Miscellaneous Minerals

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MISCELLANEOUS MINERALS.

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ALUMINUM

Aluminum is the most widely distributed of all the metals, in igneous rocks averaging about 7.98%. Because of its great affinity for oxygen, most of its minerals occurring free in nature are the oxides and hydroxides. The important minerals of aluminum are:

- Bauxite—hydrated oxide
- Alunite—a complex hydrated sulphate of aluminum and potash
- Alunogen—hydrated sulphate
- Corundum—oxide
- Ruby—red variety of corundum
- Sapphire—blue variety of corundum
- Emery—a mixture of iron and aluminum oxides
- Cryolite—aluminum sodium fluoride
- Gibbsite—hydrated oxide
- Diaspore—hydrated oxide
- Turquoise—hydrated aluminum phosphate

The most important ore of aluminum is Bauxite. Its chief uses are (1) as raw material for the extraction of aluminum; (2) in the manufacture of aluminum salts; (3) in the manufacture of bauxite bricks; (4) in the manufacture of aluminum for use as abrasives.

Geological Occurrence of Bauxite: Bauxite is found in the weathered zone of rocks associated with clays and kaolin from which it has been derived. Although clay and kaolin contain about 40 per cent alumina, their use as a source of metallic aluminum has not been found possible. The occurrence of bauxite in the United States is confined to Arkansas and the Southern Appalachian states.


Prices: The average price of bauxite per long ton at the mines was, in 1911, $4.82; in 1912, $4.81; in 1913, $4.75; in 1914, $4.87.

Uses of Aluminum: The properties of aluminum, such as its low specific gravity, malleability, ductility, conductivity, and ease of al-
loying with other metals, make aluminum a very useful metal, and the demand is growing very rapidly. Its chief use is in the manufacture of kitchen utensils, surgical appliances, jewelry, fancy articles, in the manufacture of novelties, bearings for machinery, electric wiring, etc., and in the production of a number of alloys with other metals, such as copper, zinc, antimony and silver.

The other minerals of aluminum are used as gems, as abrasives and in the manufacture of alums.

**Platinum.**

Platinum is a very rare mineral, its sources in the world, and especially in the United States, being comparatively few. Its properties, however, are such as to cause a great demand for it, both in scientific work and for the manufacture of jewelry.

The minerals of platinum are:

1. Native platinum.
2. Sperrylite or platinum arsenide.
3. Platiniridium, an alloy of platinum and iridium.
4. Osmiridium, an alloy of osmium and iridium, carrying platinum.

The most important of these is sperrylite. Platinum occurs in small quantities in the gold bearing sands of California and Oregon, and in limited quantities in Arizona, Colorado, Georgia, Idaho, Nevada and Montana.

*Geological Occurrence:* Platinum occurs in nature as a result of the crystallization of magmas. As a native metal it is associated with chromite in peridotites; as sperrylite, it is associated with sulphide minerals of magmatic origin in gabbros and diabase. The platinum in the placers forms small rounded dark grey pieces, associated with occasional bright silvery flat pieces of osmiridium. Prospecting for platinum should be confined to the placer gravels of the serpentine rocks, especially those resulting from the metamorphism of large masses of peridotite, and to nickeliferous peridotite.

*Production:* Nearly all the platinum of the world is derived from placers in the Ural mountains in Russia, although smaller quantities come from Columbia, California, and New South Wales. Although the occurrence of platinum in Arizona is known, no production of the metal from this state has ever been recorded.

The following table gives the prices of ingot platinum per troy ounce at New York for the calendar years 1913 and 1914:
In 1915 sales in New York have been made at $85 to $95 per ounce.

TIN

The principal use of tin is for the manufacture of tin plate, sheet iron coated with tin, which is used for making cans, household utensils, etc. Tin is also largely used in alloys, such as bronze, bell metal, pewter, solder, and tin amalgam. Tin foil is also made from it.

The ores of tin are:
1. Stannite, which is a sulphide of copper, tin and iron.
2. Cassiterite, tin oxide. (Several varieties of cassiterite are known.)
3. a. Tin stone, which consists of crustals in granular masses.
   b. Wood tin, occurring in radiating and fibrous masses, closely resembling wood.
   c. Stream tin, occurring as rounded pebbles and grains in alluvial deposits.

Geological Occurrence: The most important ore is cassiterite, and it originally occurs in pegmatite dikes in granite, and in high temperature quartz veins in granite. From either of these sources it may be set free by weathering and disintegration, and, on account of its high specific gravity, it easily becomes concentrated in gravel deposits of different types.

Production: The only domestic production of tin in 1914 was made in Alaska, and except a small quantity produced from the lodes on Lost River, was stream tin. The following table shows the production of tin in the United States during the period 1911 to 1914 in short tons:

<table>
<thead>
<tr>
<th>Month</th>
<th>1913 Price Per Troy Oz.</th>
<th>1914 Price Per Troy Oz.</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>$45.50</td>
<td>$43.38</td>
</tr>
<tr>
<td>February</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>March</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>April</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>May</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>June</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>July</td>
<td>45.50</td>
<td>43.50</td>
</tr>
<tr>
<td>August</td>
<td>44.90</td>
<td>50.20</td>
</tr>
<tr>
<td>September</td>
<td>43.96</td>
<td>50.20</td>
</tr>
<tr>
<td>October</td>
<td>44.00</td>
<td>49.50</td>
</tr>
<tr>
<td>November</td>
<td>43.70</td>
<td>45.45</td>
</tr>
<tr>
<td>December</td>
<td>43.45</td>
<td>42.19</td>
</tr>
</tbody>
</table>
Arizona State Bureau of Mines

1911 ..................... 51,892
1912 ..................... 56,556
1913 ..................... 51,017
1914 ..................... 48,505

No production of tin from Arizona has ever been recorded.

The following table shows the prices of Straits tin in New York for several years, average monthly prices in cents per lb:

<table>
<thead>
<tr>
<th>Month</th>
<th>1909</th>
<th>1910</th>
<th>1911</th>
<th>1912</th>
<th>1913</th>
<th>1914</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>28.13</td>
<td>32.74</td>
<td>41.39</td>
<td>43.24</td>
<td>50.25</td>
<td>37.74</td>
</tr>
<tr>
<td>February</td>
<td>28.30</td>
<td>32.96</td>
<td>42.83</td>
<td>43.46</td>
<td>48.63</td>
<td>39.93</td>
</tr>
<tr>
<td>March</td>
<td>28.74</td>
<td>32.49</td>
<td>40.76</td>
<td>42.86</td>
<td>46.83</td>
<td>38.08</td>
</tr>
<tr>
<td>April</td>
<td>29.48</td>
<td>33.02</td>
<td>42.20</td>
<td>44.02</td>
<td>49.12</td>
<td>36.10</td>
</tr>
<tr>
<td>May</td>
<td>29.16</td>
<td>33.18</td>
<td>43.10</td>
<td>46.12</td>
<td>49.07</td>
<td>33.30</td>
</tr>
<tr>
<td>June</td>
<td>29.32</td>
<td>32.84</td>
<td>46.16</td>
<td>47.77</td>
<td>44.82</td>
<td>30.65</td>
</tr>
<tr>
<td>July</td>
<td>29.17</td>
<td>33.04</td>
<td>42.96</td>
<td>44.75</td>
<td>40.27</td>
<td>31.75</td>
</tr>
<tr>
<td>August</td>
<td>30.04</td>
<td>34.10</td>
<td>43.45</td>
<td>45.87</td>
<td>41.66</td>
<td>30.59</td>
</tr>
<tr>
<td>September</td>
<td>30.35</td>
<td>35.23</td>
<td>39.98</td>
<td>49.18</td>
<td>42.37</td>
<td>32.79</td>
</tr>
<tr>
<td>October</td>
<td>30.50</td>
<td>36.63</td>
<td>41.21</td>
<td>50.11</td>
<td>40.41</td>
<td>30.39</td>
</tr>
<tr>
<td>November</td>
<td>30.90</td>
<td>36.68</td>
<td>43.13</td>
<td>49.90</td>
<td>39.80</td>
<td>33.50</td>
</tr>
<tr>
<td>December</td>
<td>33.06</td>
<td>38.28</td>
<td>44.97</td>
<td>49.90</td>
<td>37.62</td>
<td>33.60</td>
</tr>
</tbody>
</table>

Average .......... | 29.76 | 34.27 | 42.68 | 46.43 | 44.22 | 35.17 |

Cadmium

The only cadmium mineral is the sulphide greenckite.

The chief output of cadmium comes from the zinc producing regions of Silesia, where it is recovered as a by-product in the distillation of zinc. No cadmium is recovered in the United States in the distillation of zinc ores, but most of the output is gained from bag-house fumes of lead smelters, which treat lead ores containing more or less zinc. The cadmium output in the United States comes in two forms, metallic stock cadmium and the pigment cadmium sulphide, "cadmium yellow."

Uses of Cadmium: Cadmium is used in the manufacture of yellow pigments in photography. It is used extensively alloyed with other metals, in the manufacture of sterling silverware, in britannia ware, and for soldering german silver. With tin it is used in cadmium plating, and with mercury, it is used as an amalgam in the filling of teeth.

Prices: The average price of metallic cadmium per pound as based on sales was about 90 cents in 1914. It is now quoted in New York at $1.50 per pound.
NICKEL

No nickel ores are known to have been mined as such in the United States in 1914, but an equivalent of 845,334 pounds of metallic nickel, valued at $313,000, is understood to have been saved as a by-product in the electrolytic refining of copper.

The ores of nickel are:
1. Millerite, the sulphide.
2. Pentlandite—iron-nickel sulphide.
3. Niccolite—the arsenide.
4. Annabergite—the arsenate.
5. Garnierite—the silicate.

*Uses of Nickel:* The uses of nickel are many, but its most important one is in the form of an alloy with copper and zinc in the manufacture of German silver. An alloy of nickel and copper is used in coinage, both in the United States and in Europe. Nickel and aluminum are of great commercial significance.

*Prices:* Nickel is quoted at 45 to 50 cents per pound, New York, for ordinary forms, with 5 cents per pound more asked for electrolytic nickel.

COBALT

No cobalt is known to have been produced in the United States in 1914. Most of that used by steel manufacturers in the United States has been imported.

The ores of cobalt are:
1. Linnaeite—cobalt pyrites.
2. Cobaltite—sulph-arsenide.
4. Erythrite—a hydrated arsenate.

*Uses of Cobalt:* Metallic cobalt finds little application in the arts and industries. Cobalt steel has a high elastic limit and tensile strength, but it is far more costly to manufacture than manganese or nickel steel, and therefore does not possess so wide an industrial application. It is used extensively as a pigment in the manufacture of glass and pottery. Sympathetic inks are made from cobalt acetate and cobalt nitrate. Cobalt and potassium nitrate are used as an oil and water pigment for painting on glass and porcelain. Cobalt nitrate is used in medicine. Cobalt is used also in the manufacture of gold and silver ornaments.

*Prices:* Cobalt has been quoted as high as $1.25 to $1.50 per pound for 95 per cent pure metal.
ARSENIC

Arsenic is a very common constituent of metallic minerals forming arsenides, arsenates, sulpharsenides, etc. It is found native in small quantities and is considered a secondary mineral.

The ores of arsenic are:
1. Realgar—sulphide.
2. Orpiment—sulphide.
3. Arsenolite—oxide.

The other minerals containing arsenic have been previously described, the most important and plentiful being arsenopyrite.

In 1914 the output of white arsenic or arsenious oxide in the United States amounted to 4,670 short tons, valued at $313,147.

Prices: The prices of arsenic during 1914 ranged from 2.9 to 3.6 cents per pound on board the cars at works. The price of white arsenic during the year ranged from 2½ cents a pound at the beginning of the year to 5 cents at the end of July. After war broke out the price rose to 5½ and 6 cents a pound in September, from which it gradually declined to 3½ cents at the close of the year.

BISMUTH

The only bismuth produced in the United States was obtained as a by-product in refining lead bullion by the United States Metals Refining Co. at Grasselli, Indiana, and by the American Smelting & Refining Co. at Omaha, Neb. Some residues rich in bismuth were saved in corroding lead by the National Lead Co. and by the Matheson Lead Co.

The minerals of bismuth are:
1. Native bismuth.
2. Bismuthinite—sulphide.
3. Tetradymite—telluride.
5. Bismite—oxide.

The uses of bismuth are chiefly dependent upon its property of forming easily fusible alloys with other metals, especially tin, lead and cadmium. These alloys expand in cooling and are used in reproducing woodcut, in making safety plugs, etc. The salts of bismuth have many uses in medicine and in the arts; they are used in calico printing, cosmetics, and in making glass of high refractive power, also to impart lustre to porcelain.

The current New York quotations are $4 per pound.

(Note: For a description of and tests for the various minerals mentioned in this bulletin, the reader is referred to Bulletin 41, Arizona State Bureau of Mines, which may be obtained by writing Charles F. Willis, Director, Tucson, Arizona.)