

On the trail of heavy metals in ecosystems

New reports trace effects of lead, cadmium and zinc on plants and soil

For years everyone assumed the industrial outfall of mercury would do a disappearing act—sink into the soil, streams, lakes and ocean bottoms. It is now known, of course, that industrial mercury doesn't disappear at all, but goes up the food chain and is keenly toxic to humans. Now, "because nobody knew a damn thing about mercury's effects on soil, plants, animals and man until a year or two ago," says Dr. Richard Miller, a Yale University biologist, scientists suspect that excessive amounts of other metals, especially the heavy ones, may be doing similar damage.

Thus during the past few months scientists have accelerated their efforts to detect an excess of two heavy metals of special concern, lead and cadmium (SN: 6/6/70, p. 560), and of the middle-weight metal zinc, in soil, air and plants. Then they are trying to determine what an excess might mean to the vegetation and perhaps also to those animals and humans sharing the same environment. Some of the results of this stepped up effort were reported last week at the annual meeting of the American Institute of Biological Sciences in Fort Collins, Colo.

Thomas Siccama of the Yale University Forestry Department described his studies of lead in the salt marshes around New Haven, Conn. The marsh serves as an interphase between land and ocean on the Eastern Seaboard and is a highly productive ecosystem. "Looking at lead in the salt marshes was easy," Siccama said, "since there is a salt marsh right in my backyard."

To examine the vertical distribution of lead in the marsh soil, Siccama dug



Thomas Siccama

Siccama testing marsh soil for lead content.



into the soil until the surface was considerably over his head. Natural and manmade events in the marsh record themselves through the years in deposits of sediment. He used these samples both as time markers and as monitors of changes in lead content. Although he found more lead in sediment that reflected a hurricane and the building of a railroad than in the general muck, on the whole the amount of lead found in soil on the surface of the marsh was 100 percent greater than in soil deeper down.

Siccama also found that the lead content of a Connecticut peat bog was higher near the soil surface. Little is known about how much lead from salt marsh soil finds its way into plants in the marsh, although the relationship would probably be noted in cattail roots. A student in Yale's biology department intends to look at this question. But Siccama did find abnormally high concentrations of lead in the bones of a muskrat dredged up from the marsh.

The concentrations of lead are also higher in the marsh and bog soil in urban and suburban areas, Siccama found, than in soil remote from cities and the suburbs. The lead content of soil was also higher near highways, presumably from automobile exhaust. He found insects collected in his backyard had a higher lead content than insects collected in the Green Mountains of Vermont.

Says Siccama: "As a scientist I'll state the facts. Although a little lead might stimulate plant growth [SN: 8/14/71, p. 112], twice as much lead in soil than is normally present just

has to be bad for plants and animals. But the results of other studies should also be considered before anyone decides exactly how much lead is beneficial or harmful for this or that plant or animal, or for man."

Siccama's results, in fact, dovetail with those reported this week by an ad hoc panel of the National Research Council stating that atmospheric lead is almost exclusively an urban problem. Due largely to the use of lead additives in gasoline, the panel reports, the air in the largest American cities has a concentration of lead 20 times greater than air over rural areas and as much as 2,000 times greater than air over the middle of the Pacific Ocean. Heavy contaminations of lead are found in street dust, the soil of city parks and in narrow bands along major roadways, but the soil and water in rural areas show little evidence of contamination from burned lead alkyls. Two to three times as much lead enters the total environment from weathering, dumping and burning of paint pigments and metallic products than it does from leaded fuel, however.

As far as the panel can now determine, the high concentrations of lead in the air of central cities constitutes a potential health hazard to young children and certain groups of workers, but does not pose an identifiable current threat to the general population. The average American, even in cities, seems to consume more lead in food and beverages than he inhales from the air. Because of insufficient data, though, the panel calls for more studies of lead in food and drinking water.

At the AIBS conference, Dr. Thomas Nash of Arizona State University reported his study on the effects of effluents—zinc, cadmium and sulfur dioxide—on lichen between a zinc smelting plant in Palmerton, Pa., and the Delaware Water Gap. He found that the lichen on rocks and trees stretching from the plant some four to five miles toward the water gap were “in bad shape.” Zinc, the primary metal emission from the plant, was found in the lichen in large amounts. Cadmium, the secondary metal emission from the plant, was found in the lichen in lesser amounts. Little sulfur dioxide was found. An insignificant amount of this compound escapes from the smelter. Culture studies told Dr. Nash that while a little zinc stimulated the lichen, higher concentrations, such as those found in lichen near the smelter, were harmful.

Dr. Marilyn Buchauer of Rutgers University tackled the same locale to

determine the effects of zinc, cadmium and sulfur dioxide on higher plants and trees. Nearly all plants or trees extending from the smelting plant some three miles toward the water gap, she reported at the AIBS meeting, were dying or suffering from metal exposure. Zinc was found in the vegetation in the greatest amounts; cadmium was second. Sulfur dioxide content was insignificant. Where fires had wiped out vegetation in the three-mile stretch, new plants and trees were slower to take hold.

“Whenever heavy metals are found in concentrations similar to those existing around the smelter,” says Dr. Buchauer, “there is similar potential for plant and tree damage.”

Says Dr. Nash: “The situation for vegetation near smelting plants looks bad, but it points up the hassle of deciding what chemical outfall should be permitted to industry and what contaminants should be arrested on behalf of the environment.” □

make dormant the moral and ethical propensities of man and subordinate, if not eliminate, his negative and primitive behavioral tendencies.”

In other words, psychotechnology must develop a pill for world leaders that could diminish their emotional ability to start a nuclear war. Dr. Clark says he recognizes the dangers involved in this type of control and is troubled that mankind should be in need of such measures. But he is convinced that a human psychotechnology must be developed before it is too late. “I expect questioning, criticism, even name-calling, but it seems to me that just opening the debate is necessary.”

The debate opened immediately, and strong disagreement was registered. Said Dr. Karl H. Pribram of Stanford University: “The normal brain is beautiful. There is no demoniacal animal or force lying within that needs chemical treatment.” He was joined by Dr. Herbert C. Kelman of Harvard University, who said, “You cannot manufacture a human personality that can’t go wrong so long as institutional arrangements permit abuses of power.”

Dr. B. F. Skinner, the Harvard psychologist and educator who has also received much criticism in the last month for his newly published theories on social control and behavior modification (SN: 8/7/71, p. 96), presented a somewhat different view. Discussing the claims of his new book *Beyond Freedom and Dignity*, Dr. Skinner said he is not “for introducing new controls” (as is Dr. Clark). He only wants to modify existing controls. Punitive or coercive control should be replaced by various incentive programs and positive reinforcement. This, Dr. Skinner states, will “mobilize the population to its fullest.”

The proliferation of nuclear weapons, he explains, goes on in the name of protecting individual freedom. World leaders, for example, feel they must arm themselves to ensure the freedom of their people. This reasoning, according to Dr. Skinner, is false. Once the idea of freedom is rejected there will be no need to protect it and therefore no fear of nuclear holocaust being brought about by power-hungry leaders.

Dr. Skinner’s position has been attacked by persons who “bet on the wrong horse,” he said, by those people who could not make it as true psychologists. And Dr. Skinner was at the APA convention not to defend himself but to receive honors as a “pioneer in psychological research, leader in theory, master in technology, who has revolutionized the study of behavior in our time. A superlative scholar, scientist, teacher and writer, he is revered by many for his services to all.” With these words he was awarded the APA’s annual Gold Medal Award. □

APA ANNUAL MEETING

The psychologist as social engineer

A feeling of social urgency surrounded the more serious aspects of last week’s annual meeting of the American Psychological Association in Washington. Discussions and symposia centered on such topics as genetics and I.Q., the effects of TV violence on children, family planning and overpopulation, pollution control and the relevance of research.

Instead of the usual reading of the reports of the executive officer and the treasurer, the APA held for the second year an open forum or town hall meeting where members were invited to present problems and issues to fellow members and to the board of directors. Dr. Jack Sawyer, a Harvard University psychologist and socially oriented member, condemned the APA for its ineffective use of influence to halt segregation in the industries the APA does business with. And a group of women psychologists thanked the board for using the word “chairperson” rather than “chairman,” but argued that too much sexual discrimination still exists within the APA and in the academic world. Both views were well accepted by the members attending.

One view that was not so well accepted was presented by Dr. Kenneth B. Clark in his presidential address to the APA. Dr. Clark, of the City College of New York, is a prominent authority on racism and desegregation. But he addressed himself to the psychological perspectives of power. His research, he says, has “tended to reinforce my ideas concerning the fragility of the human ego.” And this “pathetic vulnerability of the human ego may be illustrated by



APA

Clark: How to control our leaders.

the insight that the most ruthless, power competitive individual may be driven by an insatiable need to be loved and accepted by others. Nowhere can such an individual obtain enough actual power to disguise from himself the essential fact—the intolerable fact—of his own essential powerlessness. In such extreme cases the drive for power blocks or destroys the capacity to love and to be loved and thereby strengthens the cycle of self-defeating obsession with power.”

This obsession with power is especially dangerous, Dr. Clark believes, in an atomic age where the possibility of nuclear war is at the fingertips of world leaders. He therefore suggested that “we might be on the threshold of that type of scientific, biochemical intervention which could stabilize and