Published on *American Council on Science and Health* (https://www.acsh.org)

Two Drops of Death: Dimethylmercury

By Josh Bloom — June 6, 2016

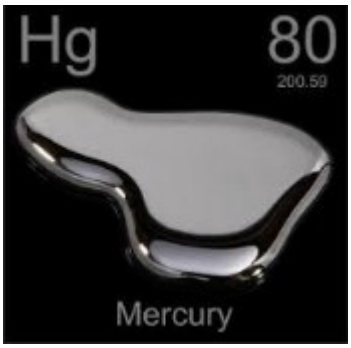

Photo credit: liquidmercury.net

In 1996, Professor Karen Wetterhahn, an organometallic chemist **(1)** at Dartmouth College, was running an experiment that required the use of a chemical called dimethylmercury, a colorless, volatile, sweet-smelling liquid**(2)**. She was using all proper safety precautions — protective clothing, gloves, and most important, a negative pressure fume hood**(3)**. During the transfer, Wetterhahn spilled one or two drops of the liquid *on the back of one of her latex gloves***(4)**. After five months, she began to display symptoms of severe neurological impairment, and was hospitalized. Three weeks later she slipped into a coma. Five months later she was dead from mercury poisoning. There was nothing that could be done to save her life, including chelation therapy**(5)**.

Professor Karen Wetterhahn (1948-1997)

Diane Stearns, one of Wetterhahn's post docs, visited her after she became comatose. Her *words were chilling* [1]*:* "She was thrashing about. Her husband saw tears rolling down her face. I asked if she was in pain. The doctors said it didn't appear that her brain could even register pain." I have written before about chemicals that are to be avoided if possible, such as t-butyllithium [2] and fluorine [3]. These are a teaspoon of honey compared to dimethylmercury. However, not all mercury-containing chemicals behave like dimethylmercury. Far from it. To understand this accident, which many consider one of the worst laboratory incidents ever, we need to talk about

different forms of mercury. They range from almost harmless to what is arguably the most dangerous chemical of all. All mercury is not created equal. Far from it.

- Elemental mercury (metal): This is the shiny liquid that you probably played with as a kid. When mixed with other metals, it forms an amalgam [4]. Silver-mercury amalgams have been used for dental fillings for almost 500 years. Despite scare tactics used by "holistic dentists" in the 1980s, which caused many people to have all of their amalgam filling replaced, three large studies, including a 2014 Cochrane Review [5], which concluded, "[There is] insufficient evidence to support or refute any adverse effects associated with amalgam or composite restorations" have debunked that myth.

Drinking mercury liquid itself is surprisingly safe**(6)**, since it passes through the digestive tract without being absorbed. This makes it a rather effective laxative, and was used as such in Asia thousands of years ago. But mercury was rare and valuable, so it had to be recovered from the stool (just in case you think *your* job sucks) and reused. Although this "profession" no longer exists, it could be argued that it has evolved into a similar one: politics. While ingestion of metallic mercury is relatively safe, the same cannot be said for its vapor. Mercury vapor is dangerous, since it is absorbed from the lungs into the blood and distributed throughout the body.

- Mercury salts: These are chemical derivatives of elemental mercury that are formed when it is reacted with certain chemicals, such as strong acids. Mercury salts are more toxic (orally) than mercury metal, but there is a wide range of toxicity, which depends mostly on water solubility. Mercury sulfate and mercury iodide are essentially insoluble in water**(7)**, so they tend to pass through the digestive tract without being absorbed, which makes them less toxic (but *not* non-toxic) than soluble mercury salts, such as mercury nitrate.

- Organomercury compounds: Of all the forms of mercury, these are the worst. When mercury is chemically bound to carbon it is readily absorbed into the blood, which makes organomercury compounds far more toxic than the other forms. The most common of these is methylmercury. It is bad news [6]. And, we unknowingly made a lot of it. Since mercury sulfate is so insoluble in water, it was assumed (many years ago) that disposing of the stuff in lakes/rivers etc. wouldn't cause problems. That was, until it was discovered that certain bacteria in the water converted the mercury sulfate into methylmercury, and this ended up introducing a considerable amount of mercury into the environment. And, of course, dimethylmercury — the chemical that killed Professor Wetterhahn is an organomercury compound, and is, of course, far worse than methylmercury.

If you are interested in more detail on this horrific accident, you can find a good summary here [7].
NOTES: (1) Organometallic chemistry is a subset of organic chemistry in which metals are bound directly to carbon. The properties of organometallic compounds are very different from organic (carbon-containing) chemicals. They are usually very chemically reactive, which makes them useful reagents for chemical transformations.

(2) "Sweet-smelling" may not sound too bad, but by the time someone has inhaled enough to detect the scent, he or she has already been exposed to dangerous levels of the chemical.

(3) Fume hoods are essential safety equipment in all labs. They operate by negative pressure, so

any fumes, vapors, etc. are sucked into vents and expelled outside the facility.

(4) In what must be one of the most awful ironies in science history, Wetterhahn was an expert on how toxic metals are able to penetrate cells. But, at the time, no one knew that *dimethylmercury easily penetrated latex*. Had she used a better glove, the accident would have been avoided.

(5) Chelation therapy is almost all quackery — something cooked up that is supposed to "detoxify" you by removing "all the poisonous heavy metals" from your blood. The only problem with this is that whatever heavy metals you may, or may not, have in your blood are there in such minuscule amounts that they are doing you no harm-unlike chelation therapy, which can be dangerous. The only legitimate use for it is real heavy metal poisoning, or excess iron. And, it only works so well.

(6) Although drinking mercury is safe, it is difficult to drink it without also inhaling some of the vapors. So, people who used it as a laxative often were poisoned by the vapors.

(7) A good analogy here is barium sulfate, which is routinely used as a contrast agent for visualization of the gastric tract. Barium salts are quite toxic, however, barium sulfate is so insoluble in water that it cannot be absorbed. This is why you can (although won't enjoy) drinking a quart of the vile stuff for an upper GI test.
