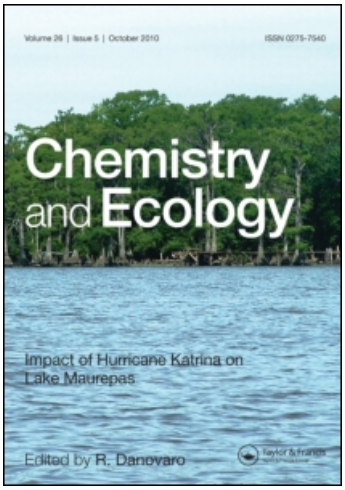

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G. Howells

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BOOK REVIEW

Chemical Speciation in the Environment, editors A.M. Ure and C.M. Davidson, Blackie Academic and Professional, Chapman and Hall, London, 1995, ISBN 0 7514 0021 1, Library of Congress Cat. No.: 94 71807, 408 pp., price £79.00 hardback.

This book explores a rapidly growing field critical to environmental investigations – the form of chemicals within specific conditions, thus determining their pathways, mobility and availability in components of the environment. The two editors, from the University of Strathclyde, have brought together 12 chapters with a distinguished cast of 21 authors. The topics develop through Techniques for Speciation (General Strategies, Direct Methods, Hybrid Methods, Prediction and Computer Simulation); Speciation in Compartments of the Environment (Atmosphere, Fresh Waters, Soils, Sediments and Combustion Waste, Radionuclides, Biological Systems; a final section reviews Trends and Developments.

In the introductory chapter, the editors point out that speciation is more important than concentration, and that as environmental conditions change, the forms and behaviour of elements may be altered fundamentally, citing examples for aluminium, uranium, arsenic and tin. Speciation seeks to characterize at least the most important forms, to understand what transformations can occur and to infer their likely consequences. However, there is no universally acknowledged definition of speciation and the term is used in different ways. The editors distinguish i) functional speciation, exemplified as "plant available" or "biologically active" or "mobile"; ii) operational, e.g. as "water soluble", "exchangeable", "residual" – a nominal association dependent on physical procedures employed; iii) as specific compounds or oxidation states – often difficult to achieve and dependent on selective and sufficiently sensitive methods. In all speciation studies the system investigated must not be disturbed since this would compromise reality.

Following chapters present alternative approaches which are available. Speciation methods are not routine, and care must be taken to match analytical information that can be obtained to the aims of the planned investigation, balancing the conflicting needs for precision, sensitivity and reality (i.e. undisturbed conditions). Sometimes a variety of techniques may be required; most investigations will require at least a separation step followed by a suitable detection system. The alternative approach through modelling thermodynamic equilibria and computer simulation is well set out; while this can aid understanding, validation may present problems in natural systems.

The chapters describing speciation in different environmental compartments highlight their diversity: in atmosphere elements are present in a range of sizes and forms and are often present in minute concentration. Their behaviour (and residence time) varies with size, form, solubility and independent conditions. As a result speciation is scarcely studied except for a few elements. In fresh waters, concentrations are also

often low but almost every element in the periodic table is represented, in a variety of forms. The nature and kinds of complexing are explored comprehensively. For soils, chemical form, – gaseous, solid or dissolved – provides the initial basis from which speciation can be elaborated. But there are no unequivocal methods for distinguishing forms of an element in soils, perhaps irrelevant as what is "available" is often sufficient, for example, to assess nutritional potential or toxicity. Understanding equilibria and kinetics in soils remains challenging but is uncertain. For sediments, understanding of biogeochemical cycling processes and assessment of environmental impacts demands species identification since metals are not immediately available (cf. air and water samples), and methods of extraction, concentration, separation etc. without disturbance become paramount. Effective, time-consuming, procedures have been developed, but the selective nature of many extractant procedures calls for caution in interpretation of the analytical data. Biological speciation is enlightened by the new, rapidly advancing, field of bio-inorganic chemistry, identifying intracellular transfer mechanisms, storage components such as siderophores, ferritin, chromatin, zinc fingers, metallothionens. The speciation aspects of these still seem baffling except for a few well studied examples.

A chapter on "Trends and Developments" notes the move to more complex and expensive equipment, with lower detection limits which, in turn, mean more rigorous sample preparation and handling, and high purity of reagents. More certified reference materials for particular species, especially organic complexes, are now available. For any investigation, fewest preparation steps, and minimal amounts of chemical reagents are advised. This has stimulated the development of procedures and equipment that can be used directly in the field, close to sampling sites.

The editors are to be congratulated on avoiding the disaggregated character of many multi-authored books, e.g. poorly edited conference presentations. In contrast, in this case, the authors have been provided a clear framework within which each contribution can expand, with little overlap or contradiction. The book is typographically well produced. There are extensive reference lists to each chapter, and an effective index. Readers will include the broad spectrum of environmental scientists, including those with chemical, geological and biological disciplines, but also to those with newly awakened interest in inorganic/metals chemistry. For the individual, those with real need may justify its purchase at £79.00, and a library copy is likely to be well used.

G. Howells
15 March 1995