

# Moon Metal

According to ancient records, silver was the third metal used by man, after gold and copper. Pure silver is sometimes found in large lumps, so it could be used without complex refinement and separation processes.

Initially, most of silver's value lay in its malleability, lustrous white color, resistance to corrosion (which allowed it to remain shiny even after being buried for a long time), and resistance to atmospheric oxidation. But in the 20th century, silver's high thermal and electrical conductivity, as well as its corrosion resistance, make it an attractive material for many high-tech uses.

Silver, one of the so-called "precious metals," is the whitest of all metals, and its reflectivity (especially in the portion of the spectrum visible to the human eye) is one of the highest among metals. Polished silver can reflect up to 95% of the light striking its surface. It has excellent ductility and malleability, though it can be easily scratched.

With the clean air of pre-industrial societies, tarnishing was not a problem, but silver reacts with sulfur compounds in the atmosphere (brought about by large-scale burning of coal). Now, silver must be coated with nickel and then rhodium, or alloyed with palladium or gold to keep it from discoloring. Silver objects found in ancient tombs were initially bright even over the ages, but they tarnish rapidly on contacting modern polluted air.

The ancients compared the yellow color of gold to the sun, and they saw the gleaming white of silver as reminiscent of the moon. Indeed, the symbol for silver in early Rome was a crescent moon. The chemical symbol for silver, Ag, is derived from its Latin root, *argentum*, meaning white and shining. The word "silver" is derived from the Anglo-Saxon *seolfor*, also meaning white and shining.

Silver is usually found in sulfide compounds in ores such as galena, so it would not be immediately recognizable as a precious metal. However, in the wakes of intense forest fires, outcroppings of the relatively common galena could have produced molten lead and leftover lumps of silver metal that could be hammered flat and used for ornamentation.

Silver ornaments and decorations have been found in royal tombs dating as far back as 4000 B.C. In about 3100 B.C., the Egyptian ruler Menes decreed that one part of gold was worth two and one-half times the same amount of silver. The book

of Genesis mentions silver as part of Abraham's treasure. Chinese and Persian references speak of silver by about 2500 B.C. By this time, mining may have begun, with workers extracting silver ore as well as accidentally melted lumps of pure metal.

The Romans developed the first extensive mining and smelting operations, using large furnaces to produce silver metal from ore. Pliny wrote that "the ore was washed and sieved five times, fused with lead and then cupelled for more silver." Cupellation, the process of heating ore to high temperatures under a blast of air, oxidizes the lead to more volatile lead oxide, which burns off.

The Roman process was used throughout the Middle Ages until the 16th century, when Spanish discoveries of enormous lodes of silver in the Americas led to the development of new techniques. Silver ore found in Mexico, Bolivia, and Peru was richer in silver than European ores. New World Spanish metallurgists ground the ore with water into a mud, mixed it with salt, and added roasted sulfide ores of copper and iron and some mercury. Mules trod on this mud for several days on a paved court, reducing the silver to metal and creating an amalgamation with the mercury. The amalgam was then collected, retorted, and sent to a refinery for cupellation. This process continued to be used for the next three centuries.

The next refining advancement did not occur until 1802, when D'Arcet in Paris developed the sulfuric acid process. Most silver-bearing ores contain a small amount of gold, which cupellation cannot remove. However, D'Arcet discovered that dissolving crude silver in boiling sulfuric acid would cause the gold to settle out, and the pure silver could be brought back to a metal by reduction with metallic copper or iron.

D'Arcet's sulfuric acid process was used for most of the 19th century, until it was replaced by an electrolytic process that used a silver anode in a bath of silver nitrate. This process produced silver that assayed to 99.9% pure.

Pure silver, however, is relatively soft. Early metallurgists found that alloying it with a small amount of copper (less than 10%) greatly improved its toughness. British sterling (0.75% copper) is probably the most famous of silver alloys. The Saxons used silver coins known as sterlings in 775 A.D. A pound of silver yielded 240 sterlings. Large payments were tallied in pounds of sterlings.

Silver has been used for money since ancient Babylonian times. Both gold and silver were probably used as money by 800 B.C. in all countries between the Nile and

the Indus rivers. While gold coinage was generally reserved for kings and priests, silver was the common exchange for the merchant class, and became somewhat standardized throughout the world as trade routes spread.

Silver's original form for trade was simple lumps of the metal, cut or sawn from larger ingots. Pieces were stamped with marks indicating fineness and weight, and with other authentication seals. These irregular shapes were difficult to store, compare, and count, and so they evolved into flat, stackable disks.

In 1486 a local mint was set up in Joachimsthal, Bohemia, where a mine produced so much silver that the mint produced coins of larger denominations. These large coins were originally called Joachimsthalers, shortened to 'thalers, then dalers. Today, we call them dollars.

In the United States, gold and silver were officially adopted as the standard of currency in 1792, when the national mint was authorized to coin as much gold and silver as it could obtain. The value ratio of gold to silver was then 15 to 1. New gold and silver discoveries in the 19th century caused the ratio to fluctuate dramatically, until the discrepancy made the two-metal base untenable for a monetary system. Silver coin was removed from circulation during the U.S. Civil War, and the 1873 Coinage Act prohibited further coinage of silver dollars. However, when the price of silver soared during World War I, silver dollars returned to circulation.

In 1965 the use of silver in U.S. coins was greatly curtailed. Silver was completely eliminated from dimes and quarters, and was reduced from 90% to 40% in half-dollar pieces. Currently, these coins are made from a layer of copper between two layers of cupronickel. Likewise, pure silver was eliminated from British coins, which went to alloys containing only 50% silver in 1920. After 1947, British "silver" was made entirely from cupronickel. The silver rouble was the monetary basis for Russian coins until gold became the basis in 1897. After the Russian revolution in 1917, Soviet coins were made mainly of alloys with very little silver.

While silver is disappearing from coins, it has found many industrial applications, ranging from silver nitrates in photographic processes to electroplated tableware, high-performance ball bearings in aircraft, electrical conductors in printed circuits, coatings for electrical conductors, amalgams for dental fillings, and high-durability prosthetic pins. Few other metals have achieved such diversity.

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