé.

Zinc-bearing sulphide ores from which sulphuric acid was made.

| Year.     | Quantity (short tons). | Value. |
|-----------|------------------------|--------|
| 1914..... |                        |        |
| 1915..... |                        |        |
| 1916..... |                        |        |
| 1917..... |                        |        |
| 1918..... |                        |        |
| 1919..... |                        |        |
| 1920..... |                        |        |

<sup>a</sup> A few thousand tons of foreign ore is included under domestic.



## TITANIUM.

BY FRANK L. HESS.

### PRODUCTION.

During 1920 rutile (titanium dioxide,  $\text{TiO}_2$ ) and iron oxide,  $\text{TiFeO}_3$ , were produced in this country by the American Rutile Co., at Roseland, Nelson County, Va.

*Titanium minerals produced in the United States*

| Year.                   | Rutile concentrates.   |                                |
|-------------------------|------------------------|--------------------------------|
|                         | Quantity (short tons). | Percentage of $\text{TiO}_2$ . |
| 1910.....               | 110                    | 95                             |
| 1917.....               | 206                    | 93                             |
| 1918.....               | 261                    | 95                             |
| 1919 <sup>a</sup> ..... | 102                    | 94-96                          |
| 1920.....               | 277                    | 94-96                          |

<sup>a</sup> Virginia production only; information regarding Florida not available.  
<sup>b</sup> Survey not at liberty to publish figures.

Considerable interest has been exhibited, during the last two or three years, in the subject of titanium. The National Lead Co., in its report for the fiscal year ending March 31, 1920, makes the following statement as to titanium pigments:

The National Lead Co., after a year's investigation, in 1919, decided to acquire one-half of the outstanding capital stock of the Titanium Pigment Co. (Inc.), having a plant at Niagara Falls, N. Y., engaged in the manufacture of titanium oxide pigment, which it sells under the registered name of "Titanium White." Titanium is a metal widely distributed throughout the world, and its form relatively easy of treatment in mines controlled by the National Lead Co. at Niagara Falls, Fla. This is a new white pigment. It is very inferior in the hiding power of pure white lead. Before the National Lead Co. option it assisted in negotiating a settlement of conflicts between the terms of which the Titanium Pigment Co. became the property of the United States previously owned by the Titanium Pigment Co. Its hiding power without increase in weight is desired, this is very valuable. Its cost of manufacture is still high, but it has increased tonnage and improved manufacturing methods, and its place amongst the best and most marketable white pigments.

The titanium deposits in Florida to which the National Lead Co. has those of Buckman & Pritchard (Inc.), on the Atlantic coast at Pablo Beach. At this place ilmenite with small amounts of zircon and considerable zircon is concentrated in sand.

high and low tide levels. As has been noted in previous reports efforts have been made to extract and market the minerals.

#### IMPORTS AND EXPORTS.

No titanium or "titanium steel-hardening ores" were imported during 1919 or 1920. The imports of such steel-hardening ores during the last six months of 1918 were 1,606 pounds, valued at \$221. No separate record of similar imports was kept prior to July, 1918.

No separate record of exports of titanium, "titanium steel-hardening ores," or ferrotitanium is kept.

#### TUNGSTEN.

By FRANK L. HESS.

#### GENERAL STATEMENT.

The only tungsten concentrates produced in the United States in 1920 were comparatively small quantities made in the Boulder field, near Nederland, Colo.

Prices during 1920 were very low, and although the prices quoted in the first part of January were \$7 a short ton for wolframite guaranteed to carry 65 per cent or more of tungsten, imported scheelite, and \$15 f. o. b. mines for domestic prices were merely nominal; the foreign ores could be sold at \$2 cheaper per unit, and the \$15 asked for domestic prices was business, and none was sold at that price.

The hope that Congress would pass a bill placing a duty on tungsten ores and metal kept the prices asked for them low, but they fell rapidly as they otherwise would have done, but Congress took without final action on the bill.

Ferberite from Rafael Taborga's mine in Bolivia was several hundred tons in New York, sold in the first part of the year for \$5 a unit on account of its purity and freedom from phosphorus. In the middle of December, however, a lot of ferberite guaranteed to contain 65 per cent or more of WO<sub>3</sub> and free from hurtful impurities sold for \$3.50 a unit f. o. b. each, in face of a freight rate of about \$50 a ton and on account of which it brought the price down to nearly \$2.50 a unit at the time.

Considering these data prices may fairly be said to be low. \$6 a unit for good wolframite ores (65 per cent or more of tungsten, less than 0.05 per cent of phosphorus, 0.1 per cent or less of tin) and to have declined to \$3.50 at the time. Chinese ore dominated the market during the year in the United States and Europe, and, in spite of local production, movement through a long distance on the Pacific coast, and steamer shipments over many thousands of tons sent to England and the United States even under the low prices, and although some who had bought their ores in China made money, others who bought in China under the low prices made money even at the lowest domestic market.

In 1920, as in previous years, the Rush & Brown copper mine was the largest copper producer in southeastern Alaska. Copper was also produced at the Salt Chuck mine, better known for its production of palladium. Relatively little prospecting and no considerable development work was done on the copper deposits of southeastern Alaska. The three large mines, the Bonanza, Jumbo, and Mother Lode, were the only producing mines of the Chitina district in 1920 and no considerable developments were made at other mines. Some alluvial copper was produced incidentally to gold-placer mining in the Nizina district. On Prince William Sound the Beatson mine was the only property operated systematically throughout the year. The most notable advances were made at the Girdwood mine, where systematic underground and surface work was continued during much of the year. Small developments were continued at the Schlosser and McIntosh mines through a part of the year.

The above review shows that the Alaska copper-mining industry is in a rather discouraging situation in spite of the relatively large output of the metal in 1920. Except possibly in Prince William Sound not much work was done during the year in opening new ore bodies. The falling copper market and certain local conditions have discouraged the launching of any new enterprises. Not only will the output of copper in 1921 be far less than that of 1920, but probably several years will pass before any new large copper-mining venture will be under way.

#### LEAD.

The lead produced in Alaska in 1920 amounted to 875 tons, valued at \$140,000, as compared with 687 tons, valued at \$72,822, in 1919. In 1920, as in other years, most of the output of lead was a by-product derived from the gold ores of the Juneau district. The increase in 1920 over 1919 was derived largely from galena ore mined in the Kantishna district.

The recent development of rich silver-lead ores in the Mayo district<sup>1</sup> of the Yukon Territory, about 100 miles east of Dawson, has started a search for similar deposits on the Alaska side of the boundary, not because of the lead content of the ore but because of the recent high price of silver. Galena ores are rather widely distributed in Alaska, but no large deposits have been found. Though some work was done on a number of Alaska galena deposits in 1920, only one mine, in the Kantishna district, shipped any ore.

<sup>1</sup> Cockfield, W. E., The Mayo area, Yukon: Canada Geol. Survey Summary Rept., 1918, pp. 12-13, Ottawa, 1919.

## LEAD AND ZINC PIGMENTS AND

By C. E. SIEBENTHAL and A. STOLL.

### INTRODUCTION.

From 1884 to 1914, inclusive, the United States Geological Survey published an annual chapter in Mineral Resources entitled "Natural mineral paints," which discussed the output and value of natural mineral paints as well as of manufactured mineral pigments. Since 1914 no chapter on natural mineral pigments has been published because of the lack of cooperation of some of the States in furnishing statistics of lead and zinc pigments, however, have been published in the lead and zinc chapters, respectively, showing the growth in use and importance of these pigments and the fact that the production of these metals has made it evident that these industries should be served by a separate chapter dealing with them. The early production of these pigments in this country is now nearly completed, but their results will be published in the near future.

### PRODUCTION.

Lead and zinc pigments and salts are made both by natural and by chemical processes. Sublimed lead, basic sulphate, and various lead oxides are examples of lead pigments produced by natural processes; basic carbonate and white lead salts are made by chemical processes. Sublimed lead is obtained directly from ore, but the lead oxides as well as white lead salts are made from pig lead.

Zinc oxide and leaded zinc oxide are made after the same manner as lead oxide directly from ore by sublimation in an oxidizing furnace. Some zinc oxide is made in this country by the French process, in which metallic zinc is sublimated in an oxidizing furnace. Zinc and zinc salts are made by chemical processes, being derived from zinc ore, metallic zinc, galvanized iron, or scrap zinc. Lithopone is made by mixing equivalent quantities of zinc sulphate and barium sulphide, which are then subjected to mutual precipitation of zinc sulphide and barium sulphide, followed by chemical combination or as a very intimate mixture.

## Lead pigments and salts marketed in 1919 and 1920.

|                                  | 1919                         |             |          | 1920                         |             |          |
|----------------------------------|------------------------------|-------------|----------|------------------------------|-------------|----------|
|                                  | Quantity<br>(short<br>tons). | Value.      |          | Quantity<br>(short<br>tons). | Value.      |          |
|                                  |                              | Total.      | Per ton. |                              | Total.      | Per ton. |
| Sublimed lead: <sup>a</sup>      |                              |             |          |                              |             |          |
| White.....                       | 9,068                        | \$1,049,107 | \$115.69 | 12,412                       | \$2,083,647 | \$167.81 |
| Blue.....                        | 1,390                        | 190,663     | 139.00   | 928                          | 153,657     | 165.58   |
| Red lead and orange mineral..... | 32,362                       | 5,314,255   | 164.21   | 34,431                       | 7,523,089   | 218.42   |
| Litharge.....                    | 46,730                       | 0,431,801   | 137.61   | 62,329                       | 12,386,185  | 198.70   |
| White lead:                      |                              |             |          |                              |             |          |
| Dry.....                         | 30,085                       | 4,845,788   | 161.07   | 33,678                       | 6,351,798   | 188.59   |
| In oil.....                      | 109,005                      | 21,579,234  | 197.97   | 112,017                      | 25,986,100  | 231.98   |
| Lead arsenate.....               | 5,783                        | 2,000,341   | 361.46   | (b)                          |             |          |
| Lead acetate.....                | 2,092                        | 552,435     | 264.07   | (b)                          |             |          |

<sup>a</sup> Includes basic sulphate lead.<sup>b</sup> Statistics from Bureau of the Census. No statistics are available for 1920, but beginning with the census will be taken biennially by the Bureau of the Census.Zinc pigments and salts marketed in 1919 and 1920.<sup>a</sup>

|                               | 1919                         |              |          | 1920                         |              |          |
|-------------------------------|------------------------------|--------------|----------|------------------------------|--------------|----------|
|                               | Quantity<br>(short<br>tons). | Value.       |          | Quantity<br>(short<br>tons). | Value.       |          |
|                               |                              | Total.       | Per ton. |                              | Total.       | Per ton. |
| Zinc oxide.....               | 117,639                      | \$20,591,877 | \$175.04 | 99,444                       | \$17,859,736 | \$179.18 |
| Leaded zinc oxide.....        | 27,601                       | 4,009,024    | 145.30   | 30,480                       | 4,497,532    | 147.55   |
| Lithopone.....                | 78,365                       | 10,218,850   | 130.40   | 89,373                       | 12,484,925   | 139.69   |
| Zinc chloride, 50° Baumé..... | 59,228                       | 4,185,351    | 70.67    | 68,945                       | 4,421,718    | 64.13    |
| Zinc sulphate.....            | 2,763                        | 194,436      | 70.37    | 3,072                        | 221,582      | 72.13    |

<sup>a</sup> The statistics for zinc chloride and zinc sulphate represent actual production.

## SOURCE.

The following table shows the source of the metal content of lead and zinc pigments and salts manufactured in 1919 and 1920.

## Metal content of lead and zinc pigments and salts, 1919 and 1920, in short tons.

| Source.                 | 1919                   |        |           |        | 1920                   |        |           |        |
|-------------------------|------------------------|--------|-----------|--------|------------------------|--------|-----------|--------|
|                         | Lead.                  |        | Zinc.     |        | Lead.                  |        | Zinc.     |        |
|                         | Pigments. <sup>a</sup> | Salts. | Pigments. | Salts. | Pigments. <sup>a</sup> | Salts. | Pigments. | Salts. |
| Domestic ore.....       | 11,179                 | .....  | 94,738    | 3,393  | 15,212                 | .....  | 106,257   | .....  |
| Foreign ore.....        | 351                    | .....  | 2,079     | .....  | 808                    | .....  | 4,438     | .....  |
| Metal.....              | 183,265                | 4,843  | 13,583    | 256    | 215,431                | .....  | 16,786    | .....  |
| Secondary material..... | .....                  | .....  | 10,702    | 10,018 | .....                  | .....  | 12,870    | .....  |
|                         | 194,795                | 4,843  | 121,102   | 13,667 | 231,451                | .....  | 140,351   | .....  |

<sup>a</sup> Includes lead in zinc oxide and leaded zinc oxide.

## IMPORTS AND EXPORTS.

The following statistics of imports and exports of pigments and salts are taken from the publications of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

## IMPORTS.

The imports of lead and zinc pigments and salts, before the World War, dwindled nearly to the vanishing point during the war, but in the last two years they have regained their pre-war importance. The imports of zinc oxide have come mainly from Belgium, with smaller quantities from Germany.

The following table shows the quantity and value of basic carbonate white lead, red lead, litharge, and orange mineral imported into the United States, 1916-1920.

| Year.     | Basic carbonate white lead. |         | Red lead.          |         | Litharge.          |        |
|-----------|-----------------------------|---------|--------------------|---------|--------------------|--------|
|           | Quantity (pounds).          | Value.  | Quantity (pounds). | Value.  | Quantity (pounds). | Value. |
| 1916..... | 88,617                      | \$8,050 | 20,467             | \$5,302 | 1,320              | .....  |
| 1917..... | 20,238                      | 1,965   | 50                 | 13      | .....              | .....  |
| 1918..... | 508                         | 202     | 5                  | 1       | 100                | .....  |
| 1919..... | 21,213                      | 2,490   | 7,199              | 1,136   | .....              | .....  |
| 1920..... | 159,977                     | 19,449  | 23,076             | 1,789   | 21,002             | .....  |

The following table shows the quantity and value of zinc oxide, lithopone, zinc chloride, and zinc sulphate imported into the United States, 1916-1920.

| Year.     | Zinc oxide.            |           |                        |         | Lithopone. <sup>a</sup> |           | Zinc chloride. |
|-----------|------------------------|-----------|------------------------|---------|-------------------------|-----------|----------------|
|           | Dry.                   |           | In oil.                |         | Quantity (short tons).  | Value.    |                |
|           | Quantity (short tons). | Value.    | Quantity (short tons). | Value.  |                         |           |                |
| 1916..... | 447                    | \$181,319 | 18                     | \$4,076 | 2,372                   | \$414,592 | 2              |
| 1917..... | 119                    | 52,649    | 5                      | 876     | 229                     | 35,718    | 2              |
| 1918..... | 162                    | 62,703    | 4                      | 1,043   | 1                       | 993       | 98             |
| 1919..... | 105                    | 44,338    | 3                      | 1,351   | 744                     | 127,121   | 1              |
| 1920..... | 1,431                  | 289,890   | 14                     | 3,506   | 1,736                   | 278,267   | 565            |

<sup>a</sup> This heading includes imports of lithopone and "zinc sulphide white." The latter is reported in pounds of "zinc sulphide white" and no lithopone; hence the high value for 1920.

## EXPORTS.

*White lead and red lead exported from the United States, 1916-1920.*

|           | White lead.            |             | Red lead. <sup>a</sup> |           |
|-----------|------------------------|-------------|------------------------|-----------|
|           | Quantity (short tons). | Value.      | Quantity (short tons). | Value.    |
| 1916..... | 13,718                 | \$2,137,072 |                        |           |
| 1917..... | 9,869                  | 2,089,659   | 1,086                  | \$267,238 |
| 1918..... | 7,704                  | 1,756,739   | 2,870                  | 662,584   |
| 1919..... | 14,017                 | 3,017,202   | 3,114                  | 735,177   |
| 1920..... | 14,901                 | 3,195,101   | 1,532                  | 365,576   |

<sup>a</sup> Not separately classified prior to July 1, 1917.<sup>b</sup> July 1-Dec. 31, inclusive.*Zinc oxide exported from the United States, 1916-1920.*

| Year.     | Quantity (short tons). | Value.      |
|-----------|------------------------|-------------|
| 1916..... | 13,942                 | \$2,394,709 |
| 1917..... | 15,440                 | 3,148,898   |
| 1918..... | 12,421                 | 2,779,807   |
| 1919..... | 14,703                 | 3,059,270   |
| 1920..... | 11,164                 | 2,151,544   |

*Zinc oxide exported from the United States in 1919 and 1920.*

| Destination.               | 1919                   |                        | 1920                   |                        |
|----------------------------|------------------------|------------------------|------------------------|------------------------|
|                            | Quantity (short tons). | Value.                 | Quantity (short tons). | Value.                 |
| Africa.....                | 11                     | \$2,855                | ( <sup>a</sup> )       | \$165                  |
| Asia.....                  | 684                    | 151,921                | 400                    | 80,288                 |
| Australia and Oceania..... | 316                    | 92,515                 | 78                     | 21,291                 |
| Philippine Islands.....    | (205)                  | (79,185)               | (31)                   | (8,047)                |
| Canada.....                | 3,792                  | 655,743                | 4,924                  | 888,046                |
| Cuba.....                  | 96                     | 24,890                 | 127                    | 35,592                 |
| Europe.....                | 7,560                  | 1,550,371              | 4,168                  | 741,024                |
| France.....                | (2,206)                | (471,636)              | (230)                  | (46,020)               |
| Italy.....                 | (448)                  | (82,804)               | (1,054)                | (187,100)              |
| Great Britain.....         | (4,351)                | (871,669)              | (2,575)                | (449,559)              |
| Denmark.....               | (325)                  | (75,587)               | (63)                   | (13,019)               |
| Mexico.....                | 190                    | 49,300                 | 230                    | 58,544                 |
| South America.....         | 1,826                  | 465,239                | 943                    | 240,664                |
| Brazil.....                | (1,370)                | (347,187)              | (559)                  | (139,027)              |
| Panama.....                | 152                    | 38,996                 | 224                    | 65,896                 |
| Other countries.....       | 76                     | 21,440                 | 70                     | 20,031                 |
|                            | <sup>b</sup> 14,703    | <sup>b</sup> 3,059,276 | <sup>b</sup> 11,164    | <sup>b</sup> 2,151,544 |

<sup>a</sup> Less than 1 ton.<sup>b</sup> Figures in parentheses not duplicated in totals.

## COPPER.

By H. A. C. JENISON.<sup>1</sup>

## INTRODUCTION.

The production of metallic copper from the consumption requires at least three distinct processes, of which the preparation of the ore for the most varied and complicated. The Lake Superior ores are the only important American source of the three operations are not necessary for the commercial copper. On account of these three operations to determine approximately the production of the States by the collection of mine statistics, refinery statistics. These three sets of statistics exactly, but each set has a peculiar advantage, of all three accurately determines the essential industry for the year.

The principal value of the mine statistics is most accurately the geographic distribution of the ore are also the only source of accurate data on the the copper and precious-metal contents of the ore which the ore is concentrated before smelting. The quantity of ore shipped from the mines, but are less smelter figures in that they represent the estimated content and not the actual recovery. The smelter figures have a fair accuracy the geographic distribution of the ore accurately the quantity of crude copper actual. The ores, including considerable copper from sulphuriferous ores that carry so little copper that the mine it and frequently do not report it. The smelter figures from the mine figures by the quantity of the materials in stock at the beginning and at the end of the refinery statistics indicate the quantity of copper recovered from industrial consumption and the quantity recovered from copper ore, but do not permit of production according to source, even the separate according to foreign and domestic sources but refinery figures differ from the smelter figures in stocks of unrefined copper at the beginning and end of the year.

The principal cause of the differences in the figures of the different sources is the time factor involved in the production of refined copper. The intermediate ore is mined until the refined copper is available.

<sup>1</sup> The statistical tables in this report were prepared by Miss Helena M. and exports were compiled from records of the Bureau of Foreign and Domestic both of the United States Geological Survey.