

# Ancient Gold

Gold, one of the first metals worked by man, has remained one of the most precious substances throughout the history of civilization on Earth.

Gold readily became important to early humans because it was found as a free metal in alluvial deposits, requiring no complex separation or smelting techniques. It could be easily worked, even with primitive instruments, into jewelry or ornaments.

Working with gold helped the development of metallurgical techniques later

used for metals more difficult to work. Gold could be hammered into a desired form; it could be melted and poured into a mold, where it would harden into a new shape. Later, people learned they could melt gold out of rock—smelting—even when they could not find pure lumps of gold.

Gold is found over widespread areas of the Earth, mostly in low concentrations, often occurring as a trace constituent in copper and lead ores. When found in high concentrations, gold is often a free metal associated with silver.

As a result of weathering and microbial action in gold ores in natural deposits, gold accumulates in downstream de-

posits. Since gold does not easily dissolve in solution, the more soluble components of ore, such as the carbonates, are dissolved and carried away. Less soluble but lighter material is washed away as a fine suspension, while insoluble hard minerals, such as quartz, remain behind with gold and are frequently associated with many surface deposits.

Since gold is soft and malleable, weathered lumps are easily rounded and squashed, but not broken. As the ore erodes, gold flecks find their way downhill to accumulate with quartz gravels and sand. Because gold is about six times more dense than most rock, it settles to

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the bottom of gravel beds in streams, coming to rest in hollows.

The washing of gold ore can be seen in Egyptian monuments from the First Dynasty, 2900 B.C. The well-known myth of the Argonauts and the Golden Fleece probably refers to a raid on miners in modern-day Armenia who were using sheepskins to catch fragments of gold (1200 B.C.) while washing river sands, much as certain current gold-washing techniques use rough cloth or blankets.

By the fourth millennium B.C. gold was sought extensively by fledgling civilizations in Persia, India, Arabia, Asia Minor, Caucasia, the Balkans, and parts of Africa. The greatest sources of gold in the ancient world were the more than 100 mines in the Nubian Desert operated by the Egyptians. Slaves and captives worked these mines, producing the largest amounts of gold used in the ancient world. The Turin gold map, a papyrus in the Egyptian Museum in Turin, indicates the locations of some of these mines. Gold mining, however, was a jealously guarded state monopoly. The Nubian mines produced the wealth on which the power base of successive Egyptian rulers rested.

As a metal, gold has many desirable material properties. The noblest (most inert) of the metallic elements, gold does not corrode or tarnish, keeping its luster and brilliant yellow color in environments that would harm other metals.

Pure gold and many gold alloys are nonmagnetic. (Exceptions are an alloy of gold with manganese, which is somewhat magnetic, and some alloys with cobalt, iron, or nickel, which are ferromagnetic.) Gold is also a good conductor of heat and electricity. Its chemical symbol, Au, is derived from the Latin name for gold, *aurum*.

Despite refining techniques, platinum group inclusions are often found in ancient gold, as are other impurities. Contaminants, though, often made the gold superior for other uses. Gold is usually alloyed with other metals to harden or color it. Most gold used in coinage and jewelry is alloyed because the pure metal is too soft and wears too easily.

The proportion of gold in an object is expressed in parts per 24, or karats, so that 14-karat gold is 14/24 pure gold. Another measurement is "fineness," or parts per thousand; gold coins formerly minted in the United States were 0.900 fine.

Gold is so malleable that it can be beaten to a thickness of three millionths of an inch (0.075  $\mu\text{m}$ ) to form semitransparent

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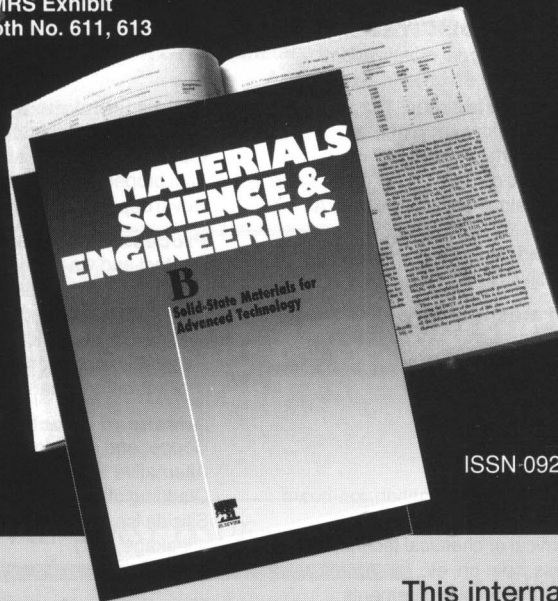
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## HISTORICAL NOTE

gold sheets that transmit green light. One ounce of gold can be beaten so flat and thin that it covers 300 ft<sup>2</sup> (30 m<sup>2</sup>). No other metal can be hammered so thin.

Gold leaf has been used since antiquity to decorate such materials as wood, glass, bronze, plaster, ceramics, and textiles. Such a decorative coating is desirable not only for its beauty, but because it provides durable protection and retains its luster.

To make gold leaf, craftsmen poured melted gold into an ingot, which they rolled to a thickness of about 0.0015 inch (or 37.5  $\mu$ m). This sheet would be cut into two-inch (5 cm) squares which were interleaved with sheets of vellum or parchment, wrapped in a sheepskin, and hammered on a stone block until the gold spread out to a thickness of 0.0004 inch (10  $\mu$ m). The thin sheets were removed from the packet with wooden pincers, placed on a leather pad, and quartered again.

This process of cutting, interleaving, and hammering was repeated until the gold was reduced to the desired thickness. The final sheets of gold leaf were so delicate they could be positioned by a slight breath.

Homer mentions the hammering of gold leaf in *The Odyssey*, and Pliny the Elder describes the technique in greater detail. Modern methods differ very little from the ancient ones, although it is now possible to create gold leaf by electrolytic deposition, cathode sputtering, or vacuum vaporization.

Since ancient times gold has been one of the most readily acceptable forms of currency. In the 7th century B.C. the kings of Lydia in Western Asia were confident enough of their refining ability that they issued coins guaranteed for purity and weight. A royal stamp on the coins assured the trading community of their value.

Gold also has a great many modern uses, ranging from dentistry, to ceramics, to electronics. Later uses of gold will be the subject of a future Historical Note.

KEVIN J. ANDERSON

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