Book Reviews

Aroused Consciences

Harvest of Death. Chemical Warfare in Vietnam and Cambodia. J. B. NEILANDS, GORDON H. ORIANS, E. W. PFEIFFER, ALJE VENNEMA, and ARTHUR H. WESTING. Free Press, New York, 1972. xvi, 304 pp., illus. $10.

Since 1961, United States armed forces have used more than 100 million pounds of assorted herbicides to defoliate forests and kill crops in more than 6 million acres in Vietnam, an area roughly equivalent in size to the state of Massachusetts. We have also used more than 14 million pounds of so-called riot-control gases; one of these, Agent CS (*o*-chlorobenzalmalononitrile), pumped into underground bunkers, has undoubtedly caused the deaths of some people, although it is alleged to be nontoxic. In addition, when used as a prelude to carpet bombing by B52's, CS bombs have probably caused the death of Vietnamese flushed from underground bunkers, who might have survived the bombing had they remained underground.

The antiplant chemical warfare agents are alleged to have seriously affected about 10 percent of the agricultural lands of South Vietnam, one-third of the forested lands, and almost half of the extensive mangrove communities lining the estuaries. Possible side effects of these operations have been several kinds of ecological havoc including increased nutrient runoff from areas cleared of vegetation, increased soil erosion, invasion of forest areas by noxious weeds such as bamboos and Imperata grass, dislocations of animal and fish populations, induration of lateritic soils which have been deprived of organic matter and exposed to the baking action of the sun, and possible spread of diseases like bubonic plague due to migration of wild rodents toward urban areas. Superimposed upon all this is the possibility that serious malformations and stillbirths may have been caused in developing embryos of pregnant Vietnamese women who consumed as little as two to three liters of water per day after a usual spray of 25 pounds per acre of mixed 2,4-D and 2,4,5-T herbicides (Agent Orange). It has been conclusively shown that at least some of the Agent Orange used in Vietnam was contaminated with 2,3,7,8-tetrachloro-*p*-dibenzodioxin, a potent teratogen effective at a concentration of about 0.01 part per billion.

In a war already marked by Mylai and similar incidents, by the burning of entire villages and the enforced evacuation of inhabitants to relocation centers, and by the "protective reaction strikes" in which, whether by design or not, churches, schools, hospitals, and dwellings are hit, why should we be disturbed by the use of chemicals that nauseate or kill a few additional people and devastate a few million acres? How can one weep for a tree when there are few tears for the killed, the wounded, the uprooted and impoverished victims of the war? One of the answers seems to be that our massive use of chemical warfare agents adds a new dimension to the escalating horror of modern war; no nation besides the United States has used chemical warfare massively since World War I.

It is estimated that in World War I more than 125,000 tons of chlorine, phosgene, and mustard gas were used in battle; as a result, there were more than 1,300,000 casualties, including more than 100,000 killed. In World War II, despite a whole new armamentarium of weapons, not a single casualty was listed as due to chemicals. Why the difference? One reason, say many, is the Geneva Protocol of 1925, inspired and written but never ratified by the United States. This protocol has now been ratified by 84 nations, and of the major powers only the United States is not a signatory. This is an accident of history; ratification by the Senate was proposed at a time when a spirit of isolation and opposition to Wilsonian doctrines was growing in the United States. That spirit, plus the opposition by the chemical industry and other branches of the then military industrial complex, prevented favorable Senate action. The issue has remained dead until the present administration. Late in 1969, Richard Nixon proposed that the Senate reconsider ratification of the protocol, which forbids the use in war of "asphyxiating, poisonous or other gases, and of all analogous liquids, materials or devices." But the President, while asking the Senate for ratification, attached an "understanding" that herbicides and riot control gases were not included within the list of items proscribed. In a vote taken shortly after at the United Nations, 80 nations opposed this view and only three, including the United States, supported it. Our only allies in this losing fight were Australia and Portugal; the latter is currently using herbicides and gases against revolutionaries in Angola. The Senate Foreign Relations Committee understandably balked at approving ratification under terms which would invite others to make similar reservations and thus, in effect, undercut the treaty. It now seems that there is no hope of our ratifying the protocol while the war in Vietnam is going on.

Although the massive use of herbicides sprayed from fixed-wing aircraft has apparently been terminated in Indochina and the practice is now restricted to helicopter-based operations around the perimeters of base camps and along certain roadsides and waterways, the use of CS gas still continues, and the military seems to want to keep its options in chemical warfare open for the future. When one notes that the United States is a party to a United Nations Resolution of 1966 which calls for observance of the provisions of the Geneva Protocol of 1925, one can understand to what extent this massive chemical warfare in Vietnam has isolated and damaged the United States in the world community. It also explains why the issue of chemical warfare in Indochina has served to politicize previously uninvolved scientists and organizations.

The authors of this book are respectively a biochemist, two zoologists, a medical doctor, and a botanist whose consciences have been outraged by our

use of chemical warfare weapons in Indochina. Indeed, all of them reveal their understanding of a fact of which awareness has been growing slowly in all of America, that the bulk of the people against whom we are fighting in Indochina are united and determined to continue a struggle which for most of them began more than a generation ago and has proceeded uninterruptedly against Japanese, French, and now American invaders. With our superior technology and especially with our command of the air, we can go far toward "smashing them back into the stone age," as General Curtis LeMay is quoted as having advocated, but we can do so only at the expense of committing ourselves to a near genocidal policy of exterminating the Vietnamese as a people. By and large, we have decided that this is too great a price to pay, even for "containing communism." Accordingly, we have steered our policy between ending the war immediately ("surrendering to communism") and wreaking such destruction on the Vietnamese that the conscience of the world would be even more aroused than it has been recently. During my visit to North Vietnam in 1971, I saw both massive destruction caused by our bombs and an apparently unquenchable determination on the part of the North Vietnamese to continue the struggle. It was enough to convince me that the conflict must not and cannot be terminated by military victory, but only by negotiation, and that the time for negotiation is now, rather than later, when additional bloodshed and destruction will have made the situation even more desperate.

I know four of the five authors personally, and I think it is fair to say that all of them share the view of the war stated above; it is therefore not surprising that they decry our chemical warfare operations. Clearly if one accepts the Indochina war as a necessary operation, then one is not apt to be so bothered by U.S. transgressions against international law and by our use of chemical weaponry. There seems to be no neutral ground.

The book consists of four chapters. The first, by Neilands, documents the use of gas warfare in Vietnam; the second, by Vennema, is a brief treatment of medical effects of antipersonnel gases; the third, by Pfeiffer and Orians, chronicles the military uses of herbicides in Vietnam; and the fourth, by Westing, deals with herbicidal damage to Cambodia. The chapters are followed by several appendices, including documents such as the Geneva Protocol of 1925, a list of properties of toxic agents used in Vietnam, statements by President Nixon, Dean Rusk as Secretary of State, and the editor of *Chemical and Engineering News*, and finally a discursive review of chemical warfare by the Legislative Reference Service of the Library of Congress and an article by Philip Boffey in *Science* (**171**, 43 [8 Jan. 1971]) reviewing the work of the Herbicide Assessment Commission of the AAAS. The chapters are different in length and style. Neilands is personal, specific, opinionated, hard-hitting, frequently biochemically sophisticated, and bolstered by 341 references. Vennema is general, gentle, compassionate, brief, and without references. Pfeiffer, Orians, and Westing tend to be more objective and less passionate than Neilands, but the vigor of their arguments and occasionally their prejudices shine through. Despite the unevenness of the treatment, this book can serve better than any other to document how the aroused consciences of only a few individuals have had a major effect on the course of recent history.

It is to me a sad and sobering fact to recognize that, by and large, the American scientific community has been uninterested in its own complicity in the chemical warfare operations in Vietnam, or if interested has been unwilling to act, either from timidity, lack of involvement, or from approval of U.S. policies. In 1966, when I appeared before a business meeting of the American Society of Plant Physiologists (of which I had been president a few years earlier) with a letter addressed to President Johnson asking for clarification of his policy concerning the uses of herbicides in Vietnam, I was met by a refusal of the executive committee even to schedule the item on the agenda for the open business meeting. When I arose to present the issue from the floor, I was able to get 12 additional signatures, enough to send the letter as a petition to President Johnson. This letter elicited a reply from an undersecretary of state, spelling out clearly that we were, in fact, using herbicides to kill crops and defoliate forests. At about the same time, John Edsall and Matthew Meselson of Harvard, acting as leaders of a petition campaign initiated by Milton Leitenberg, then on the staff of *Scientist and Citizen*, got 5000 scientists to sign an anti-chemical-warfare petition, which was presented to the President. Receipt of the document was acknowledged, but no reply was ever received from the White House. Meselson went on to become head of the Herbicide Assessment Commission of the AAAS, in which capacity, together with Westing and others, he conducted investigations, partly summarized in Boffey's article in the appendix of this book, which have not yet been published. In the meantime, the National Academy of Sciences has picked up the ball, and under a grant from the Department of Defense (!) is conducting an additional survey. Thus, of all the major scientific organizations in the United States, only the AAAS has taken timely action and that only after determined prodding by Pfeiffer and a few other interested individuals.

Despite the opinionated stance of several of the authors, scientists of all persuasions will find something of value in this book. There is much authentic factual information, although occasionally the wish is father to the thought. I noted several inaccuracies, including Pfeiffer's assigning to me credit for the unearthing of information about 2,4,5-T which more properly belongs to Meselson. There are biased statements and sometimes the authors openly admit their biases. The scientific reader will be able to pick his way clearly through the melange of facts and opinions, since, in general, each is clearly demarcated. At the moment this book is the best collection of information on chemical warfare in Vietnam extant. It will serve as a primary standard, at least until such time as the Herbicide Assessment Commission of the AAAS makes its final report.

At a conference on War Crimes and the American Conscience held in Washington in 1970, I said, "After the end of World War II, and as a result of the Nuremberg trials, we justly condemned the willful destruction of an entire people and its culture, calling this crime against humanity *genocide*. It seems to me that the willful and permanent destruction of an environment in which a people can live in a manner of their own choosing ought similarly to be considered a crime against humanity, to be designated by the term *ecocide*." If this view is correct, then the book under review is a document of a kind of Mylai perpetrated against the Indochinese countryside. As such, it is required reading for scientists with a

social conscience, and will be useful, in addition, for the many courses now arising in response to the students' desire to consider the social relevance of the findings of biology.

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Quantitative Approach

Statistical Ecology. Vol. 1, Spatial Patterns and Statistical Distributions. A symposium, New Haven, Conn., Aug. 1969. G. P. PATIL, E. C. PIELOU, and W. E. WATERS, Eds. Pennsylvania State University Press, University Park, 1971. xxviii, 582 pp., illus. $14.50. Penn State Statistics Series.

This is the first of three volumes reporting the papers and discussions at a symposium held at Yale University in 1969. Two subsequent volumes are to deal with "Sampling and Modeling Biological Populations and Population Dynamics" and with "Many Species Populations, Ecosystems and Systems Analysis." Twenty-three specialized papers and some general addresses are featured in the current volume. The application of statistical and mathematical techniques in ecology has rapidly proliferated during recent years, and one of the editors (Pielou) is the author of a successful introductory text. Thus ecologists have generally accepted a quantitative approach. Yet this volume will leave many ecologists, even those with statistical proclivities, seriously perplexed. If this volume faithfully reflects the progress and achievements of statistical ecology, the direction of this science would seem misguided. At least 11 of the papers deal with the properties of various statistical distributions that *might* be of interest to ecologists. Yet the relevance of these distributions to real biological data and the biological significance of their occurrence are not discussed, biological keywords in the titles of articles notwithstanding. Some of these papers will be of interest to statistically minded ecologists, who will have to dig hard to extract for themselves kernels of material useful for their work. Other contributions clearly belong to the statistical literature. The fact that empirical data in ecology often do not permit decisions among alternative distributions is brought out in the discussion. Whether this will inhibit the generation of further distributions in the future is doubtful. The multiplicity of biological interpretations of given distributions is taken up in a paper by Hairston, Hill, and Ritte in this volume.

At least two important contributions to statistical ecology should be singled out. Morisita develops an index of environmental density which is likely to be taken up by ecologists, as were his earlier contributions, and Iwao and Kuno undertake an interesting analysis of aggregation patterns in biological populations and their implications for various theories of population dynamics. There are other papers of specialized interest which will be read with profit by ecologists of various persuasions.

Users of this volume will be seriously impeded in their ability to locate desired information by the editors' omission of any kind of index and by the publisher's unfortunate decision to employ uniform running heads for the entire volume, yielding a Shannon-Weaver diversity index of zero as one thumbs through the pages.

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Neurochemistry

Recent Advances in Adrenergic Mechanisms. BUDH DEV BHAGAT. Thomas, Springfield, Ill., 1971. x, 134 pp., illus. $13.75.

In this book Bhagat provides an introduction to the concepts of the biochemistry and pharmacology of the sympathetic nervous system. It may well serve the needs of many students, medical scientists, or practicing physicians with an inquiring interest in the field, who must have difficulty in finding a place to begin reading the accumulation of sophisticated and complete reviews, symposia, and monographs dealing with catecholamines and related subjects.

A concise account of any large and rapidly advancing field must necessarily suffer from simplifications, omissions, and personal bias. Bhagat has freely acknowledged and accepted these dangers in his attempt to present clearly and simply an account of adrenergic mechanisms. The result, although a somewhat personal view of the field, does bring to the reader a fair coverage of the major facts and concepts. In the interest of brevity, conclusions are stated with minimal attention to the data from which they were derived. Bhagat has effectively used schematic representation to explain the complex interactions of drugs with the mechanisms for synthesis, storage, release, and action of norepinephrine. The only original data presented are the author's own work, six smoked-drum tracings of cat blood pressure and nictitating membrane contraction; and as might be expected of any active investigator, the citations are skewed toward his own contributions to this field. In some of the references, abstracts rather than the full published work are cited.

It would be quite easy to suggest how this book might have been enlarged, but perhaps only at the expense of the author's objectives. There is little or no discussion of the isotopic or biochemical methodology used in catecholamine research; the cardiovascular system is the only area in which any clinical correlations are considered; the central nervous system is ignored; controversial subjects such as compartmentation or metabolic pools of norepinephrine are avoided; there is nothing about the role of nerve growth factor in the development of the sympathetic nervous system; and some important, relatively new information (for example, the release of dopamine-beta-hydroxylase from sympathetic nerves and its presence in blood) probably was still unpublished when the monograph was sent to the publisher. These omissions will not seriously hamper the reader's gaining an overview of current concepts, but the author might have included a list of other reviews and monographs which could be used to build on the foundation provided by this relatively brief introduction.

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Chemical Processes

Inorganic Reaction Mechanisms. JOHN O. EDWARDS, Ed. Interscience (Wiley), New York, 1970. x, 350 pp., illus. $15.95. Progress in Inorganic Chemistry, vol. 13.

Those who investigate mechanisms of reactions must always be aware that each specific reaction has its own characteristics; yet they hope the results on a specific system will aid in formulating a general scheme of reactivity for a class of reactions. As a field of investi-