

The metals of antiquity – copper

Rob Tyson - Mining International Ltd. | March 30, 2021 | 3:17 pm [Education Copper](#)



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If gold has been humankind's most valuable friend throughout the ages, copper has certainly been our most useful. Kind of like dogs and cats, or horses and dogs for the horse fanciers amongst us. Copper has been the more important 'friend' to us in terms of its usefulness, because we used it to make tools, weapons and various other implements. Gold, on the other hand has always been considered far more valuable due to its scarcity, and was predominantly reserved for precious items like jewellery and status symbols.

Which one were we using first?

We know our ancient forebears were mining and producing gold objects as early as 4,600BC. The ancient gravesite at [Varna Necropolis in Bulgaria](#), where around 3,000 gold objects were found, dates back to 4,600 – 4,200 BC. Our association with copper though goes back even further. A small copper awl found in Israel for instance has been dated to ~5,100BC. Even older (~8,700BC) is a copper pendant uncovered in the region that is now part of northern Iraq. So, it seems on current evidence that we figured out how to extract native copper from its ores almost 11,000 years ago, well before any of the other native metals associated with prehistoric civilisations were in use.

The first 3

One significant reason our use of 3 metals in particular – copper, gold and meteoric iron – predates those of most other metals is because they belong to a group of metals that can occur as native metals ie can be found naturally in pure metallic form. It was therefore relatively easy for ancient humans with their primitive stone and bone tools to extract and/or work with these metals without the need for the various smelting and other extraction techniques that were developed later.

Much later as it turns out

Archaeologists are inclined to believe from evidence uncovered so far that it wasn't until 4,000 – 3,000 BC, during the mid-Mesopotamian era, that more sophisticated methods of extracting copper were developed.

Notably, we discovered that by heating copper containing rocks, we could extract even more of it. Pre historic miners used a technique called **fire-setting**.

Fires were lit up against the rock or working face to heat the rocks. Cold water was then thrown onto the hot rocks to soften and crack them, making it easier for miners to extract the copper from the normally hard rock with their primitive tools.

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Eye catching discoveries

Is there a link between the fact that gold and copper are the only 2 non-silvery / grey coloured metals, and that their discovery and use predates other metals?

Possibly....

Just as the first gold discoveries were likely in the form of shiny attention grabbing nuggets washed up in creeks and rivers, it's also possible it was the attractive rose gold colour of veins and nuggets of pure native copper that originally drew the metal to our attention. Once we figured out how to get it out, it wouldn't have taken us very long to discover that the attractive looking substance was more than 'just' a pretty colour.



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Pure copper is a soft ductile metal so its earliest uses would likely have been restricted to items that didn't require much rigid strength (jewellery, decorative artefacts, utilitarian items like vessels, and some types of light duty tools). Its widespread use in heavy duty applications, ie heavy duty tools, didn't happen until around 3,300 BC when we learned that by mixing it with tin (another metal of antiquity) we could produce a much harder, stronger metal called bronze. This discovery ushered in the Bronze Age, and marked the beginning of the end for stone and bone tools. Around 1,400 BC we discovered copper also worked well with another antique metal, namely zinc, and so brass, another incredibly valuable copper alloy, was born.

Modern copper

Today, we've found a myriad of uses for the soft, ductile, malleable metal that also comes in several colours depending on what it's been mixed with. The pure metal is a pinkish gold or red brown colour. Copper sulphate / nitrate / chloride / hydroxide are blue, copper carbonate is green, and copper oxide is black.

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- Copper is now the 3rd most used industrial metal in the world. The only metals we use more of are iron and aluminium.
- Around 75% of the copper produced today is used in the electronics, communication and energy industries where its excellent conductivity and ductile properties make it ideal for wiring and electronic circuitry, telecommunication cables, and electrical wires. In fact, 60% of copper ends up in wiring alone. The rest finds its way into building construction, coins, cookware, plumbing, electronics products other than wiring, and many other products.
- When it comes to electrical conductivity, only silver outranks copper.
- Copper is fully recyclable (and valuable) which is probably why around 80% of what we've mined to date is still being used. Much of it has likely been through a number of reincarnations since it was taken from the earth but essentially copper is one of those commodities that can, and should, be used over and over and over.
- The average car contains 1.5 kms of copper wiring.
- Copper and copper alloys are commonly used in protective coatings for ship hulls because copper is toxic to invertebrates like mussels and barnacles, and thus discourages them from attaching themselves to the ship.
- Koppers logs, or CCA treated pine logs, have been soaked in a copper based wood preservative called copper chrome arsenate to protect them from harmful pests like termites and borers. A lot of the timber used in construction, particularly pine and other insect susceptible woods, has usually likewise been treated with copper based preservatives and pesticides.

Historically:

- A 5,300-year-old frozen man found in the Italian Alps near Oetzi, and subsequently called Oetzi the Iceman, had an axe with him that had an almost pure copper head. He also had high levels of arsenic in his hair, indicating he'd probably worked in or had extensive exposure to copper smelters.
- King Tut was buried with a stack of tiny copper farming tools to help him in the afterlife.
- Most of the famous ancient Dead Sea Scrolls are made of animal skins but one of them for some reason is made of copper. Also unlike the rest of the Scrolls, this one doesn't have any religious text or biblical passages written on it. Rather, it contains clues to a treasure that as yet remains undiscovered.

Metallurgically:

- Copper is particularly obliging when it comes to forming binary compounds and alloys with other metals. Amongst the better known copper alloys are bronze (copper and tin), brass (copper and zinc), and sterling silver (copper and silver, although copper is the minor metal) whilst common copper compounds include copper chloride, copper oxide, and copper sulphide.
- Pure copper US pennies were a 'thing', but only briefly before the copper content in them started dwindling. Those minted between:
 - 1783 and 1837 are pure
 - 1837 and 1857 are 95% copper and 5% tin / zinc mix

- o 1857 and 1864 are 88% copper and 12% nickel
- o 1864 and 1942 are 95% copper and 5% tin / zinc mix
- o 1943 are zinc coated steel
- o 1944 and 1946 are 95% copper and 5% zinc
- o 1947 and 1962 are 95% copper and 5% tin / zinc mix
- o 1962 and 1982 are 95% copper and 5% zinc
- o 1982 to current are 2.5% copper and 97.5% zinc – the coins are zinc and they have a thin copper coating.
- Many other countries also have varying amounts of copper in their coins. How much usually varies according to the market price of the constituent metals so when the price of copper goes up, the amount in coins comes down and vice versa.

Copper production

- Chile produces the most copper of any country, and their 537 million metric tons in 2020 was more than double that of second placed Peru with 2.2 million metric tons. China, the US, Australia, China, the DR of Congo, Zambia, Mexico, Russia, and Kazakhstan round out the top 10 list of top copper producers.

And now for some really **fascinating copper facts**. Nutritionally, copper is one of a number of essential trace elements that many species, including humans, require on a daily basis.

- In particular, copper has an interdependent relationship with iron, zinc and manganese with respect to absorption. These 4 minerals need to be present in a specific dietary ratio with each other to ensure adequate uptake and optimal health ie too much or too little of one will adversely affect uptake of the others. Copper levels for instance directly affect iron metabolism, and vice versa. Notably, **research** has found that a diet high in iron but lacking in copper causes both iron and copper deficiency anaemia. Similarly, diets high in copper but low in iron have the same effect, indicating that these 2 minerals must be present in the correct ratios for optimal health.
- Copper is also an **important nutrient for plants** because without it, they don't grow well, can have their flowering delayed or worse case scenario, can be sterile. Some cropping soils around the world are deficient in copper, zinc, and manganese and require the addition of fertilisers rich in these trace elements to produce good quality crops.

Copper and our health

- First and foremost, both copper and iron are needed to create red blood cells (erythropoiesis). As mentioned above, imbalances in the ratio between these 2 minerals will directly and adversely affect this process, resulting in copper and iron deficiency anaemia.
- It helps keep blood vessels, bones, nerves and the immune system healthy.

Copper and its considerable anti-microbial, anti-pathogenic properties:

- Copper / silver ionisation is a long established method of purifying water. Copper ions penetrate the cell walls of these organisms and create openings for silver ions (Ag⁺), which then invade the cells and bond to various parts of its structure, immobilising its life support systems and preventing cellular growth and cell division. When this happens, the organism can no longer multiply and eventually die out.
- Copper water vessels were used in ancient cultures to carry and store water because of copper's ability to prevent organisms growing in the water. Today, there is renewed interest and **research** into the use of copper and copper vessels to assist in the microbial purification of drinking water, particularly for eliminating common bacterial pathogens like Escherichia coli, Campylobacter jejuni, Staphylococcus aureus, and Salmonella enterica. It's surmised the copper ions that leach into the water damage the cell membranes of these organisms, which subsequently prevents them from 'breeding'.

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- Copper sulphate is a common component in algae inhibiting products like trough blocks for livestock drinking water, although it's probably worth noting that special care needs to be taken when adding any type of copper product to water intended for sheep because they have a very low tolerance for excess copper. Alternatively, a piece of copper (usually pipe or copper pennies but any copper will do) can be placed in iron troughs, causing a process correctly called bimetal or galvanic corrosion (although many incorrectly call it electrolysis) to occur when the 2 different metals touch. As water flows past them, it creates an electric current that causes the outer atoms of the metals to lose an electron and become positively charged. In this case, it causes copper ionisation ie the outer atoms in the piece of copper lose an electron and become positively charged. These electrically charged copper ions (Cu²⁺) in the water search for particles of opposite polarity, such as bacteria, viruses, fungi, algae etc. Positively charged copper ions form electrostatic compounds with negatively charged cell walls of microorganisms, which disturbs cell wall permeability and causes nutrient uptake to fail. The organisms then die. It's probably worth noting that sheep typically do not respond well to copper in their drinking water!
- Copper sulphate is also an effective debriding agent for removing proud flesh (hypergranulation tissue) in livestock wounds. It also has bactericidal and fungicidal properties so has been used as disinfectant and in the treatment of animal diseases like foot rot.
- We mentioned copper's natural antibacterial properties above. These along with its other anti-microbial qualities make copper and brass a good choice of metal for items in public buildings that are used by the public (door handles, stair railings etc) as they help reduce the spread of disease causing pathogens.
- **Research** carried out in 2013 showed that the use of copper and copper alloys on surfaces that are touched a lot in hospitals significantly reduced the 'microbial burden' of those surfaces, and thus reduced the patient's chances of acquiring hospital-borne infections.
- The same research team looked at copper coating on stethoscopes and found that those with the copper coating had 'significantly fewer bacteria' than those without it, and that around 66% of the copper coated stethoscopes had no bacteria whatsoever.
- Some types of IUDs contain copper wiring; the copper sets up an inflammatory reaction that kills off eggs and sperm, thus preventing pregnancy.

Other interesting copper facts:

- If you thought it was the chlorine in water turning your hair green, you'd be wrong. The real culprit is copper, added via algaecides or naturally present in some hard waters. To be more precise, the copper molecules in the water attach themselves to the protein in hair strands. When the copper oxidises, which it does naturally in water anyway but does so even more when bleach like chlorine is added, it turns green. All hair colours are actually affected but it only shows up on the lighter hued blonde and white hair.
- Related to the point above – copper is often used in cheap jewellery but unfortunately, because it turns green when it oxidises, it can also turn our skin green.
- Copper is a key ingredient in some fabric preservatives and can be woven into the fabrics themselves to produce garments that are anti-microbial ie fungus fighting socks and underwear.

So there you have it – the many ways in which copper has ingratiated itself into our lives on a daily basis.

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