

COPPER

A Marvelous Metal



GALLERY

by Mary Erickson, Ph.D. and
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Commonly known as The Copper State, Arizona is the largest copper producing state in the United States. The copper-colored star in the center of its flag symbolizes the metal's importance to the state.

Sometimes copper is found surrounded by rock or in nuggets. Copper is also found combined with other elements in copper ore. Heat and acids are used to separate the copper from the ore.



Copper in rock



Copper Ore

In Arizona's historic copper towns, like Bagdad, Jerome and Bisbee, miners labored underground in mines to bring ore to the surface in cars and buckets like these.



Today, copper ore comes from huge open-pit mines.



The Morenci mine, in southeastern Arizona, is expected to produce approximately 225 million pounds of copper in 2014.

The history of copper inspired artist Karla Elling to make this book with its shiny copper covers.



Troy Moody
incorporated copper,
cattle and citrus,
three of Arizona's three "Cs"
in this work.

He used glass, iron,
and copper to make
Desert Harmonies #1.



Jose A. Benavides built his artwork from Arizona license plates crowned with copper antique car plates.



Metal working changed human history, and it all began with copper.



- During the **Stone Age**, people made tools from stones.
- Later, people made rather soft metal tools of copper.
- In the **Bronze Age**, they learned to smelt (heat) copper and tin together to make bronze, which is harder than copper.
- Much later, in the **Iron Age**, people invented a way to raise temperatures even higher to extract iron from iron ore, which is even harder than bronze.
- Today steel is made by combining carbon with iron.

- Mary Bates Neubauer's work bridges the millennia.
- She uses a computer to generate forms based on data from the environment.
- She casts her pieces in copper, bronze and iron.



Copper has been important to people for thousands of years, and still is today. It is valuable not only for its practical uses but also for artistic qualities.

- Copper is **malleable**.
- Copper is **ductile**
- Copper is a **good conductor**.
- Copper produces **rich colors**.

Wall-mounted light fixture



Most metals are **malleable**, which means you can hammer or press them to change their shape without breaking or cracking them.

Because copper is relatively soft, it is easier to shape than harder metals.



Both these objects were shaped from copper.

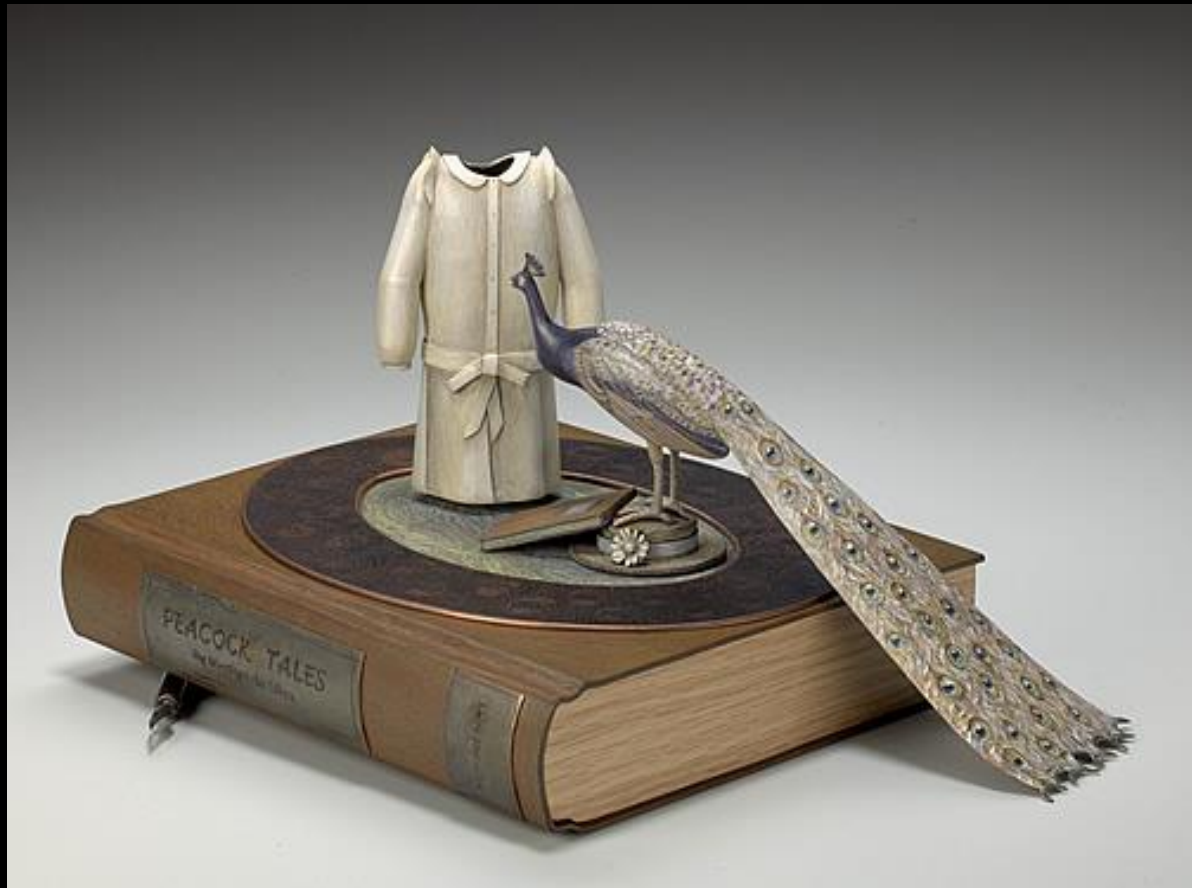
- Which shows hammer marks?
- Which was pressed into a mold?



All sorts of things have been formed from copper such as the examples below: coffee table, diving helmet and dust pans.



Marilyn Da Silva hammered petal-like copper shapes to make this piece, which she then coated and added detail with colored pencils.

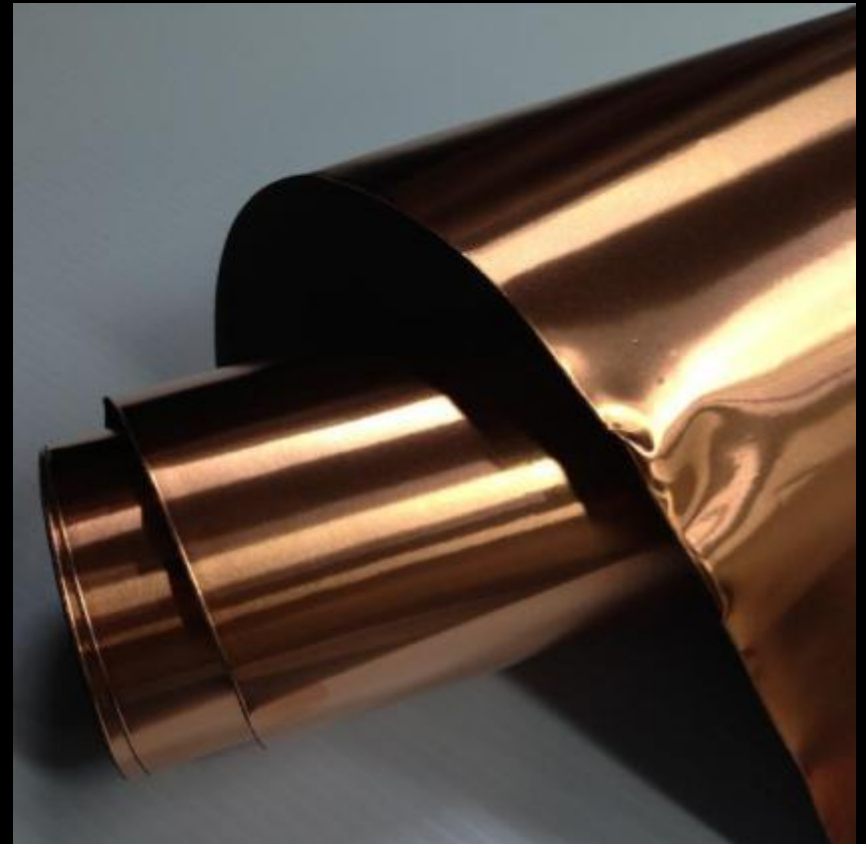


Perrin Gilbert's *Inside and Out* is made of bronze, an alloy (mixture) of copper and tin.

Because bronze is harder than copper and not as malleable, his sculpture will hold its shape over time.

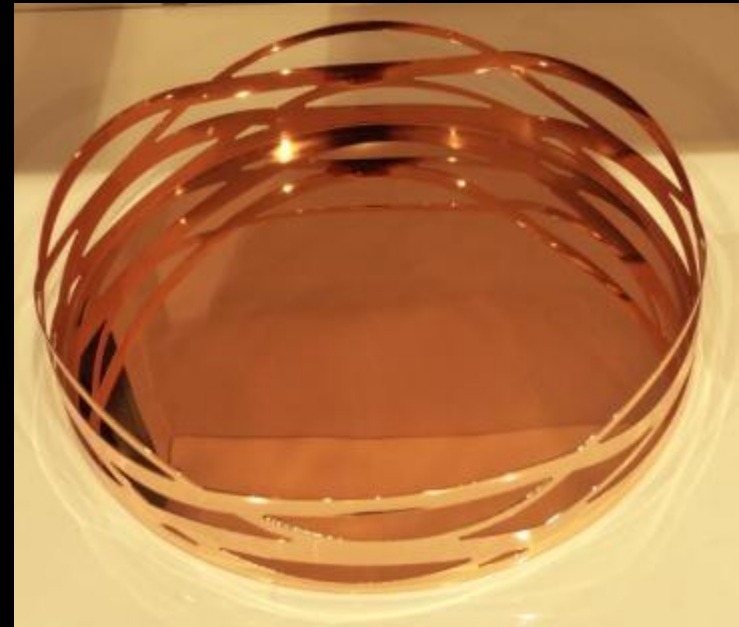


Copper is **ductile**, which means it can be rolled into sheets or drawn (or **extruded**) into wires of various widths or thicknesses.



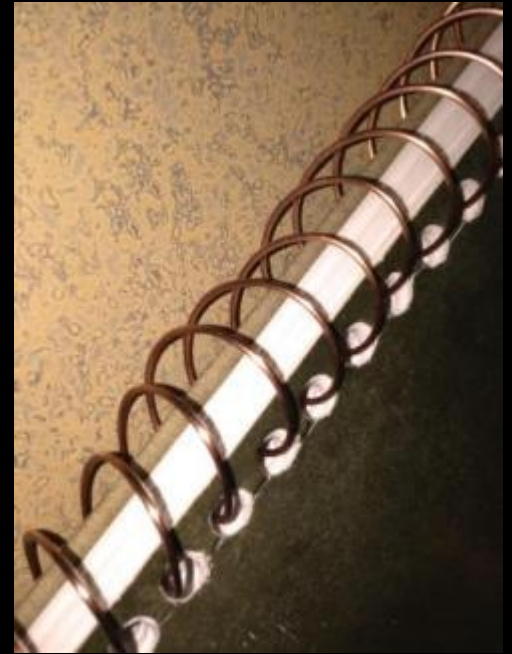
This roof edging and tray began as copper sheets.

- Which had holes cut through the sheet?
- Which sheet was bent at angles?



Copper wire was used to make all of these objects.

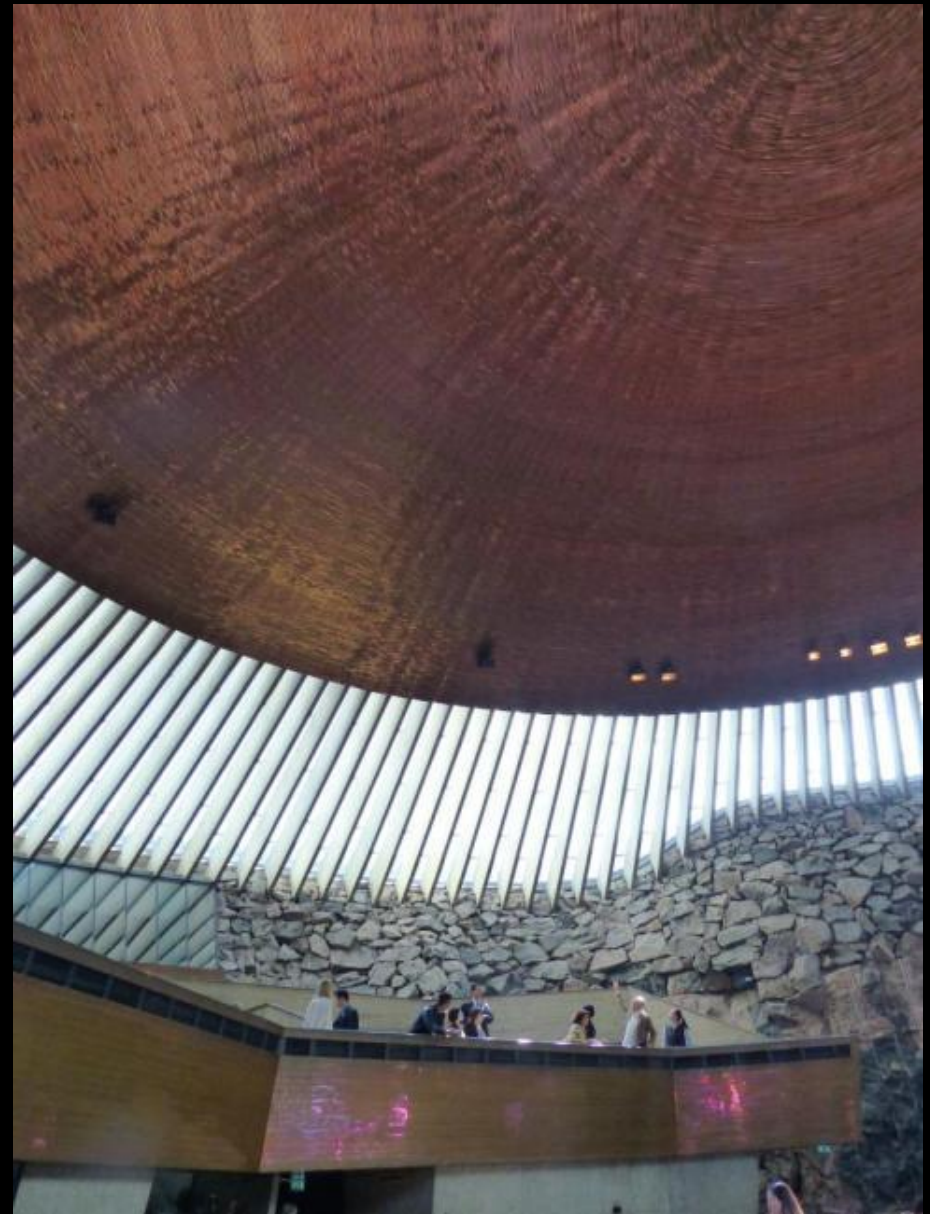
- Which were meant to be practical?
- Which were meant to be visually interesting?



The roof of this church
was made of 14 miles of
copper wire!

By Timo and Tuomo
Suomalainen, 1969

Temppeliaukio Church,
Helsinki, Finland



- Besides being malleable and ductile, copper is a great **conductor**.
- A material that is a good heat conductor allows heat to transfer easily through it. That's why many cooks like copper pots.



Copper is also a very good conductor of electricity.

Electrical cords are made of twisted copper strands covered with insulation to keep the electricity from flowing into us we touch them.

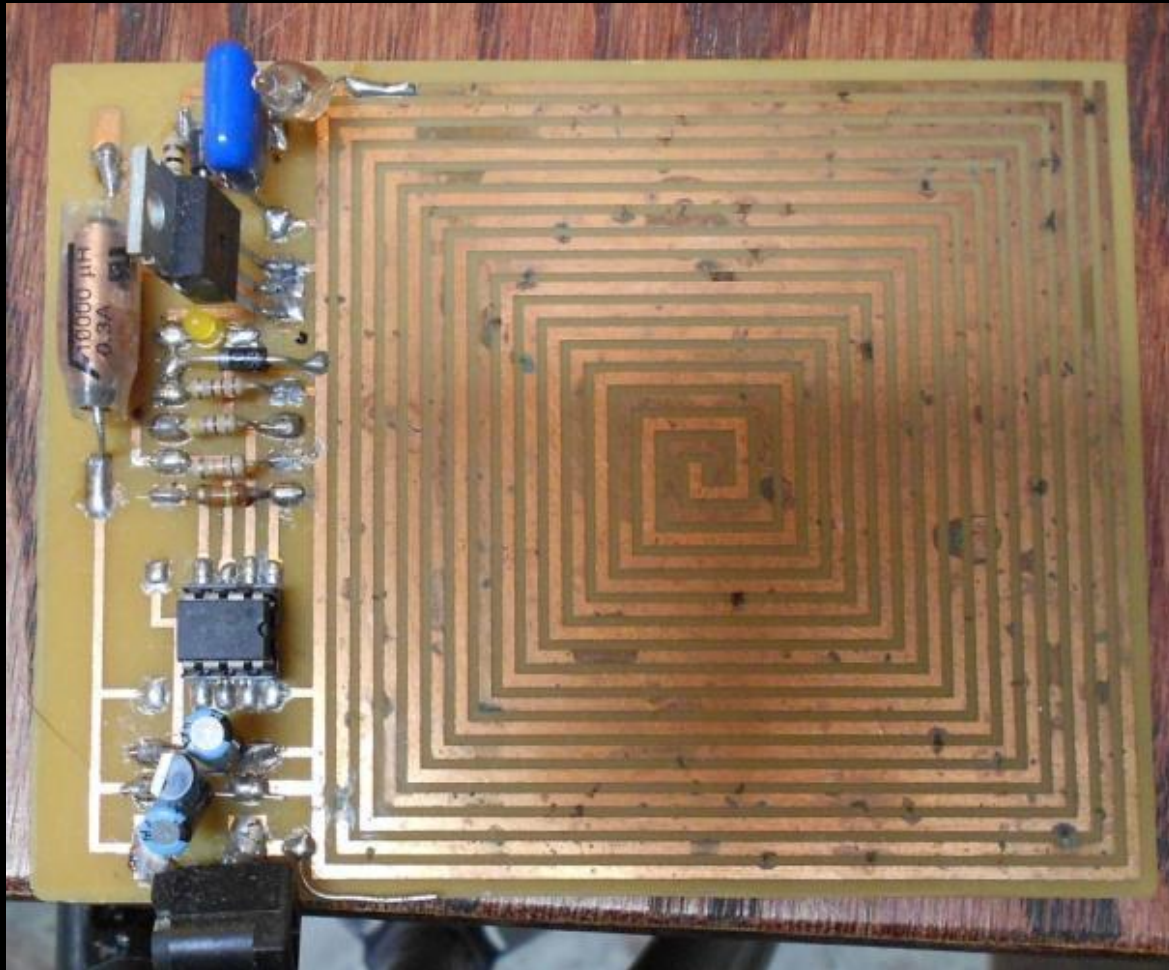


Small gauge household electrical wire.

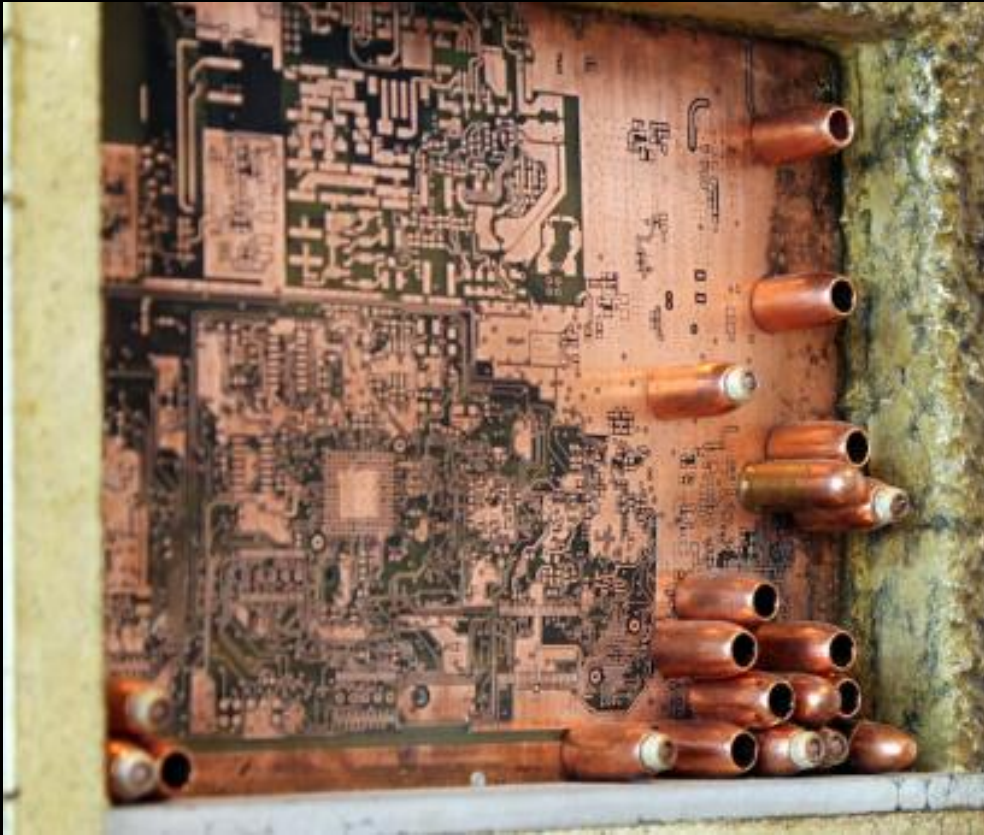


Large gauge insulated copper cable with 230,000 volt capacity. A single strand in the cable is much larger than all seven strands in the household wire.

Computer circuits direct electrical energy, so they are sometimes made of copper.



Artist Christine Cassano incorporated a printed copper circuit board in “*Drone*,” an artwork about complex natural and industrial systems.



- All 91 metal elements are gray or silver except copper, gold and two others (caesium and osmium).
- Artists appreciate copper's many **colors**. It starts out a beautiful, shiny, orange-ish color and **tarnishes** over time.



- A thin, rich brown layer of tarnish forms when copper interacts with oxygen in the air. Tarnish protects the surface and can be removed by polishing.



- Can you see how the copper ring around the Tempe Center for the Arts has tarnished from 2007 to 2014?



Over many years, through the slow interaction of copper with carbon dioxide and water, tarnished copper turns green. This green surface is called a **patina**.

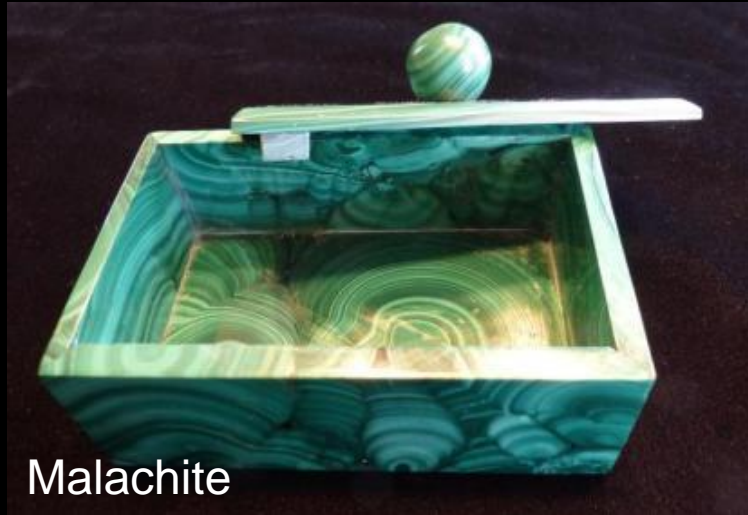


Detail from the Price Tower, by Frank Lloyd Wright, Bartlesville, OK



Gargoyle from Ponce de Leon Hotel, Saint Augustine, FL

Copper within stone can make that stone greenish or bluish as it does in these. Copper is used to make some green paints.



Malachite



Chrysocolla



Turquoise

Artist Thomas Roy Markusen says that he is fascinated by copper's "diverse palette of colors."



Michelle Startzman's brooch showcases copper's rich colors by nestling copper within other metals.



- Jackie Kahn chose blue and green glass to “resemble the natural turquoise found in the copper mines of Arizona.”
- Then she used acid and an electrical current to transform copper foil into a layer of tiny orange beads.



Visit the Biennial Copper exhibitions at Tempe Center for the Arts to see artworks made of, made with, or inspired by, that marvelous metal – copper.



Red Rohall
Copperville Café
oil on canvas



Tom Philabaum
Wisconsin Sideways,
glass on panel