

# Quicksilver

Mercury, also popularly known as quicksilver, has been known and used by civilizations for about 3,500 years. As early as 1500 B.C. the Chinese and Hindus used the element for various purposes, many of them medicinal or alchemical. Mercury was also found in an Egyptian tomb from 1500 B.C.

In the fourth century B.C., Aristotle described mercury as being like "liquid silver" or "water silver"; the Greek word for this term, *hydrargyros*, is the source for the chemical symbol of mercury, Hg. In the first century A.D., Pliny the Elder also wrote about mercury, describing ways to extract it from rocks and how to amalgamate it with gold.

Because of its strange properties, mercury was considered a magical substance. Mercury is first mentioned in the oldest Indian writings, the Hindu Vedas *Arthashastra*, in the fourth to third centuries B.C. In the sixth century, alchemists first used the term *mercurius* and assigned it the astronomical symbol for the planet Mercury because of its lustrous silvery white color (similar to the appearance of the planet Mercury in the sky) and its mobile form (Mercury is the swiftest of all the planets).

The most well-known Chinese book on alchemy, *Great Secrets of Alchemy* (probably written by Sun Ssu-miao between 581 and 673 A.D.), is a practical treatise on creating elixirs to attain immortality. These elixirs contain mercury, sulfur, and salts of mercury and arsenic—all toxic. Joseph Needham, a historian of science, compiled a lengthy list of Chinese emperors who likely died of elixir poisoning. Eventually, the succession of royal deaths led to greater caution and skepticism—among both the alchemists and their royal guinea pigs—and Chinese alchemy dwindled.

Liquid at room temperature, mercury freezes at  $-39^{\circ}\text{C}$  and boils at  $357^{\circ}\text{C}$ . Mercury is not attacked by dry air, oxygen, or carbon dioxide. Because it has good electrical conductivity, mercury is widely used in sealed electrical switches and relays. In fact, the value of the ohm is defined in terms of the conductivity of mercury.

Lamps containing mercury vapor in a fused silica bulb are used to provide ultraviolet radiation. An electric current passing through the mercury vapor excites the mercury atoms, which give off ultraviolet light of wavelengths of 1,849 and 2,537 Å. The UV light is transformed into blue-green visible light by a phosphor.

The primary source of mercury is the ore

cinnabar, or mercury sulfide, which is generally found in a brownish-red massive, granular, or earthy form. Cinnabar is mined in Eastern Europe, Italy, Mexico, and some parts of the United States. The cinnabar mines in Almaden, Spain, have produced mercury for 2,000 years. The pigment vermilion was formerly made directly from cinnabar, though it is now made by grinding mercury and sulfur together and treating the mixture with a caustic potash solution. The resulting black sulfide of mercury yields vermilion pigment after a long steam treatment. The name *vermilion* comes from the Latin term meaning "little worm" after the dried bodies of small insects from which a similar reddish pigment, carmine, is obtained.

Mercury's ability to form amalgams with other metals was exploited for many purposes. Gold and silver dissolve readily in mercury, and this allows "winning" or extracting precious metals from some ores. Mercury drives off impurities in gold or silver amalgams; the amalgam can then be heated to drive off the mercury, leaving purified gold or silver. This amalgam-purification technique was known to the ancients, then forgotten before being rediscovered by the Spanish in the 16th century.

Copper, tin, and zinc also form amalgams with mercury. Sodium and potassium amalgams are used as reducing agents. Zinc electrodes in batteries are amalgamated with mercury to decrease corrosion. Tin, silver, and gold amalgams are used in dentistry.

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Because mercury expands uniformly and rapidly as temperature increases and because it does not wet glass, mercury is widely used in thermometers. By the early 18th century, as many as 35 different temperature scales had been proposed by chemists and physicists. In Germany from 1700 to 1730, Daniel Gabriel Fahrenheit produced accurate mercury thermometers calibrated to a standard scale. The first centigrade scale was created in Sweden in 1742 by the astronomer Anders Celsius who also used mercury thermometers. The

symbol "C" stood for centigrade until 1948, when it was officially changed to honor Celsius's name.

At room temperature, mercury vaporizes slightly into a colorless, odorless gas, which is extremely toxic with cumulative effects. Chronic methylmercury poisoning affects the liver, kidneys, and brain, resulting in slurred speech as well as loss of coordination, peripheral vision, and memory. In the 19th century, use of mercuric nitrate in the hat industry to lay felt fibers caused severe tremors in workers and a manic physical disturbance that led to the phrase "mad as a hatter." Mercuric nitrate was eventually banned in the hat industry.

For many years, large quantities of mercury were discharged as industrial wastes into lakes and rivers, where they sank to the bottom and remained supposedly harmless. In 1967 it was discovered that bacteria in the sediments could convert this waste mercury into organic methylmercury that could be incorporated and concentrated in the food chain.

The first major outbreaks of methyl mercury poisoning occurred in Japan in the 1950s and 1960s, when a number of people died from eating mercury-contaminated fish. Because the outbreak occurred in Minamata, Japan, this form of mercury poisoning became known as Minamata disease.

In the United States during 1970-1971, large amounts of swordfish and canned tuna were removed from the shelves because of high levels of mercury.

Another source of environmental mercury contamination was the methylmercury fungicides sprayed on crop seeds during the 1940s. Environmental mercury accumulated from these fungicides increased rapidly until the practice was discontinued. In the late 1960s, several families were severely poisoned after eating meat from livestock fed with grain treated with methylmercury fungicides.

During World War II, many new uses of mercury were introduced, including a mercury clutch for small electric motors in washing machines, air conditioners, and refrigerators. Another development was a type of dry-cell battery. By 1947 mercury batteries had been adapted for such peacetime uses as hearing aids. In recent years, battery manufacturers have modified their designs to remove mercury due to concerns about environmental contamination.

Because of other alternatives and increasing awareness of biological hazards, demand for mercury in the United States has declined since 1969, and world production has been dropping since 1971.

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