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### Book reviews

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## BOOK REVIEWS

**POLLUTION: ECOLOGY AND BIOTREATMENT**, S. McEldowney, D.J. Hardman, S. Waite, publ. John Wiley and Sons, New York, USA. ISBN 0-582-08655-8 322 pp. UK Price (£19.99) (soft covers)

About 63 000 chemicals are thought to be in common use around the world, with 200 to 1000 new ones added each year. This alone justifies consideration of their direct release, further distribution and fate in the environment, even where hard information on their toxicity is lacking. There is also a growing expectation that methods for rendering their residues harmless should be developed and made available. This textbook is aimed at undergraduate and post-graduate students, presumably in both UK and USA, to help them understand the principles of pollution control and to provide examples of biotreatment strategies effective in at least the initial stages of a polluting event.

The first chapters deal with some basic principles and practices. Chapter 1 distinguishes between point and diffuse sources of pollution, and compares and contrasts environmental legislation in UK and USA, very briefly referring to international protocols. Inevitably the former are always changing with time and even the latter have been overtaken by those promulgated at the Rio UNCED meeting (Agenda 21) in 1992. Chapter 2 extends traditional toxicology, based on physico-chemical characteristics to define pollutant behaviour, with single exposure/single target testing, to qualitative and then quantitative predictions. Biological models of effects are reviewed through data derived from microcosms, synthetic communities (macrocosms) and field observations on bioconcentration, bioaccumulation, biomagnification, and effects on individuals. Responses at the community level are not well covered, however, although this might not have been considered relevant to the topic of biotreatment. The third 'general' chapter on current treatment technologies lists landfill and incineration (but not 'disperse and dilute strategies') as the traditional options but promotes the potential of physical, chemical and particularly biological techniques for remediation of pollution. The focus of later chapters is to review biotreatment technologies as applied to various classes of pollutants. They deal with organic pollutants (C cycle and xenobiotic compounds), their degradation and transformations; nitrate and phosphates, with analysis of the potential for microbial treatments, or removal by macrophytes; other inorganic pollutants, including S and N oxides, with the potential for desulphurization of fossil fuels by microbial activity; a final section deals with the fate and effects of metals and radionuclide pollutants.

Two chapters in particular attracted my interest. The chapter on S and N oxides contains familiar material. The formation of 'acid rain' is briefly presented, but some misleading statements appear – for example that this process is 'very rapid', and that only SO<sub>2</sub> and NO<sub>x</sub> are responsible, ignoring the Cl and the complex interactions of NH<sub>3</sub>/NH<sub>4</sub>. There is also little quantification, for example on rates of reaction or estimated precision (at best ±50% for deposition). Direct effects of acid gases on plants are reviewed, including those due to surface hydration of SO<sub>2</sub> to sulphite

( $\text{HSO}_3^-$ ). Although a figure demonstrates the much greater toxic effect of other gases (HF,  $\text{Cl}_2$ ,  $\text{O}_3$ ) this relativity is not discussed in the text. Comparing current ambient rural concentrations of  $\text{SO}_2$  and  $\text{NO}_x$  in UK and USA with thresholds for their toxicity for commercial crops, forest trees and other plants, it is argued that 'growth ... may be significantly impaired'. This is scarcely supported by recent literature, in particular that of the recent exhaustive survey (USA/NAPAP\*) of conditions in northeastern states. However, the phenomenon of 'forest decline' is more balanced, with the responses to a variety of possible agents and climatic conditions being recognized. Acidification of surface waters is even more briefly reviewed. The following chapter takes up the potential bioremediation only in relation to desulphurization of fuels, promoting oxidation of inorganic sulphur by *Thiobacillus* and other bacterial species; application on a sufficient scale and rate in practice must inevitably pose problems, although conditions to optimise this process are presented. Remedial techniques, whether physical, chemical or biological, for remedying adverse effects are not reviewed.

The section on metals/radionuclides first sets out some basics of the periodic table, perhaps unnecessary for readers with some chemical background, but justifiable in view of the widespread misuse of terms such as 'heavy' or 'trace' metals. The importance of chemical form and behaviour is brought out with reference to groupings of metals or metalloids, their charge and complexing properties so as to distinguish between accumulated, recycled, and scavenged elements. Toxicity is reviewed briefly, with reference to a few case studies. Biotreatment again focuses on microbial desulphurization in anaerobic conditions using *Desulfovibrio* to provide  $\text{S}^-$  for formation of insoluble metal sulphides that can accumulate as sludge. Other organisms (e.g. *Klebsiella*) can also detoxify metals directly by precipitating metal sulphides. Further microbial transformations of potential use involve alkylation, reduction, oxidation reactions, leading to intra- or extra-cellular, or biopolymer accumulation of material.

Overall, these two chapters follow a pattern of information on the nature of each problem and then the potential for exploitation of biological, principally bacterial, processes for avoiding adverse effects. In some instances, however, recent work is not included and if the potential for biotreatment is to be exploited more fully some updating and wider perspective might be encouraged. Even so, the present text should stimulate interest and further enquiry among the coming generation of pollution managers.

The volume provides selected references by chapter, illustrations in the form of tables, diagrams and specific examples, and an index. It is well produced within a modest price, although a few 'typos' have survived through the proof-reading stage. As a student text it should fill a need, although perhaps too complex in its entirety for undergraduate students, although a selective dip into its contents might be helpful. For the general reader, it also provides a guide to how knowledge of biological processes could be harnessed via appropriate technology to prevention or treatment of pollution.

G. Howells

\*P.M. Irving (1991) Acidic Deposition: State of Science and Technology, summary report of the US National Acid Precipitation Assessment Program, US Govt. Printing Office, ISBN 0-16-035925-2

FISH ECOTOXICOLOGY AND ECOPHYSIOLOGY, ed. T. Braunbeck, W. Hanke & H. Seger. Proceedings of an International Symposium, Heidelberg, September 1991. 1993. 418 pages with 204 Figures and 50 Tables. ISBN 3-527-30010-4 £76.00, VHC Weinheim.

The distilled essences of a Symposium at Heidelberg in September 1991 are offered in this volume and the reader is invited to sample a variety of papers on a theme which is essentially the environmental biology of fish. This is a wide ranging subject and the editors have done their best to package material from many areas into four sections. The first is Ecotoxicology of Fish, then Environmental Pathology of Fish, followed by Ecophysiology of Fish and finally Environmental Endocrinology of Fish.

Section I (Ecotoxicology) contains thirteen papers including two review articles, the first by P. Rudolph and the second by R. Nagel, which discuss the nature of ecotoxicology and where it is going. Other articles are on subcellular and cellular aspects and explore a productive area into which the subject may well expand although the important area of toxicity relating to molecular genetics is not addressed.

The section on Environmental Pathology contains 4 papers, two on parasitism and two on fish immunology.

The third section, Ecophysiology of Fish, contains four papers on the biology of larval fish, a subject of growing importance; these include hatching, and effects of starvation in *Coregonus*, growth swimming and feeding in silver carp and RNA/DNA ratio with tryptic activity as indicators of starvation in laboratory reared and wild reared herring larvae. The remaining 8 papers are on adult fish and cover a variety of topics in feeding, nutrition, body composition, muscle recruitment in swimming and metabolic responses of fish to mechanical stimuli.

The final section contains 6 papers on a variety of endocrine topics including osmotic adaptation, steroid secretion, effects of cck/P<sub>2</sub> on cultured exocrine cells from fish pancreas, effects of steroids on extradiol receptors in pancreas of developing trout and finally 2 papers on atrial natriuretic peptide (ANP) in heart and kidney.

Within the subject area of fish ecotoxicology and ecophysiology, this book represents a loose collection of papers on diverse subject material and one wonders if this is the right way to present such material. The book will be useful only to research scientists working in particular areas. Readers with a general interest in this field will be disappointed, since most of the material is very specialised and specific and there are only a handful of articles which attempt a broad review. However, the book is well produced and the Editors have done well in ensuring that all the papers are properly refereed and of a high scientific standard.

F.B. Eddy

METHOD IN ECOLOGY: STRATEGIES FOR CONSERVATION. K.S. Shrader-Frechette and E.D. McCoy (University of South Florida). Cambridge University Press, 1993. Price, £40.00 ISBN 052/41861 5 (hardbook); £17.95 ISBN 0 521 44693 7 (paperback)

This is not a cookbook of ecological methodology. Rather it is an investigation of the usefulness of community ecology theories in attempts to solve practical environmental problems. The authors' basic conclusion is that ecological theory has

proved to be of little use, and that 'when we wish to apply ecology in order to promote conservation or preservation, our knowledge of particular taxa is more important than our knowledge of general theory.'

The individual chapters are: What ecology can't do; Ecological concepts are problematic; Ecological theory is problematic; Ecological science is value laden; What ecology can do; Ecology and a new account of rationality; Objections to ethical rationality in ecology; two chapters – together forming 28% of the text – describing a detailed case study of the Florida panther; and Conclusions. As might be deduced from the above, one of the authors is a philosopher whilst the other is a biologist.

To a large degree, what the authors have to say about the imprecision of ecological concepts and the incompleteness of theories of community ecology is nothing new and has been widely appreciated for many years. Problems generated by the vagueness of the terms 'stability' and 'community' especially in cases where different authors – or the same author at different times – mean different things when using apparently the same concept, have clearly led to much past confusion, as witness the old and long-since exploded notion that diversity generates community stability. Equally, ecologists have long since given up notions that the theory of island biogeography provides a complete explanation of community composition – if indeed any ever held that view. To those of us, like this reviewer, who were lecturing to these effects more than a decade ago, parts of the book therefore read like rediscovery of the wheel.

Nevertheless, it may well be true that some conservation biologists are still using out-dated ecological notions and are exercising a faith in the all-encompassing truth of apparently relevant ecological theory that is out of all proportion to the known (at least to ecologists) limitations of that theory. If that is so, then there really is great need for conservationists to keep abreast of modern developments in ecology, and of ecologists to be aware of the problems and needs of practical environmental conservationists. In this respect this book should serve as a useful reminder to members of both disciplines of the extent to which their subjects should interlink.

The authors' thesis that ecological information becomes less precise the more one moves away from an individual population of organisms (itself an imprecise abstraction from reality) towards more grandiose and even less realistic abstractions such as communities and ecosystems is also self-evidently true and widely known within ecological circles. However, their analysis of the direction that conservation biology should take, granted the nature of ecological data and theory, with its emphasis on minimising type II (rather than type I) statistical errors and on knowledge of the requirements of individual species, was to me lucid, valuable and a helpful contribution to conservation theory. Although, as they emphasise, we remain ignorant of the natural history of most organisms, without basic information on individual species we are whistling in the dark when it comes to attempts to conserve them, let alone whole habitats. This is perhaps a lesson that several funding bodies still have not learned.

If one can get over the feeling from the earlier chapters that this book has been caught in a time warp, the book could be read with profit by all ecologists and conservation biologists with an interest in the foundations of their sciences.

R.S.K. Barnes