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Toxic Substances
Module 12
Mercury and the Troll

I don't know what I was thinking. How could a cave be a short cut? Nevertheless, there I was, deep underground and quite hopelessly lost. There isn't much in a cave to get a sense of direction and I had, in my arrogance, ignored all safety precautions like a rope or marking my way back to where I started or spelunking buddy. No one even knew I was down there.

Then I thought I saw something. Was that a light? It didn't look quite right, but it was the best option for a woman whose flashlight batteries were nearly gone. So I carefully made my way toward the light and found myself in a chamber filled with an eerie bioluminescence. There were plenty of exits from the room, but no way to know which might take me out and which might lead me deeper into the earth.

I heard a noise and turned toward it, shining my flashlight into a corner where I saw a being that could only be described as a troll. He was large with skin that had obviously not seen sunlight in a long time and large eyes designed to maximize his ability to see in the dark. Despite his pallor, I notice that his nose, cheeks and lips were very red and he had very little hair. He was also drooling and his hands were shaking.

He was not a comforting sight. However, he was my best, if not only, hope of getting out of the cave. So I carefully asked, "Please, sir, could you show me the way out of this cave?"

"Why should I?" He replied. "I am tired, my tummy hurts and I don't like the light anyway."

"If you don't help me I will never find my way out. I could die down here."

"So what," he said, "the death of another coward will not be a loss to the world."

"But I am not a coward," I protested.

"Prove it," he said. "I have three vials of poison here." As I followed his unsteady progress with my flashlight, he brought three small vials from a cubbyhole behind him and placed them on a rock in the center of the chamber. "Choose one and drink it. Then I will show you out."

"Don't you mean 'I will show you out if you survive?'"

He laughed. It wasn't a pleasant laugh and it showed his missing teeth and the gray inside of his mouth. "These are mercury poisons. They don't kill you right away. You might last for hours, even months, but then you will get very sick and very crazy before you die."

It hit me then. There must have been a lot of naturally (or perhaps unnaturally) occurring mercury in this cave because the troll had many of the symptoms of chronic mercury poisoning. The flushing of his cheeks, nose and lips was part of a syndrome called acrodynia or "pink disease" from a hypersensitivity to mercury. The tooth loss, tremors, photophobia, gray mouth, hypersalivation and obvious craziness were also symptoms.

I looked at the vials. There was an equal volume of substance in each that appeared to be just a few drops. He held up the first one. The substance in it was a clear, colorless liquid. "Methylmercury," he said. "Surely anything organic is really safe."

I knew better. "Organic is safe" is just marketing. In reality, the organic addition to the mercury made it more dangerous. The methyl group makes the mercury more lipophilic. Therefore it is easily

absorbed into the body and 90% of it is absorbed in the GI tract. The lipophilicity of the material also lets it easily cross the blood-brain barrier so that the mercury can accumulate in the brain. I even heard about a chemist who died just by getting a few drops on her hands. The ultimate cause of death is neurological degeneration...no way I was going near that stuff.

The troll set down the first vial and picked up the second one. It contained a white powder. "Mercuric chloride," he said, "like sodium chloride."

Not exactly like sodium chloride. The body uses both sodium and chloride ions. It has no use for mercury ions, but nevertheless they love to bond to biological sulfur groups and screw up enzymes and other protein structures. At least only 10% of it is absorbed in the GI tract. I might be able to survive that one.

The troll traded the powder for a third vial. The shiny metal was also a liquid. Even I could recognize that as metallic mercury. "Mercury metal," the troll said, "the poison in its purest form."

I hid my smile of relief. Mercury metal does not like to bond. Consequently, it is only negligibly absorbed in the GI tract. It gets eliminated before it can be absorbed. For all practical purposes, it is nontoxic. Now if he were asking me to breathe its vapor as he heated it up, that would be another matter. It can sit in the lungs and eventually be absorbed and you would end up poisoned after all. However, did the troll know that? It was probably a good idea not to enlighten him. He said he was testing my bravery, not my education (or my memory of chapter 92 of Goldfrank's...).

"I'll take that one," I said pointing to the vial of liquid mercury. "It's pretty."

He handed me the vial and I downed it quickly. After all, nontoxic is not the same as tasty. It felt weird going down my throat. It dropped fast, being thirteen times denser than water. "Which way out?"

He grumped a little and led the way through the rightmost tunnel. His walk was not well-coordinated (more mercury toxicity), but soon I saw a glimmer of light. I had just become sure that it was real sunlight and enough to be a door not a window when the troll said, "This is as far as I go."

I nodded. "Thank you," I said.

"We'll see if you feel that way next month," he made a sound that might have been a giggle and disappeared into the darkness.

I followed the light and did indeed find my way out. One month later, I passed by that cave exit again. I was feeling fine and appreciating the sunlight and admiring the new sign. It had recently been put there by the EPA after my anonymous tip. It read: Warning! Do not Enter! Mercury-contaminated Hazardous Waste site. I kept on going.

Young-Jin, S. "Mercury" in Flomenbaum, N.E. (ed): *Goldfrank's Toxicologic Emergencies*, 8th Edition. New York: McGraw-Hill, 2006.