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academic ecologists are quite willing to help, fewer have the requisite information, and fewer still the time to fulfill satisfying roles as advisors. Because of the structure of the universities themselves, science professors do not become involved in the affairs of government at a level other than that of the occasional testimony at a hearing. Universities were intended for teaching and research, and the reward structure is so oriented. A professor who is asked to supply a detailed memo on a topic of immediate concern to a congressional committee cannot drop other responsibilities for 2 weeks while he completes the task. Not, that is, unless universities provide some mechanism and incentive to make such involvement possible. Allowing interested professors a term off, at full pay, independent of sabbatical leave, to research some issue of concern to Congress, is one possibility. Encouraging a professor to spend sabbatical leave in Washington, and giving credit to such experience when promotions are made, is another. Acknowledging the merit of research of an immediate and applied nature, is a third. These are certainly departures from traditional academic roles. Those university administrators who proclaim a desire for university involvement in community affairs need to determine whether the priorities and rewards characteristic of their own institutions are at all conducive to such activity.

In addition to a lack of professors' time, there is currently a deficiency of requisite environmental information. This phenomenon may stem from the stigma still attached to applied research in some circles of academic ecologists, as well as to the difficulty of doing such research without the sponsorship of a government agency or company with a bias about the desired results. The new Institute of Ecology, the RANN (Research Applied to National Needs) program of the National Science Foundation, and the National Environment Center bill (S.1113) which has passed the Senate, may help the latter situation.

Clearly, there is much more that politicians could do to encourage the involvement of academic scientists—publish in *Science* or elsewhere an account of current problems that need to be solved; embrace facts offered in their full complexity, without simplifying problems to the extent that scientists are turned off; support the appropriation of funds for long-term basic research and immediate problem-solving research.

At the same time, immediate steps can be taken within the universities to bring the expressed concern for involvement in environmental problems, and incentives for such involvement, into closer consonance.

WALTER E. WESTMAN
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Technology Assessment

The report on the Office of Technology Assessment (News and Comment, 3 Mar., p. 970) contains an unfortunate non sequitur which might lead some readers to infer that Raymond Bowers and I feel that our technology assessment of microwave devices (*1*) was a complete assessment —even though we did not consider the social impact of the use of these devices.

The original title of our paper, when it was given at last summer's Cornell Conference on High Frequency Generation and Amplification, was "A preliminary technology assessment of solid state microwave devices." Within the *Scientific American* article itself, we admitted that, "Our attempt cannot be comprehensive. . . . We hope these first steps will lead to an analysis of broader social implications."

We agree entirely with the Congress that technology assessment must include the "physical, economic, social, and political" effects of a technology.

JEFFREY FREY
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1. R. Bowers and J. Frey, *Sci. Amer.* **226**, . . (Feb. 1972).

PCB's in the Environment

It is simple to assert that an event, having once occurred in a laboratory, "may" take place again. Thus it took no great foresight for Mosser *et al.* (14 Jan., p. 191), in their study of the effects of polychlorinated biphenyls (PCB's), to conclude:

Selective inhibition of sensitive phytoplankton species by PCB's, DDT, and other stable pollutants in the environment may alter the species composition of natural algal communities. . . . Such effects at the base of aquatic or estuarine food webs could profoundly affect higher organisms as well.

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Letters

Ecologists

Paul Sear's defense of ecology (Letters, 22 Oct. 1971, p. 360) is well stated, but for the sake of perspective more should be said. One of the most unfortunate things a fighter can do is to go into battle with unjustified confidence in his weapons of defense. Our environmental problems merit the most competent thought and attention that civilization can muster. It is important to recognize, therefore, that the necessary leadership and know-how for solving these problems cannot come *solely* from those who call themselves professional ecologists.

Ecology is beginning to develop a structure of conceptual theory. Professional ecologists who are predominantly field biologists have knowledge of particular field situations that is invaluable. But ecologists generally cannot identify organisms with the competence of a taxonomist. They are seldom well versed in physiology, epidemiology, pharmacology, or toxicology. Their training in mathematics, chemistry, and physics is usually not strong. Their formal acquaintance with the humanities and the social, economic, and political sciences is usually limited. Ecologists have a heritage of pride in studying the "natural," which by their definition has not included man, and an anathema for the applied. They generally are not acquainted with the problems or practices of engineering or agriculture and often have no detailed knowledge of management practices for forests, wildlife, fish, water, or soils. Doctoral degrees are awarded by our "best" graduate programs in ecology to people who do not know the names of the plants and animals in their region that are agriculturally most important. Most ecology programs are housed in departments of botany or zoology, and many departments in each of these disciplines actively discourage students from becoming deeply involved in the other, let alone in the social, physical, or applied sciences.

With the possible exception of a few outstanding individuals, of which Sears is one, the profession of ecology has not attained the ideal of producing versatile generalists to guide our efforts to solve environmental problems. To my knowledge, no adequate program for selecting and training such individuals has yet been planned. When one is, the strategies for neutralizing territorial defenses that will have to evolve if such a program is to survive and be successful will undoubtedly change the whole face of higher education.

I have been discouraged to see a chain of editorials and comments appearing in professional ecological publications during the past year which bemoan the rising involvement of "nonecologists" in environmental problems, which urge "ecologists" to unify in efforts to minimize this involvement and to prevent "nonecologists" from taking "center stage," and which cry vacuously, "Who shall speak for Ecology?" It is relevant that the phenomenal increase in concern about environmental problems that has developed in the past 3 years has not been due primarily to the efforts of professional ecologists. More clarity of thinking, openmindedness, and humility are in order. Our environmental crises are serious enough to demand that we give up the luxury of professional snobbery, roll up our collective sleeves, and do what we can to cope with them while encouraging others to do the same.

To those from whom these remarks draw fire, I pose the following questions: (i) What is an ecologist? One who has graduated from a curriculum bearing the name "ecology"? A member of a professional "ecological society"? Or one who holds the "point of view" (*1*) that an organism's interactions with its environment are important, and who seeks to rigorously define the natural rules by which these interactions are determined? (ii) Which academic programs in ecology now attract and hold students of a caliber comparable to those in our better schools of medicine? (iii) Which offer a breadth and depth of training that will minimize the deficiencies I have mentioned? If none, which I strongly suspect, what are the deficiencies and limitations of the best, and how might they be most quickly corrected?

BRUCE L. WELCH
Friends Medical Science Research Center, Inc., 52 Wade Avenue, Baltimore, Maryland 21228, and Johns Hopkins University, Baltimore, Maryland 21205

References and Notes

1. H. J. Oosting, personal communication, 1959.

I see a need to improve the institutional incentives for the involvement of university ecologists in environmental affairs. In the spring of 1970, around the time of the first Earth Day, there was a cautious optimism among students and other citizens about ecopolitics. At Cornell University, the optimists were saying, "Despite our misgivings about politicians, we think ecologists have a lot to contribute to politicians who are writing environmental legislation." A group was subsequently formed in Ithaca that successfully raised donations to send an ecologist to Congress as a full-time adviser for 1 year—I began work as an adviser to Senator Muskie's Subcommittee on Air and Water Pollution in early 1971.

My role was to transfer ecological information from academia to the Congress. It was assumed that ecologists had the information, time, and willingness to help Congress write its bills and that politicians were eager to have objective scientific input to help unravel the complex issues of the environment.

In pursuing my task, I organized a group of faculty and graduate students in environmental sciences at Cornell who expressed a willingness to supply information regularly; I enlisted undergraduates from an environmental course who were willing to conduct bibliographic searches; I consulted a panel of advisers to the Public Works Committee, contacted scientists around the country, wrote newsletters and letters of inquiry, and gave lectures on topics of current environmental concern in Washington.

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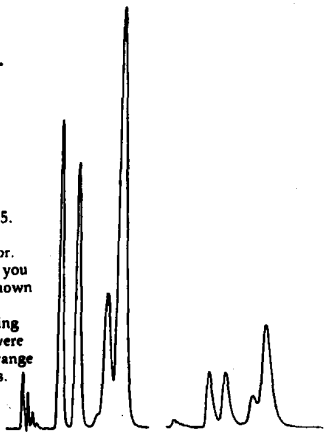

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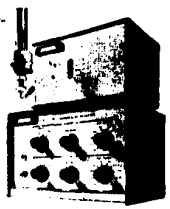

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The authors' conclusion that selective species alteration "may" occur is indisputable but obvious, since the addition to an ecological system of almost any *long-lived contaminant is likely to alter* species composition.

An estimate of the probability of ecological damage likely to occur as a result of PCB usage would have been meaningful. C. G. Gustafson (*1*) has pointed out that "All studies of PCB's in animals indicate that acute toxicity is not a significant factor . . . ," and, further, "Compared to DDT . . . PCB's have a relatively low acute toxicity. . . ." That PCB's "could profoundly affect higher organisms" is dubious because, as the authors failed to mention, PCB distribution is much more tightly regulated than it was a few years ago, and the levels prevalent in the environment are likely to cause little, if any, harm to plants or to animals. Statements to the contrary sound like the fantasies that robins are "on the verge of extinction" (*2*), and that the supply of planetary oxygen could diminish as a result of DDT usage.

CYRUS ADLER
Science for the Citizen Program,
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1. C. G. Gustafson, *Environ. Sci. Technol.* **4**, 815 (1970).
2. R. Carson, *Silent Spring* (Houghton Mifflin, Boston, 1962).

The alteration of species composition within phytoplankton communities is indeed the expected result of differential sensitivity to long-lived environmental contaminants, but documentation for its occurrence is lacking. Our laboratory studies (*1*) provide suggestive evidence that it may occur with PCB's and DDT, among the most widespread of all pollutants. We cannot assess fully the ecological significance of our findings because we do not know to what extent such alteration is occurring in nature, but we doubt that our conclusions can be considered "fantasies." We would point out that we have never subscribed to the theory that DDT (or PCB) usage could diminish the earth's oxygen supply (*2*). Hopefully, our reports will lead to the required studies on natural algal populations.

Acute toxicity tests with animals have no bearing on the potential hazard of *phytoplankton species alterations* by PCB's or DDT. Changing the food source at the base of a food web would be expected to affect animals higher in

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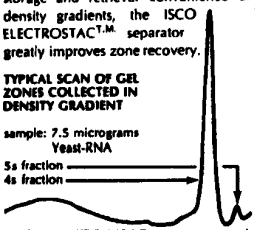

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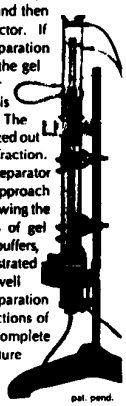

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the web, since many herbivores have specific food requirements. Higher organisms therefore need not be directly sensitive to these substances to be affected.

The tight regulation that Adler claims for PCB distribution has not been manifested by any decline in PCB concentrations in environmental samples. Furthermore, we are aware of no law that permits regulation of their escape into the environment. Pesticides, at least, can be regulated under the Federal Insecticide, Fungicide and Rodenticide Act, but PCB's are not pesticides. Who, then, is tightly regulating PCB's?

We believe that the environmental impact of a chemical should be studied before it is released into the environment; DDT and the PCB's were released first and studied later. Assurances of safety based on little or no evidence, such as those by Adler, are no longer sufficient for most environmental scientists. Too often these assurances have proven misleading and naive.

JERRY L. MOSSER
NICHOLAS S. FISHER
TZU-CHIU TENG
CHARLES F. WURSTER
Marine Sciences Research Center, State University of New York, Stony Brook 11790

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1. J. L. Mosser, N. S. Fisher, C. F. Wurster, *Science* 176, 533 (1972).
2. C. F. Wurster, *ibid.* 159, 1474 (1968).

Canceled Invitation

I was invited to attend the 2nd International Ocean Development Conference and Exhibition, which will be held in Tokyo, Japan, from 4 through 9 October 1972. My paper "Strontium distribution in sea waters from the South China Sea" was accepted for presentation.

However, because several oceanographers from Communist China were later invited to participate, my invitation was canceled by the chairman of the organizing committee, Seiichi Tagawa. Apparently, politics is governing science at the conference, which is not only regrettable, but also harmful to the world's scentific community.

JU-CHIN CHEN
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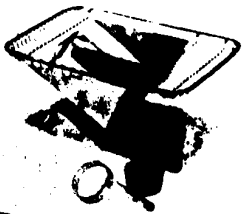

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