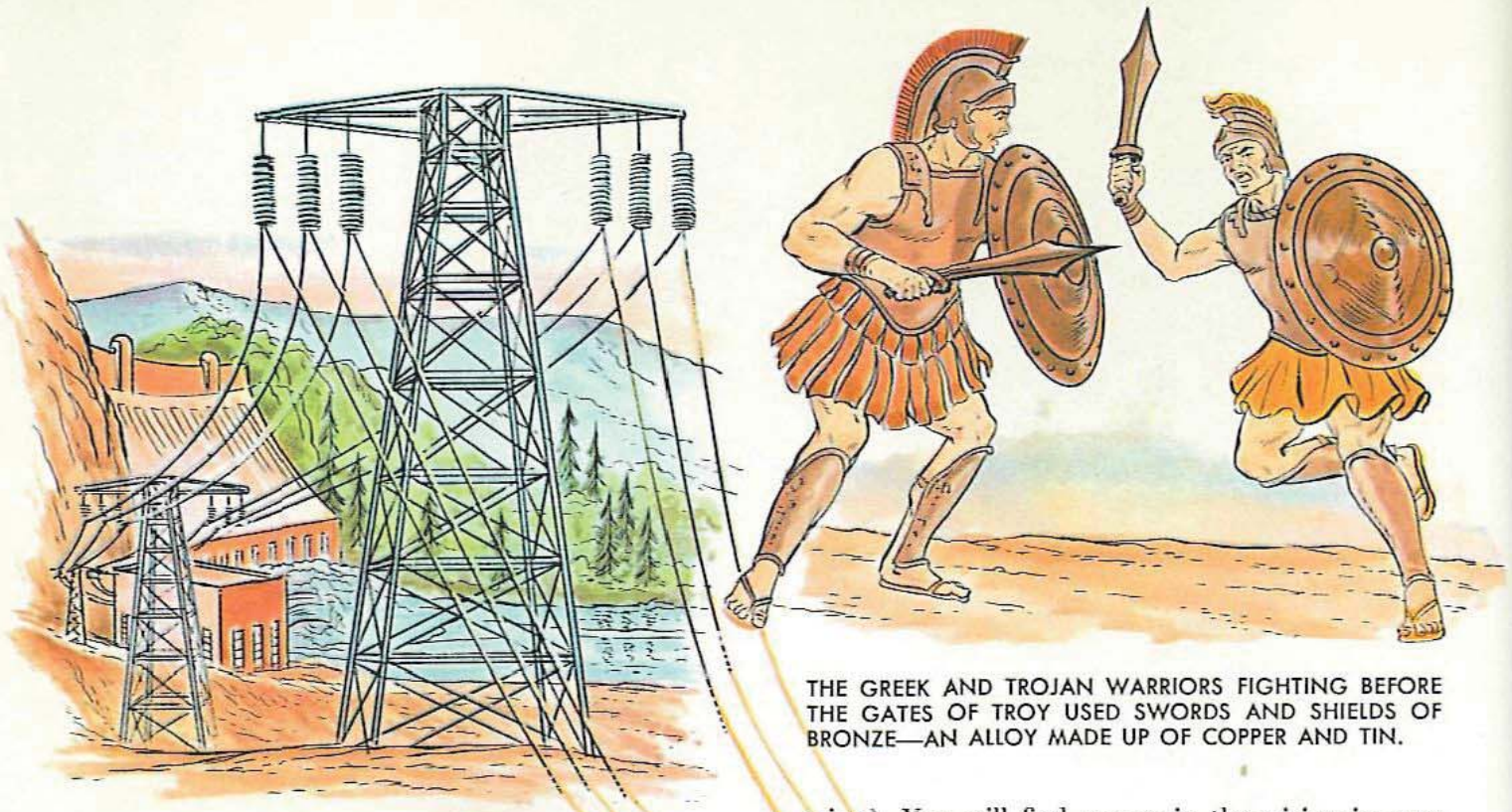


THE GREEK AND TROJAN WARRIORS FIGHTING BEFORE THE GATES OF TROY USED SWORDS AND SHIELDS OF BRONZE—AN ALLOY MADE UP OF COPPER AND TIN.

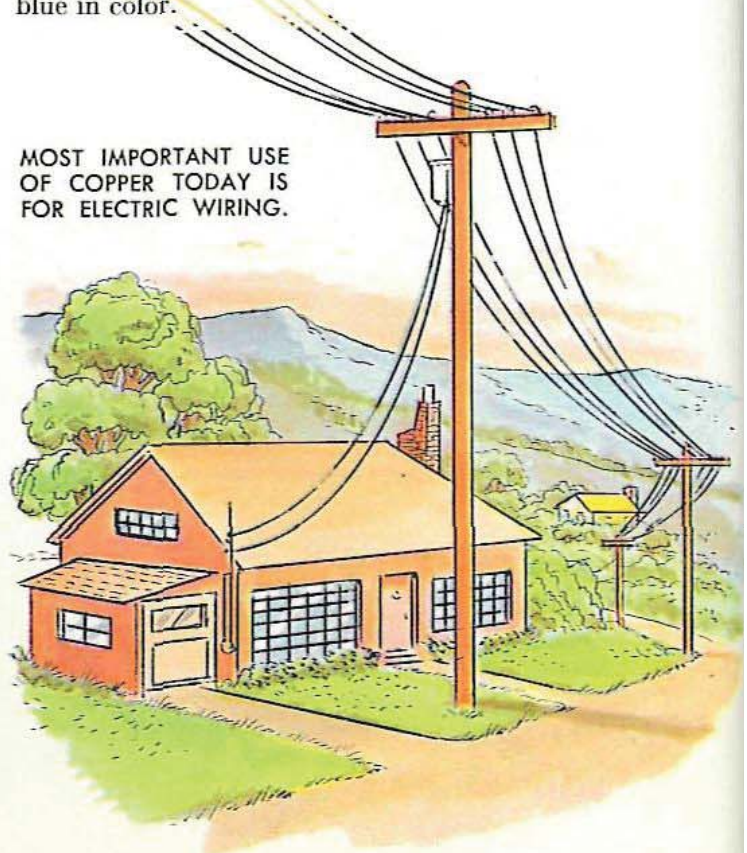
Copper—Yesterday, Today

COPPER IS ONE of the few metals found free in nature. That is why it was used long before historic times for weapons and utensils. The main trouble with it was its softness. This was remedied when some early coppersmith discovered that copper and tin (also found free in nature) melted together formed an alloy that was much harder than either of the two metals. This alloy gave its name to more than two thousand years of human history — the period called the "Bronze Age."

A great number of weapons from the Bronze Age have been found in Greece. When they were dug out of the ground, they were covered with a green "rust." This deposit was called verdigris — literally "green of Greece" (from old French, *vert de Grèce*). It consists of basic cupric carbonate — the same compound you will see on a bronze statue or a copper-clad church spire exposed to wind and weather.

Copper became especially valuable less than a hundred years ago when a satisfactory method for producing a steady flow of electricity was invented. After silver, copper is the best conductor of electricity. Today, the most important use for copper is for electrical purposes. It serves to bring the current from the place where it is produced to the place where it is to be used (although, within recent years, some aluminum has taken its place for high-tension wires). You will find copper in the wiring in your own home and in every electrical gadget you use.

Copper makes two kinds of salts. In cuprous salts, one copper atom has taken the place of one hydrogen atom; in cupric salts, one copper atom has taken the place of two hydrogen atoms. Cuprous salts (such as cuprous chloride, CuCl) are colorless, while cupric salts (such as cupric sulfate, $CuSO_4 \cdot 5H_2O$) are bright blue in color.

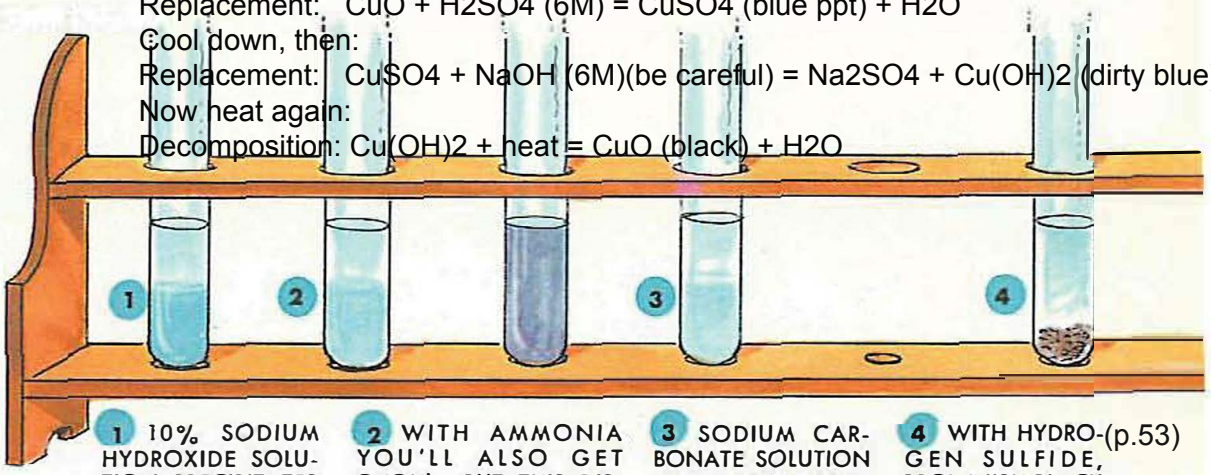


MOST IMPORTANT USE OF COPPER TODAY IS FOR ELECTRIC WIRING.

MAKING COPPER COMPOUNDS

Synthesis: Cu (wire) + O2 + heat (use a torch) = CuO (black)
Replacement: CuO + H2SO4 (6M) = CuSO4 (blue ppt) + H2O
Cool down, then:
Replacement: CuSO4 + NaOH (6M)(be careful) = Na2SO4 + Cu(OH)2 (dirty blue)
Now heat again:
Decomposition: Cu(OH)2 + heat = CuO (black) + H2O

DISSOLVE 10 g COPPER SULFATE IN 100 ml WATER. POUR 10 ml INTO EACH OF FOUR TEST TUBES.



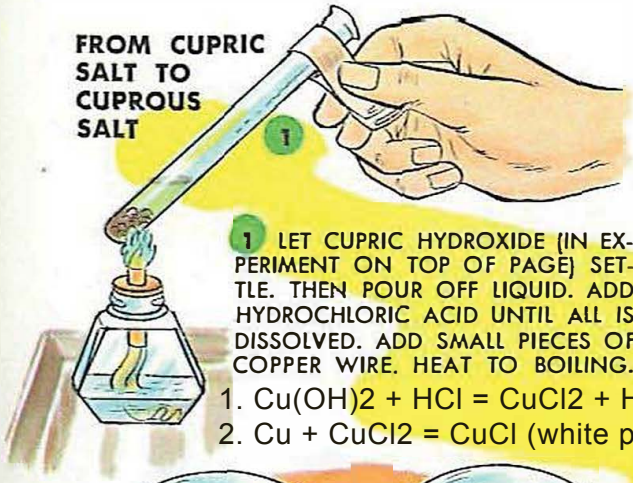
1 10% SODIUM HYDROXIDE SOLUTION PRECIPITATES DIRTY-BLUE CUPRIC HYDROXIDE ($Cu(OH)_2$).

2 WITH AMMONIA YOU'LL ALSO GET $Cu(OH)_2$, BUT THIS DISSOLVES IN MORE AMMONIA WITH DEEP BLUE COLOR.

3 SODIUM CARBONATE SOLUTION GIVES BLUE-GREEN CUPRIC CARBONATE PRECIPITATE. Cu(CO3)2

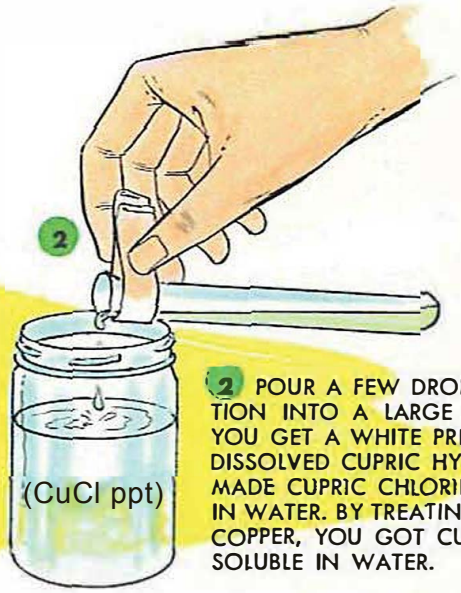
4 WITH HYDROGEN SULFIDE, BROWNISH-BLACK PRECIPITATE OF CUPRIC SULFIDE. (p.53)

FROM CUPRIC SALT TO CUPROUS SALT



1 LET CUPRIC HYDROXIDE (IN EXPERIMENT ON TOP OF PAGE) SETTLE. THEN POUR OFF LIQUID. ADD HYDROCHLORIC ACID UNTIL ALL IS DISSOLVED. ADD SMALL PIECES OF COPPER WIRE. HEAT TO BOILING.

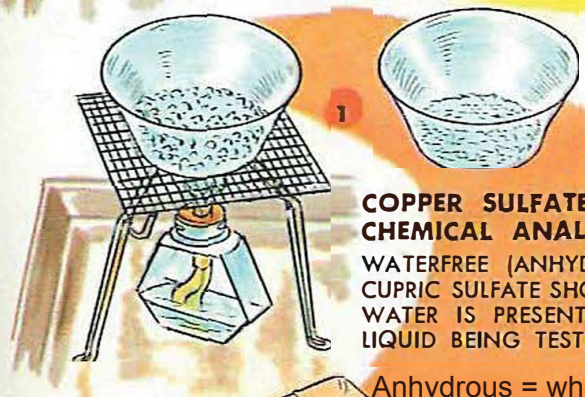
1. Cu(OH)2 + HCl = CuCl2 + H2O
2. Cu + CuCl2 = CuCl (white ppt)



2 POUR A FEW DROPS OF THE HOT SOLUTION INTO A LARGE AMOUNT OF WATER. YOU GET A WHITE PRECIPITATE. WHEN YOU DISSOLVED CUPRIC HYDROXIDE IN HCl, YOU MADE CUPRIC CHLORIDE WHICH IS SOLUBLE IN WATER. BY TREATING THIS WITH METALLIC COPPER, YOU GOT CUPROUS CHLORIDE, INSOLUBLE IN WATER.

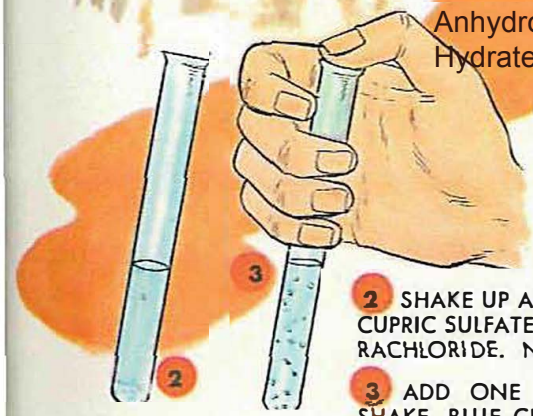
Cu **COPPER** Element 29. Atomic wt.: 63.54. Density: 8.97. Soft metal of reddish color. Easily rolled and drawn into wire. Next to silver, is the best conductor of electricity.

COPPER SULFATE IN CHEMICAL ANALYSIS



WATERFREE (ANHYDROUS) CUPRIC SULFATE SHOWS IF WATER IS PRESENT IN A LIQUID BEING TESTED.

Anhydrous = white ppt
Hydrated = blue ppt



1 CRUSH A FEW CUPRIC SULFATE CRYSTALS. HEAT WHILE STIRRING UNTIL THEY HAVE TURNED INTO A WHITE POWDER

2 SHAKE UP A LITTLE ANHYDROUS CUPRIC SULFATE WITH CARBON TETRACHLORIDE. NOTHING HAPPENS.

3 ADD ONE DROP OF WATER. SHAKE. BLUE CRYSTALS FORM.

Single replacement: CuSO4 + Fe = FeSO4 + Cu

REPLACING COPPER WITH IRON

1 DROP SEVERAL CLEAN NAILS INTO A SOLUTION OF COPPER SULFATE. LEAVE FOR HALF AN HOUR.

2 NAILS ARE NOW COATED WITH METALLIC COPPER AND THE SOLUTION CONTAINS FERROUS SULFATE.

METALS CAN BE ARRANGED IN A REPLACEMENT SERIES. ANY METAL IN THE SERIES WILL DRIVE OUT ANOTHER METAL BELOW IT AND TAKE ITS PLACE IN THE SALT.

REPLACEMENT SERIES

POTASSIUM	Good anodes
SODIUM	
CALCIUM	
MAGNESIUM	
ALUMINUM	
ZINC	
CHROMIUM	
IRON	
NICKEL	
TIN	
LEAD	
COPPER	
MERCURY	
SILVER	
PLATINUM	Good cathodes
GOLD	

CCl4 nonpolar: E = 2.2. Try using a nontoxic nonpolar solvent (gasoline, ether, starter fluid, toluene, etc)
The blue crystals in step 3 are CuSO4 * 5H2O