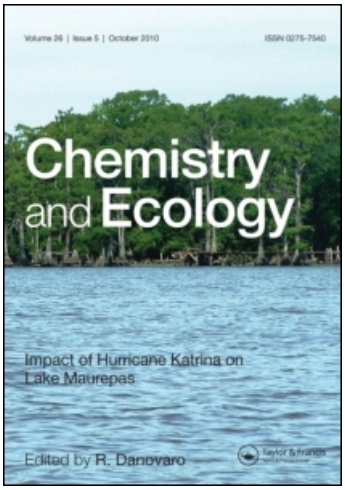

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Book Reviews

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BOOK REVIEWS

Bioaccumulation – what is its value for risk assessment? R. Nagel and R. Laskill (editors): *Bioaccumulation in Aquatic Systems – Contributions to the assessment.* Proceedings of an international workshop, Berlin, 1990, published 1991 VCH Weinheim, New York, Basel, Cambridge. 239pp. illus.

This book contains papers presented at a scientific meeting held in Berlin in December 1990. The editors argue that "the biaccumulation of chemicals is an important element in the assessment of environmental hazards", justifying the need for the workshop and a complementary literature study. In addition to introductory and closing comments, ten topics are explored in some detail by the contributing authors. It is accepted that the application of regulatory procedures (e.g. OECD or EC guidelines or criteria) are not necessarily based on the reality of biosystems. While the accumulated residues of pollutants provide evidence of exposure, and can often be measured chemically with a degree of precision, evaluation and assessment often needs greater insight and understanding of relevant biological processes. The workshop was challenged to consider the three major issues of validation, extrapolation and evaluation, namely:

- do present tests yield reliable results and are they sufficient? Can bioconcentration be modelled? How accurate are log P_{ow} – log BCF correlations?
- can test data be extrapolated between organism groups? Can laboratory results be applied to environmental conditions (or vice versa)? Is it necessary to distinguish bioconcentration and biomagnifcation?
- does bioaccumulation reflect toxicity? Can bioaccumulation data be evaluated differentially? What approaches can be made to assess bioaccumulation?

Even though these questions are often raised, bioaccumulation is often seen as a useful measure of exposure and as an indicator of environmental hazard. With accessible analytical equipment, a prodigious amount of chemical data has been accumulated in the scientific archives. Do these records provid a basis for judging pollution risks?

While these questions relate to a wide variety of environmental contaminants, the scope of the workshop was limited to organic compounds, i.e. those with log $P_{ow} > 3$ (the *n*-octanol/water coefficient) and only to aquatic systems, thus predominantly through direct intake from the aquatic medium.

The presentations and the summing up are suitably critical. On validation – it was noted that test conditions vary substantially, with test concentrations sometimes in excess of solubility or availability; steady state conditions may not be reached within the test period. Log P_{ow}/Log BCF relationships are full of assumptions that are untested and may not be justified. Many other parameters are involved, some of which cannot yet be quantitatively evaluated. On extrapolation – simple transfer of laboratory findings to field conditions cannot be justified since may unmeasured factors may be significant, food inputs are usually ignored (and seldom included in tests). Very large differences in the levels of accumulation are found between

species, and even in strains. Evaluation is often flawed since bioaccumulation need not mirror toxicity, whereas true hazard assessment seeks a quantifiable match between exposure and effects. Many formalized assessments rely heavily on test exposing named species (often fish, i.e. gill exposure), sometimes substituted by endemic species of different behaviour and life cycle.

None of the contributions follows up toxicity findings with population or community responses, difficult within the framework set out at the start. However, it would have been appropriate to acknowledge that this is a crucial component, and that decisions based on single species exposure in the field or laboratory should be validated by later surveillance of the exposed community.

The overall impression is that the phenomenon of bioaccumulation, even for a selected group of chemicals, has little value until test guidelines can be proposed and validated, and formalised assessments related to field conditions over a suitable time. As a review of the doubts and disadvantages, rather than the advantages, of this method of risk assessment, it is a salutary exercise, but might perhaps have been balanced by greater dissent. No doubt, test procedures and assessment protocols will continue to follow the bioaccumulation trail and sceptics will continue to challenge their value. This workshop has been helpful in exposing some of the flaws (and some of the strengths) in that approach.

The book is reasonably produced, although, as with all multi-authored conference proceedings, the standard of the different contributions varies. There are some typographic errors, and at times the English used is unidiomatic to a degree that leads to ambiguity. A test check of references found some missing. More ruthless editing could have avoided these errors.

G. Howells
2 June 1992

Chemical Hazards, R.P.Cote and P.G.Wells (editors): *Controlling Chemical Hazards ; Fundamentals of the Management of Toxic Chemicals,* 1991, publ. Unwin Hyman, London, distributed by Chapman and Hall, 310pp., price £40.00. ISBN 0-04-604002.

This book is aimed at environmental managers and advanced students, setting out the basic principles, facts, altenative approaches and a variety of complex management procedures. It highlights critical issues related to the manufacture, transport, storage, use and disposal of chemicals and calls on a wide range of engineering, economics, and social and political science. Several of the authors are Canadian, and many of the cases used to illustrate the principles formulated stem from this nation's strong environmental policies. Others come with a variety of experience in industry, academia and international agencies.

The editors provide opening and closing chapters, with invited authors setting out physical, chemical and toxicological concepts needed for assessment of toxic chemicals, integrative accounts of effect/exposure information and of occupational and environmental risks. Different control and management strategies are reviewed. Later chapters also consider the problems in economic, legal, and socio-political perspective.

There is no universal definition of a toxic chemical – often this reflects the mandate of regulatory agencies, for example for ocuupational or public safety, or environmental protection, as well as different national policies. Hazard ranking is

practised at both national and international level (for instance, the IMO/GESAMP guidance on transport at sea), but again reflects different purposes.

The task of achieving the safe use of chemicals is daunting – about 100 000 are in commercial use, with 1000 new chemicals being promoted each year. Tens of thousands of accidents occur every year, some of global notoriety. Since the publication of Rachel Carson's *Silent Spring* brought this problem to public attention, the real, potential, and perceived problems have increased exponentially. However, the capacity to measure low levels of chemicals in the environment has outpaced our ability to interpret our findings, to find appropriate ways to manage their use, and to assess their hazards. While standardized tests can show effects on targets at relatively high concentrations, these often raise fears which are difficult to dispel since a comprehensive estimate of risk is rarely attempted.

The development of systematic labatory test systems has progressed to a level where exposure/effects can be presented as a hierarchical system where the user can select the appropriate level of complexity. However, any substance can impact its target by a variety routes (inhalation, ingestion, skin contact, water for gill breathers) and simultaneously from a variety of sources. A further complexity arises from chemical transformations, synergisms and the influence of other factors found in the real environment, in contrast to controlled laboratory tests. Thus, surveillance and monitoring of communities of exposed environments is an important feature of management.

In conclusion, this book reveals currently a fragmented approach to the investigation and documention of effects/exposure data, risk assessment as well as for legislation and control. Too often, a "crisis" strategy is mounted in response to some chemical disaster (real or perceived), and so is reactive rather than preventive. In the past, waste management was equated with waste treatment (often emission control), but a more diverse approach is now promoted. The 4 R's – reduction, recovery, re-use and recycling – lead to a more prudent use of resources and to waste minimization.

There is a real potential for improvement – in improving the scope and complexity of test procedures (to include multiple exposures), in setting up surveillance and monitoring programmes to detect significant effects, and in developing more effective control strategies aiming for fail-safe systems. Management schemes must identify the major problem to be tackled – for example, pest management or pesticide management – and reflect the pervasive nature of many contaminants.

Most readers will find material for thought here – there are revealing examples of "wrong" management – but few of "right" strategies, possibly because the tone is one of improvement. The editors hope that the basic principles and approach could be applied to other environmental problems as well; wildlife management and land/water resource issues come to mind and might (and perhaps do) benefit from a similar systematic approach. In all cases, it is clear that we have the means to improve environmental management systems if only we can focus objectively on the important issues and work in a coordinated and sufficiently comprehensive scale.

The book is well produced, written in an easy and consistent style throughout (in spite of multiple authorship). Each chapter has a fairly extensive list of references for the reader who wishes to explore in greater depth. There is a fairly effective index, although I found reference to tables (without their page numbers) irritating. Typography is good, but there are a few curious spellings.

G. Howells
4 June 1992