



LEAD

BASSAM Z. SHAKHASHIRI
UNIVERSITY OF WISCONSIN, MADISON

As a child in my native Lebanon, I collected ancient coins, digging Phoenician and Roman coins from olive groves near my hometown and from other locations. Several times, my parents took me to areas where archaeologists were carefully digging for artifacts. Occasionally, I would show some of my coins to one of the archaeologists and he would tell me in French or English what it was made of and how old it was. I was intrigued by the solidity of the coins, and I wanted to know more about their composition. I was told that most were alloys of copper. None had gold, but one or two may have had some silver. The coins felt heavy, and I wondered if there was lead in them.

One of my classmates was overweight, and we nicknamed him "lead." Later on, when we learned about the symbols of the elements, we referred to him simply as Pb, an abbreviation of the Latin plumbum, from which we also get the word plumbing. A Jesuit archaeologist told me that lead is mentioned in the Bible many times, that alchemists believed it was the oldest metal, and that they tried to change it into gold. He also told me that lead is poisonous. This fascinated me because I wondered how a solid piece of metal could be eaten. The Romans used lead to make pipes, some of which may still be in use. Later, I read that the Romans also used lead in cookware and drinking cups and that lead poisoning may have contributed to the fall of the Empire.

In high school and later as a freshman at the American University of Beirut, I learned more about lead. I was astonished to discover that lead is the end product of three series of naturally occurring radioactive elements and that lead has more than two dozen radioactive isotopes. In my sophomore year at Boston University, I learned that lead was in a gasoline additive--an organometallic compound called tetraethyl lead. I learned that lead is a major component of automobile batteries, that it was widely used in paint, and that it is used in soldering. Later, I learned that even in ancient times, some physicians believed that lead was poisonous, but it continued to be used in medicines and cosmetics until the 20th century.

Concerns over lead exposure in recent decades reflect heightened societal concerns for health and safety. All developed countries have banned two uses of lead that were once almost universal--tetraethyl lead and lead-based paint for residential use. The use of lead shot for hunting waterfowl has also been banned in the U.S. because bottom-feeding birds can ingest spent shot. Hunters must use steel shot instead. Older U.S. cities that have lead pipes or heavily soldered pipes are replacing them at considerable expense. There is continuing concern about lead glazes still used in some ceramics made in developing countries, but the lead found in fine china and crystal glass does not readily leach out and is not a concern.

Until recently, lead poisoning was diagnosed by its symptoms, but it is now diagnosed by analyzing its presence in blood by atomic absorption methods. The mechanism is not well understood, but lead is believed to bind to proteins involved in neurological signaling and development that otherwise would bind to calcium or zinc. Removing lead from the body safely remains a major challenge.

Today, lead is essential to the manufacture and operation of many high-tech products. Lead solder is a reliable method of connecting transistors and other electronic components, and without leaded glass, we could not safely sit in front of our computer screens. Lead is the best material for nuclear radiation shielding and allows for the safe operation of CAT scans and other imaging diagnostics.

I have been a Wisconsin Badger for more than 30 years. The nickname of the state, and the mascot of the University of Wisconsin, Madison, are derived from lead. Lead mining in southwestern Wisconsin was one of the state's first industries. During the 1830s, lead miners, mostly young, single men, came up the Mississippi and Wisconsin Rivers from St. Louis and points south to spend their summers digging for lead. Not wanting to waste time on frills like housing, they lived in dugouts in the sides of hills. Some residents said they lived like badgers, a derogatory label they adopted with pride.

Bassam Z. Shakhshiri is professor of chemistry at the University of Wisconsin, Madison. His annual "Once Upon a Christmas Cheery in the Lab of Shakhshiri" is in its 34th year and is presented on PBS and cable stations.

LEAD AT A GLANCE

Name: From the Anglo-Saxon *laedan*, lead. The symbol is from the Latin word for lead, *plumbum*.

Atomic mass: 207.2.

History: Known to ancient civilizations. Alchemists believed lead to be the oldest metal and associated it with the planet Saturn. They also believed it could be transmuted into gold.

Occurrence: Usually obtained from galena (lead sulfide). Elemental lead is found only sparingly.

Appearance: Bluish white, soft metal.

Behavior: Lead is moderately toxic by ingestion and is a cumulative poison. Lead is very soft, highly malleable and ductile, a poor conductor of electricity, and very resistant to corrosion.

Uses: Used in batteries, glass, solder, radiation shielding around X-ray equipment and nuclear reactors, cable covering, plumbing, and ammunition. Lead was once used extensively in paints but has been phased out of most to eliminate health hazards.



GETTING THE LEAD OUT

University of Wisconsin, Madison, mascot Bucky Badger, named after Wisconsin's former lead miners, pours colorless potassium iodide solution into a colorless solution of lead nitrate, forming brilliant yellow, solid lead iodide.

PHOTO BY BRENT NICASTRO