Second Life for Quicksilver?

Mercury is an amazing element in many ways. Not only is it the only metal that is a liquid at room temperature, mercury use was thought to prolong life, heal fractures, and to generally maintain good health in ancient Chinese and Tibetan folklore. Mercury was found in Egyptian tombs that date back to 1500 BC, and during the height of the Roman Empire in the first century AD, Pliny the Elder published a 37-volume encyclopedia on the interaction of this element with other forms of matter. On the other hand, mercury's health dangers were well-known even before tests to detect its presence in the bloodstream were developed. In fact the common English expression "mad as a hatter" describes the psychotic symptoms presented by European hat makers of the 18th century who were poisoned by mercury that was used for processing fur pelts. (Incidentally Lewis Carroll's Mad Hatter in *Alice's Adventures in Wonderland* is a play on words of this expression although this character did not exhibit any signs of mercury poisoning.)

Of course this element is no stranger to electrochemistry laboratories that have routinely used it as a cathode material for a wide variety of electroanalytical and industrial electrochemistry applications. The Nobel Prize in Chemistry was awarded in 1959 to Jaroslav Heyrovsky in recognition of his discovery of the electroanalytical technique, polarography, that was originally based on the dropping mercury electrode (DME). The high overpotential associated with mercury as an electrode surface translates to a wide accessible window for the study of many useful electrode processes in the cathodic polarization regime. However, because of environmental concerns, the DME configuration has been gradually replaced by other alternatives containing much less mercury (*e.g.*, mercury thin film electrode). Thus the DME setup in my own research laboratory has not seen use in many years nor have my students had to deal with mercury spillage on the laboratory floor. The use of mercury cathodes in chlor-alkali cells has also been largely supplanted by solid (*e.g.*, metal oxide or carbon-based) electrode counterparts that are much more environmentally benign.

It turns out that mercury is an exceedingly rare element in the Earth's crust (*ca.* 0.08 ppm average abundance). However it can be extraordinarily concentrated with the richest mercury ores containing up to 2.5% by mass. Mining of the most common mineral, cinnabar, and its subsequent refining pose severe health hazards and for this reason, this element has garnered recent media attention. The European Union has banned mercury exports and the U.S. is poised to do the same very soon. With the price of gold reaching a record high last year and the fact that mercury is the best element to refine the gold (by forming an amalgam), selling mercury has become an increasingly lucrative business these days. Like the entrepreneurs who made fortunes selling pickaxes during the California Gold Rush, mercury traders today are cashing in on gold fever. However mercury is not sold on a public exchange (unlike gold) and there is no spot price for it. Perversely international efforts to outlaw trade (because of health concerns) are making it more profitable to engage in illicit transport of mercury.

Interestingly enough, while electrochemists have curtailed their use of this element as an electrode material, mercury is still the material of choice for many technological applications. You will likely not find a mercury thermometer in your neighborhood pharmacy nor will the new thermostat in your home be mercury contact-based, both having been replaced by solid-state devices. However mercury is still used for dental restoration in many countries, and is the material of choice for fluorescent lighting. In fact the new-generation compact fluorescent lamps (CFLs) that are gradually phasing out incandescent bulbs are based on mercury. This has ignited new demand for this element and has prompted many countries (*e.g.*, Columbia, China) to re-open cinnabar mines. We have certainly not seen the last of this rather amazing element. Stay tuned.

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