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THE METALLURGY OF COPPER.

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I.

METALLIC copper was known to the ancients and its use dates from an earlier period than that of iron, although copper is by no means so extensively distributed over the earth's surface.

Copper, the chemical symbol of which is *Cu* and atomic weight 63.4 crystallizes in the cube, octahedron or rhombic-dodecahedron and when fractured presents a pale, salmon-red colored surface with a finely crystalline, or when hammered a fibrous structure.

When heated and rubbed the metal has a slightly disagreeable odor and nauseous taste but does not become oxidized to any extent in dry air unless heated to a red heat. In moist air, however, it becomes covered with a green carbonate of copper.

SOLUBILITY. Copper is but slightly attacked when in a fine state of division by cold hydrochloric acid (*H.C.L.*) or H_2SO_4 , but dissolves in boiling sulphuric acid H_2SO_4 , strong nitric acid HNO_3 does not attack it but upon slight dilution the copper, whether in a fine state or not, dissolves rapidly, with evolution of N_2O_2 nitric oxide and formation of nitrate of copper. When acted upon by sea water an oxychloride of copper is formed.

The metal is elastic and sonorous, possesses malleability and ductility to an eminent degree, and may be beaten into sheets or drawn into wire of moderate thickness, but during the process it becomes hard and has to be frequently annealed by heating to a red heat and cooling rapidly, this producing an exactly opposite effect to that developed in iron by the same process.

In the scale of tenacity it occupies a place second only to that of iron, but this quality varies with a change in temperature, as in other metals.

Copper is valued as a conductor of heat and electricity, but this latter quality is much impaired by the presence in the copper of impurities such as arsenic, phosphorous and cuprous oxide. The metal fuses at about $1091^{\circ}C$ near the fusion point of silver $1000^{\circ}C$, and below that of gold 1200° . It expands on solidifying and is not volatilized to any appreciable extent by the ordinary furnace temperatures, but can be volatilized by the oxyhydrogen blowpipe flame. When heated to near the fusing point it becomes brittle, and if fusion takes place it has the power of absorbing considerable quantities of cuprous oxide which it retains on cooling. The pigs containing this compound have a longitudinal furrow on the surface extending along their whole length and when fractured exhibit a dull purplish color without the fibrous structure of pure copper.

IMPURITIES. *Commercial Copper* contains almost invariably small quantities of iron, arsenic, silver and tin. Antimony and sulphur are frequently found, except in Russian and Australian specimens. Gold, cobalt, nickel and bismuth are also found but not so frequently as the others. Lead is present invariably in sheet and bolt copper but not in cake copper.

EFFECT OF IMPURITIES. Iron has the effect of making copper hard and paler in color, antimony and sulphur exercise a deteriorating influence on the malleability and tenacity also giving the copper a greyish shade of color.

Dr. Miller states that copper containing 10oz. of antimony per ton is absolutely unfit for rolling. Arsenic in small quantities hardens but does not impair the malleability to the same extent as antimony. Bismuth effects the toughness and produces a red short copper, cuprous oxide (Cu_2O) renders it red as well as cold short. From one to two per cent. of lead is rather an advantage in copper which is to be rolled, but its presence to that extent renders the copper unfit for the manufacture of brass.

The only workable deposits of native copper to be found in Canada occur in the upper copper bearing series of Lake Superior, but it also occurs in Siberia, Brazil, Cornwall (Eng.) and its ores are widely and abundantly distributed in nature. Those most important for the production of copper are given below with the percentage of copper in pure specimens.