Reviews of Environmental Contamination and Toxicology

VOLUME 102

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Continuation of Residue Reviews

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Springer-Verlag
New York Berlin Heidelberg
London Paris Tokyo

New York: 175 Fifth Avenue, New York, N.Y. 10010, USA
Heidelberg: 6900 Heidelberg 1, Postfach 105 280, West Germany

Library of Congress Catalog Card Number 62-18595.
Printed in the United States of America.

ISSN 0179-5953

ISBN-13: 978-1-4612-8361-4
e-ISBN-13: 978-1-4612-3810-2
DOI: 10.1007/978-1-4612-3810-2

Foreword

Global attention in scientific, industrial, and governmental communities to traces of toxic chemicals in foodstuffs and in both abiotic and biotic environments has justified the present triumvirate of specialized publications in this field: comprehensive reviews, rapidly published progress reports, and archival documentations. These three publications are integrated and scheduled to provide in international communication the coherency essential for nonduplicative and current progress in a field as dynamic and complex as environmental contamination and toxicology. Until now there has been no journal or other publication series reserved exclusively for the diversified literature on "toxic" chemicals in our foods, our feeds, our geographical surroundings, our domestic animals, our wildlife, and ourselves. Around the world immense efforts and many talents have been mobilized to technical and other evaluations of natures, locales, magnitudes, fates, and toxicology of the persisting residues of these chemicals loosed upon the world. Among the sequelae of this broad new emphasis has been an inescapable need for an articulated set of authoritative publications where one could expect to find the latest important world literature produced by this emerging area of science together with documentation of pertinent ancillary legislation.

The research director and the legislative or administrative adviser do not have the time even to scan the large number of technical publications that might contain articles important to current responsibility; these individuals need the background provided by detailed reviews plus an assured awareness of newly developing information, all with minimum time for literature searching. Similarly, the scientist assigned or attracted to a new problem has the requirements of gleaning all literature pertinent to his task, publishing quickly new developments or important new experimental details to inform others of findings that might alter their own efforts, and eventually publishing all his supporting data and conclusions for archival purposes.

The end result of this concern over these chores and responsibilities and with uniform, encompassing, and timely publication outlets in the field of environmental contamination and toxicology is the Springer-Verlag (Heidelberg and New York) triumvirate:

Reviews of Environmental Contamination and Toxicology (Vol. 1 in 1962 as *Residue Reviews* through Vol. 97 in 1986) for basically detailed review articles concerned with any aspects of chemical contaminants, including

pesticides, in the total environment with their toxicological considerations and consequences.

Bulletin of Environmental Contamination and Toxicology (Vol. 1 in 1966) for rapid publication of short reports of significant advances and discoveries in the fields of air, soil, water, and food contamination and pollution as well as methodology and other disciplines concerned with the introduction, presence, and effects of toxicants in the total environment.

Archives of Environmental Contamination and Toxicology (Vol. 1 in 1973) for important complete articles emphasizing and describing original experimental or theoretical research work pertaining to the scientific aspects of chemical contaminants in the environment.

Manuscripts for *Reviews* and the *Archives* are in identical formats and are subject to review, by workers in the field, for adequacy and value; manuscripts for the *Bulletin* are also reviewed but are published by photo-offset to provide the latest results without delay. The individual editors of these three publications comprise the joint Coordinating Board of Editors with referral within the Board of manuscripts submitted to one publication but deemed by major emphasis or length more suitable for one of the others.

Coordinating Board of Editors

Preface

At this writing, there are three notable subjects holding the attention of those involved in regulating or researching environmental quality: The ozone layer, dioxin in paper products, and detoxification of organic toxic waste.

The ozone layer: NASA spokesmen have recently reported that the rapid decrease in stratospheric ozone over Antarctica that has developed each year in the fall for the past decade has occurred again in 1987. This "ozone hole" is being monitored by the agency's total ozone mapping spectrometer (TOMS) on its weather monitoring satellite Nimbus 7. The hole develops in September and disappears in November; thus, it is premature to predict its magnitude and extent. NASA aircraft based in Chile have been overflying Antarctica studying the phenomenon, and the agency's stratosphere-capable aircraft, the ER-2, an updated version of the U-2 spy plane, has flown into the hole twice this year.

Internationally, at a September, 1987 conference in Montreal sponsored by the United Nations Environment Program, 24 countries signed an accord that promised to reduce by 50% the production and use of ozone-destroying chemicals by 1999. These chemicals are the synthetic chlorofluorocarbons (CFCs) believed to be destroying the ozone shield that reduces the penetration of the sun's ultraviolet radiation. The Montreal Protocol attempts to reduce CFCs, which are used as coolants in refrigeration equipment, and as ingredients in aerosols and plastic foams. The Protocol also limits the use of halons, an ozone-destroying group of fire suppressant chemicals, believed by some researchers to cause 20 times the damage of CFCs. Estimates indicate that as much as 7% of the ozone shield, which stretches from 10 to 50 km above the earth, has already been destroyed. This milestone represents the first effort in international air-pollution controls.

Dioxins in paper products: Early in 1987 the U.S. Environmental Protection Agency (EPA) conducted a study of the sludge, effluent and pulp of five paper mills and the fish caught downstream, for dioxins (several of the TCDDs, or tetrachlorodibenzo-*p*-dioxins). Low levels, in the sub-parts per million range, were discovered. This prompted the paper industry to expand its ongoing survey to include the search for dioxins in its paper products. And as expected, trace levels (less than 1.0 ppm) were detected in products ranging from stationery to disposable diapers. The U.S. paper industry quickly responded, stating that these paper products pose no health hazard to consumers. Dioxins are generally associated with the use of chlorophenols, and more specifically 2,4,5-trichlorophenol. In this instance, however, the traces of dioxins are the probable result of the use of chlorine as a bleach in the whitening of paper pulp. Lignin, the cellular

wrapping agent in wood, is an aromatic polymer, and in the process of digesting the complex mixture of cellulose and lignin, some of the smaller aromatic complexes are chlorinated. The not too surprising result is the production of trace quantities of dioxins in the bleached pulp. Because dioxins are relatively stable, they would then appear in the finished paper products.

Detoxification of organic hazardous waste: In the summer meeting of the American Chemical Society, a symposium in the Environmental Chemistry Division explored nonstandard methods of chemical and biochemical detoxification of hazardous waste. Here a distinction was made between detoxification and destruction of such waste. An approach that appears promising is the use of fungi to degrade certain organic molecules.

One fungus, *Phanerochaete chrysosporium*, belonging to the wood-rotting fungi, decomposes wood by breaking down lignin, a complex aromatic polymer that is otherwise resistant to decay. Cultures of this fungus have been observed to degrade chlorinated biphenyls, aromatic hydrocarbons, and dioxins, the subject of the above paper contamination.

Because the fungus does not normally grow in soil, impregnated wood chips are used to fortify experimental soils. The fungus then moves away from the chips to partially metabolize, or in this instance, detoxify, organic pollutants. Another possible use for this technique is the treatment of waste streams from industrial processes. This particular strain was isolated from decaying grapevines in the Soviet Union by U.S. Department of Agriculture researchers. In all instances, the major hurdle remains the same, inducing the fungus to grow and metabolize beyond its natural environment of decaying wood. The outlook, however, is excellent.

One of man's major contemporary concerns is protecting the environment in the face of a 5-billion world population, urbanization, and rising standards of living. Effective strategies for safeguarding our surroundings require knowing what is there, where it came from, and what we can do about it. The purpose of this book series is to address the what and where, and frequently what can be done to correct it, as in the case of the above wood-rotting fungus.

Reviews, therefore, rededicates itself to the timeliness and high standards of scholarship that have carried it to its eminence in the literature of a dynamic and complex field, environmental contamination and toxicology. It will continue to bring, in concise form, all aspects of the many real problems and some solutions arising from the introduction of xenobiotics in the biosphere.

Despite attempts by the media to convince us our surroundings are under continual chemical assault and not faring well, there is abundant evidence that most chemicals are degraded or dissipated in our not-so-fragile environment. Yet, we must contend with leaking underground fuel tanks, movement of nitrates and nitrites into our groundwater reservoirs, increasing air pollution in our large cities, and seemingly frequent contamination of our food and animal feeds with pesticides, industrial chemicals, and bacterial toxins.

Without continuing surveillance and intelligent controls, some of these chemicals could at times conceivably endanger the environment, wildlife, and the public health. Ensuring safety-in-use of the many chemicals involved in our highly industrialized culture is a dynamic challenge, for the old established materials are continually being displaced by newly developed molecules more acceptable to environmentalists, toxicologists, and federal and state regulatory agencies.

These matters are of genuine concern to increasing numbers of governmental agencies and legislative bodies around the world, for some of these chemicals have resulted in a few mishaps from improper use. Adequate safety-in-use evaluations of any of these chemicals persisting into our air, drinking water, and foodstuffs are not simple matters, and they incorporate the considered judgments of many individuals highly trained in a variety of complex biological, chemical, food technological, medical, pharmacological, and toxicological disciplines.

It is hoped that *Reviews of Environmental Contamination and Toxicology* will continue to serve as an integrating factor both in focusing attention upon those matters requiring further study and in collating for variously trained readers present knowledge in specific important areas involved with chemical contaminants in the total environment. This and previous volumes of "Reviews" illustrate these objectives. Because manuscripts are published in the order in which they are received in final form, it may seem that some important aspects of analytical chemistry, bioaccumulation, biochemistry, human and animal medicine, legislation, pharmacology, physiology, regulation, and toxicology are being neglected. To the contrary, these apparent omissions are recognized, and some pertinent manuscripts are in preparation. However, the field is so large and the interests in it are so varied that the editor and the Editorial Board earnestly solicit suggestions of topics and authors to help make this international book-series even more useful and informative.

Reviews of Environmental Contamination and Toxicology attempts to provide concise, critical reviews of timely advances, philosophy, and significant areas of accomplished or needed endeavor in the total field of foreign chemicals in any segment of the environment, as well as toxicological implications. These reviews are either general or specific, but properly they may lie in the domains of analytical chemistry and its methodology, biochemistry, human and animal medicine, legislation, pharmacology, physiology, regulation, and toxicology. Certain affairs in the realm of food technology concerned specifically with pesticide and other food-additive problems are also appropriate subject matter.

The justification for the preparation of any review for this book-series is that it deals with some aspect of the many real problems arising from the presence of any "foreign" chemicals in our surroundings. Thus, manuscripts may encompass those matters in any country. Added plant or animal pest-control chemicals or their metabolites that may persist into food and animal feeds are within this scope. The so-called food additives (substances deliberately added to foods for flavor, odor, appearance, and preservation, as well as those inadvertently added

during manufacture, packing, distribution, and storage) are also considered considered suitable review material. In addition, chemicals contaminant in any manner to air, water, soil, or plant or animal life are within this purview and these objectives.

Manuscripts are normally contributed by invitation but suggested topics are welcome. Preliminary communication with the editor is recommended before volunteered reviews are submitted in manuscript form.

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G.W.W.

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