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RACHEL'S HAZARDOUS WASTE NEWS #270

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EPA'S DIOXIN REASSESSMENT--PART 2: DIOXIN DAMAGES HUMAN IMMUNE SYSTEM

U.S. Environmental Protection Agency [EPA] is presently reassessing the dangers of dioxin, one of the most toxic chemicals ever tested on laboratory animals. As a result of animal tests, EPA has declared only exceedingly small amounts of dioxin "safe" for the human food supply. Americans eat food routinely containing roughly 10 to 100 times more dioxin than EPA considers safe. [SEE [RHWN #269.](#)]

No one makes dioxin intentionally, but many industries create dioxin as a byproduct of their main activity. Industries that emit dioxin into the environment (paper, plastics, chemicals, and solid waste incinerators) are being sued for their emissions by citizens claiming harm from exposure, and one industry--paper--faces billions of dollars in lawsuits.

Partly to please the paper industry, and partly because there were new scientific findings worth considering, EPA chief William Reilly announced a year-long dioxin reassessment to begin in April, 1991.

Now, nine months into the year-long process, EPA scientists responsible for parts of the reassessment have begun talking openly about new findings that make dioxin seem as bad as, or worse than, EPA used to think.

For two decades dioxin has baffled toxicologists. They are used to seeing cancer-causing chemicals that predominantly cause cancer in one organ or another--like asbestos, which chiefly affects the lungs, or benzene, which chiefly affects the blood-forming cells, causing leukemia. But dioxin seems to cause cancer in many organs, raising the general level of cancer in a population without causing a huge increase in any one type of cancer. In addition, dioxin causes certain toxic effects in one species and other effects in another species. Likewise, dioxin at low doses causes one kind of illness, and at higher

doses it causes different illnesses. Only recently have EPA scientists concluded that this puzzling pattern occurs because dioxin acts like an "environmental hormone." Hormones are potent natural chemicals that send messages via the bloodstream, turning on and off chemical switches throughout the body, creating an array of effects in different organs. Dioxin behaves this way. Hormones are present in the body in tiny amounts, yet they can trigger huge changes in various bodily systems. For example, it is hormones that trigger the different stages of growth in a fetus, and that cause young humans to go through puberty.

New Information

EPA chief William Reilly was right--there IS new information about dioxin. But it won't be reassuring to the paper industry. On the contrary, two studies of workers exposed to dioxin, published during the past year, have shown unmistakable increases in cancers of several types. A study of 5172 American workers revealed a cancer rate 46% above the norm.^[1] Likewise, a study of 1583 German workers revealed a cancer rate 39% above the norm; among German workers 20 years on the job, the rate was 82% above the norm, and among the most heavily exposed Germans workers, the cancer rate was three times the norm.^[2] Notably, among female German workers, the risk of breast cancer was doubled. Whereas a year ago one might have argued whether dioxin had ever been shown to cause cancer in humans, now such arguments are only voiced by the kind of people who say it still isn't proven that cigarettes cause lung cancer.

Linda Birnbaum, one of the scientists conducting EPA's reassessment of dioxin, says these two studies have convinced her that dioxin causes cancer in humans, at least at relatively high exposures. But, she told SCIENCE NEWS (January 11, 1992, pgs. 24-27.), she has an even greater concern about dioxin: "I'm very concerned that much lower exposure to dioxin may result in adverse health effects that are very subtle and difficult to detect." She was talking about dioxin's impact on the immune system.

The immune system is an exceedingly complex network of organs, cells, and chemical secretions (hormones) that react to preserve health in the face of a vast array of hostile microorganisms and toxicants that our bodies encounter every day. The immune system fights against common colds, influenza, and the body's own cells that go haywire and start to multiply uncontrollably (a definition of cancer).

A degraded immune system leaves the body less able to defend itself against hostile forces in the natural environment. Dioxin attacks the immune system.

EPA's dioxin reassessment will "focus much greater attention on toxicological data revealing TCDD's [dioxin's] reproductive, developmental, and immunotoxic effects," says SCIENCE NEWS. Immunotoxic means toxic to the immune system. Furthermore, "This document [EPA's draft reassessment][will also establish TCDD as the first pollutant to be regulated on the basis of toxicity observed at the cellular level."

This is one reason why the dioxin controversy is being followed so carefully by industry and by environmentalists. It promises to set precedents in the way chemicals are regulated in the future. In the past, chemicals were considered harmless if they caused no "clinical" damage (damage your family doctor might detect). Now, with the dioxin reassessment, evidence of chemical changes inside individual cells is being considered important to a person's well being.

"So far, studies in mice suggest that dioxin's immunotoxic punch occurs in extremely low doses and may well be more important than cancer in determining dioxin's primary health risk," says Birnbaum."

To study TCDD's toxicity to the immune system, researchers use mice, whose immune systems model those of humans. For example, EPA researchers have measured how well TCDD-treated mice withstand the influenza virus. Mice pre-treated with TCDD readily die after exposure to a quantity of virus that rarely kills healthy mice.

Naturally, it would be very difficult to detect such effects in people. If people exposed to unusually high levels of dioxin, say from a solid waste incinerator, had damaged immune systems and consequently experienced various illnesses, no one might ever suspect dioxin as a cause.

People might question whether some of dioxin's low-level effects represent real harm to people, but "... few people will contend that suppression of the immune system is not an adverse health effect," Birnbaum told SCIENCE NEWS.

Unlike hormones, which remain in the body only a few hours, dioxin has a half-life in the body of seven years. At the end of one half-life, half the initial dioxin remains. What this means is that dioxin has, relatively, a very long half-life in the body, unlike the hormones that it mimics, so it stays around to play havoc with the body's chemical systems year after year. "Thus one TCDD [dioxin] molecule can continuously disrupt normal cell physiology," says SCIENCE NEWS, citing work by well-known dioxin researcher Thomas A. Gasiewicz at the University of Rochester (NY) Medical School. EPA's Birnbaum, and Michael Holsapple, a well-known di-oxin researcher at the Medical College of Virginia, say studies of humans at Times Beach, Missouri, and of Vietnam veterans, were essentially bungled. Holsapple says, "If I were to take mice and ask the same [research] questions that are routinely asked of the populations of Times Beach or in the Ranch Hand study [of Vietnam vets exposed to dioxin-contaminated herbicide], I would come up with a very nebulous picture [of dioxin's immunotoxicity]," says Holsapple. "But when we ask different questions [in mice], we can certainly show very strong effects on the immune response," he says.

Is there a threshold for dioxin's damage to the human body? Is there a level of dioxin below which no effects can be observed? George Lucier of the National Institute of Environmental Health Sciences in Research Triangle, North Carolina, has been asking this question in his laboratory. His data show no evidence of any threshold. "My data might not prove that a threshold doesn't exist," he told SCIENCE NEWS, "but there's also no evidence of any thresholds." In other words, any amount of dioxin does some damage, according to Lucier's findings. This means the only safe amount is zero.

This conclusion is not what the paper industry wanted to hear when its executives urged William Reilly to initiate EPA's dioxin reassessment. As the reassessment reaches its draft stages early this summer, we'll have new measures of the potency not only of dioxin, but also of industry's muscle in a contest with unwelcome scientific conclusions.

For all of us, much is riding on the outcome.

--Peter Montague, Ph.D.

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[1] Marilyn Fingerhut and others, "Cancer Mortality in Workers Exposed to 2,3,7,8-tetrachlorodibenzo-P-dioxin," NEW ENGLAND JOURNAL OF MEDICINE Vol. 324 (1991), pgs. 212-218.

[2] A. Manz and others, "Cancer Mortality Among Workers in Chemical Plant Contaminated With Dioxin," THE LANCET Vol.

[338] (October 19, 1991), pgs. 959-964.

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