Sounding out metal toxicity

by Joan Arehart-Treichel

During the past few years, environmentalists have been taking a close look at the sources, distribution and effects of trace elements. They now have a fairly good idea of which elements are beneficial to health and which elements are hazardous (SN: 6/6/70, p. 560; 8/14/71, p. 112). The harmful elements are mostly the heavy metals, such as lead, nickel, cadmium and mercury.

When these metals are present in man or animals in high enough levels, they are highly toxic, even lethal. Lead causes central nervous system deterioration, possibly mental retardation. It settles in bone and soft tissues such as liver and kidneys, and causes anemia by inhibiting enzymes that make hemoglobin. Methyl mercury attacks the central nervous system. Nickel goes for the lungs, cadmium for the kidneys. Nickel and cadmium can cause cancer in experimental animals. Cadmium, in fact, appears to be the most potent of all known carcinogens. One injection of the metal can induce tumors.

Aside from these more general physiological effects, the more intimate physiological and biochemical aspects of heavy metal toxicity are scarcely understood. Pharmacologists, toxicologists and biochemists are anxious to get at these basics. Some of the progress they are making toward this end was reported at the recent Fifth International Congress of Pharmacology in San Francisco.

A. P. Alvares and Attallah Kappas, pharmacologists at Rockefeller University, report that lead and methyl mercury can inhibit the major drug-metabolizing enzymes in man and animals. These enzymes are located in the liver. If lead or methyl mercury are thus present in the bloodstream in high enough amounts, the liver enzymes are not able to break down (metabolize) drugs as fast as they normally would. This is the first time, it appears, that anyone has reported that lead can impair these enzymes, although researchers at the National Institutes of Health recently found that mercury can do so.

"What these findings mean clinically, it's too early to say," Alvares told SCIENCE NEWS. He and his co-workers are now looking at the ability of lead to impair the drug-metabolizing enzymes in children who have been diagnosed for lead poisoning.

Toxicologist Arthur Furst and molecular biologist C. P. Flessel of the University of San Francisco and immunologist M. E. Kelly of California State University in San Francisco report that those heavy metals that are definitely known to cause cancer in experimental animals, such as nickel and cadmium, are carried in the bloodstream by albumins, whereas noncancer-causing metals, such as iron and zinc, are carried by globulins. Albumins and globulins are normal protein constituents of blood.

"This finding may or may not be a way of differentiating between metals that cause cancer and those that do not," Furst says. To find out for sure, his team will now be testing the carcinogenic potential of other heavy- and middle-weight metals, and will see which are carried by albumins and which by globulins. Furst doubts that lead is a carcinogen, although he admits some other investigators disagree with him.

Eddie Wei, R. C. Spear and Leonard Doberne of the University of California School of Public Health at Berkeley are pulling together all that is known about the presence of lead in the environment and the effects of lead on man and animals. Their goal is to set up a computer model that would predict whether persons might be exposing themselves to dangerous levels of lead. The computer model could be used to answer questions such as how much lead might a person pick up in his body during a work week in a particular environment. The model will primarily predict threats to a person's general body, Wei explains, since scientists need to learn more about what concentrations of lead produce toxicity and in what tissues of the body. About the only hard correlations that have been made are between brain levels of lead and death from lead poisoning. "If we had such information now," says Wei, "it would be a lot easier to predict what concentrations of lead would be toxic or not." Biochemical information about lead toxicity, he says, would also strengthen the model's predictive capabilities.

Furst, a consultant on heavy metals for the World Health Organization, anticipates that more information about the pharmacology and biochemistry of heavy metal toxicity should become available to the scientific community in November, when some of the world's authorities on the subject meet for a conference in Lyon, France. □