

Book Reviews

Chemistry of the Sea

Chemical Oceanography. J. P. RILEY and G. SKIRROW, Eds. Second edition. Academic Press, New York, 1975. Two volumes. Vol. 1. xx, 606 pp., illus. \$49. Vol. 2. xx, 648 pp., illus. \$51.50.

In 1965, the publication of the first edition of "Riley and Skirrow" provided an urgently needed synthesis of information on chemical oceanography. It is a testimony to the quality of that work that despite the introduction of other texts it has remained the premier reference in the field. Now we have a second edition.

A second edition of a successful book usually brings enlargement, to cover omissions and new material, and some editing and rewriting to clarify and modernize portions of the text, with the meat of the book remaining intact. The second edition of *Chemical Oceanography* goes well beyond this norm. It is a different book, as is evident in the fact that of 14 authors who presented material on seawater chemistry in the first edition only four are contributors to the second, two of these being the editors themselves. On the evidence of the two volumes that are the subject of this review the work will continue to occupy its pre-eminent place in the field. [Since this writing, volumes 3 and 4 have been published. The remaining two volumes are scheduled for spring 1976.—ED.]

The structure of the work is pleasingly logical. Volume 1 covers the physical chemistry of the seawater solution and the inorganic composition of seawater, with some speculations on the origin of the composition, while volume 2 has the relationships among organic matter, nutrients, and carbon dioxide as its principal subject. Later volumes will treat the analytical chemistry of seawater, radioactivity, marine pollution, marine resources, and sedimentary geochemistry.

Volume 1 with its broad and detailed coverage provides an excellent review that incorporates most of the progress in data and ideas that has been made in recent years, and it is unfortunate that the lead chapter on oceanic and estua-

rine mixing processes does not aspire to the standard of the remainder. Perhaps it is inevitable in a treatise on chemical oceanography that subject matter traditionally regarded as belonging to physical oceanography is too briefly discussed. Substantial fractions of the later chapters discuss the distribution of various chemical species in the ocean. The oceanic variance of almost all these species is strongly influenced by physical mixing, and the chemical oceanographic literature contains many inferences and deductions about chemical processes occurring within the water column, when the actual data may be more parsimoniously described in terms of simple physical mixing. In view of this, the omission of a reasonably comprehensive discussion of ocean circulation and mixing is unfortunate. This reviewer would have liked to see a broader discussion of the important new discoveries on the mesoscale eddy circulation and of some of the recent ideas on western boundary currents in order to set a time scale for the mixing processes. The importance of a consideration of the relative time scales of physical and chemical processes to interpretation of the distribution of chemical species in the ocean is evident in many sections of Brewer's chapter on minor elements and Kester's discussions of processes affecting the distribution of dissolved gases, both of which are solid contributions. Undoubtedly Williams, in his discussion of aspects of dissolved organic carbon, would have been less puzzled about the so-called Menzel-Craig controversy concerning deep in situ oxygen utilization had he considered the effects of the relative rates of horizontal and vertical mixing in the context of exponentially decreasing oxygen utilization rates with depth.

Completely new material is provided by chapters on seawater as an electrolyte solution, by Whitfield; chemical speciation, by Stumm and Brauner; and adsorption in the marine environment, by Parks. Although there is some repetition, particularly of basic definitions, the chapters as a group form one of the most thorough and comprehensive exposi-

tions of the physical chemistry of seawater that has yet been written. Whitfield's contribution is particularly noteworthy. For those who are not physical chemists it will require, but repay, multiple readings. In his introduction, Whitfield points out how the lack of a fundamental treatment of seawater as an electrolyte solution has led to confusion and inability to predict physical-chemical processes in seawater. In an attempt to remedy this situation, he leads the reader in a rigorous and compelling way from basic definitions, through models of the structure of pure water and single- and mixed-electrolyte solutions, to seawater. The consistencies and inconsistencies of the various models are examined, and the reader is left with a remarkable picture of the degree to which aspects of the complex interactions associated with the major electrolyte components of seawater may be predicted from a few basic parameters and fundamental constants.

Carbon dioxide and the carbonate system in the ocean have received much attention in recent years. Skirrow's chapter on the subject has been completely rewritten and provides a well-documented and complete account of our current knowledge of theoretical aspects, speciation, and oceanic distribution of carbonate species.

Another welcome addition to the second edition is Liss's account of the chemistry of the sea surface microlayer, which, although somewhat weak in theoretical discussion, provides a good summary of the composition of this important ocean boundary together with some comment on the limitations of various sampling techniques.

The most disappointing chapter is that on the micronutrients, inorganic species of silicon, phosphorus, and nitrogen. This system, which stands at the boundary of chemical and biological oceanography, has received extensive study and has many important implications for geochemical and physical as well as chemical and biological processes. The brief account that is given, although it covers major aspects, does not do justice to the effort expended or the knowledge gained. It seems particularly inexcusable, considering the wealth of recent data available, that the distributions of nitrate and phosphate in the Atlantic, Pacific, and Indian oceans are characterized by oversimplified single profiles taken from Sverdrup, Johnson, and Fleming's *The Oceans*, published in 1942.

The contributions of both Williams and Parsons on aspects of dissolved and particulate organic matter are valiant efforts to bring order to chaos, but the

reader is left with the strong impression that our understanding of this complex subject must await the systematic application of more powerful analytical techniques. The last chapter of volume 2, on the hydrochemistry of landlocked basins and fjords, is somewhat anomalous in that it is specific to an area. Nevertheless, Grasshoff has produced a carefully documented and complete account of salinity, temperature, nutrient, and oxygen distributions in the Baltic Sea, the Oslo and Flensburg fjords, the Black Sea, and the Red Sea. He includes, particularly for the Baltic, an extensive discussion of the conditions leading to, and the results of, the development of anoxic waters.

As with most multiauthored volumes, its quality is not consistent, but *Chemical Oceanography* has been revitalized and is even more firmly entrenched as the leading reference work in its field. The editors are to be congratulated for the organization of the book and their selection of authors but should take a mild rebuke for allowing the authors too much freedom in the presentation of units. For example, it is irritating for chemists and bewildering for non-chemists to find data reported haphazardly in moles, grams, and gram-atoms not only within one book but within a single chapter.

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Lipids in Plants

Recent Advances in the Chemistry and Biochemistry of Plant Lipids. Proceedings of a symposium, Norwich, England, Apr. 1974. T. GALLIARD and E. I. MERCER, Eds. Academic Press, New York, 1975. xvi, 398 pp., illus. \$28. Proceedings of the Phytochemical Society, No. 12.

By judicious selection of participants and topics, the editors have assembled a volume that is both broad and timely. It is not bogged down with attempts to reconcile conflicts but is replete with efforts to provide both good reading and the critical bibliography essential to further research.

Plant lipid biochemistry has led its mammalian counterpart on several notable occasions. The discovery of the alpha-oxidation pathway for fatty acid metabolism in peanut cotyledons by P. K. Stumpf and co-workers elicited enthusiasm for the relevance of plant lipid

metabolism to mammalian studies. This pathway, which involves flavoprotein-mediated production of the α -D-hydroperoxy acid and its decarboxylation or, alternatively, its reduction to the α -D-hydroxy acid, was subsequently recognized in mammalian brain and is involved in its requirement for degradation of phytanic acid derived from chlorophyll.

In its 12 chapters the book covers fatty acid structure, methodology, biosynthesis, and their roles in plant lipid function. The intimate relation of acetyl coenzyme A carboxylase to the chloroplast lamellar membrane is represented in a chart of synthesis, elongation, and desaturation systems for the plant cell. The role of lipids in plant structure is introduced in a chapter entitled "Biosynthesis of phosphoglycerides in plants," where pathways and in vivo conditions are outlined and appropriate references to bacterial and mammalian systems are given. Recent studies have led to the assignment of intracellular sites for the synthesis, translocation, and function of these glycerolphosphatides in membranes. Lipid exchange processes are particularly discernible in plant membranes: their study integrates much of the content of the volume.

The physical role of the glycoproteins of mammalian cell membranes appears to be assumed by the glycolipids of plant membranes. Besides the cerebrosides, which in plants include an extensive spectrum of sphingosine analogs, plant membranes contain galactosyl diglycerides, sulfoquinovosyl diglycerides, and a number of complex polyglycolipids. Their biochemistry and that of the related steryl glucosides is reviewed in an elegant chapter that covers their fatty acyl compositions, biosynthesis, and subcellular distribution. The plant sulfolipid, a glycolipid of 6-sulfo-6-deoxyglucose (quinovose) unique to green plants, has been studied for 15 years and yet no pathways for biosynthesis of its $-SO_3H$ group have been demonstrated.

The lipid composition of plant cutin, the essential water barrier of plant surfaces, is ably reviewed by P. E. Kolattukudy, who emphasizes both chemical and microstructural aspects of these remarkable materials. The very-long-chain wax esters and hydrocarbons, being components of the cuticular lipids, are of interest to geologists as well as to biochemists. The polymeric nature of suberin and cutin as delineated by mass spectrometry leads to an elegant molecular picture of the surface of the leaf or apple.

The commercially important oil seeds

are examined from biological and enzymological points of view. Metabolic changes that occur in their lipids and structures during development on the plant or during storage in the granary point up the importance of the biochemical reviews by Beevers and by Galliard on contemporary concepts of seed lipid degradation and utilization.

The influence of the work of P. K. Stumpf and his many distinguished collaborators prevades this volume. Although its cover may not outlive the usefulness of its contents, the book will be a standard reference for a long while.

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Fluviology

River Ecology. B. A. WHITTON, Ed. University of California Press, Berkeley, 1975. x, 726 pp., illus. \$40. Studies in Ecology, vol. 2.

A look at the list of contributors to this book is enough to give the potential reader a sense of anticipation. In general, he or she will not be disappointed. Some of the chapters are almost at the level of definitive works on their topics. Especially noteworthy are the treatment of river zonation and classification by H. A. Hawkes and the imaginative framework and rationale for quality control systems presented by J. Cairns, Jr.

Overlap between chapters is minimal and, with a few exceptions, coverage is comprehensive insofar as present knowledge permits. Most of the obvious omissions, for example, Asian, Southeast Asian, and Arctic rivers, reflect lack of investigation rather than oversight. Subjects which could profitably have been emphasized but which receive only cursory treatment or are omitted altogether include waterborne viruses, disease vectors, problems presented by large-scale removal of water resulting in the entrainment of immature fish, and riverine fisheries. Although the treatment of impoundments by J. E. Ridley and J. A. Steel is an excellent summary of their work on those of the relatively small, pumped-storage variety, the important topic of large, run-of-the-river impoundments, especially in tropical rivers, is addressed only superficially. The chapters on thermal streams and estuarine fauna, although interesting in themselves, could have been omitted with little prejudice to the comprehensiveness of the coverage of river ecology.

The technical editing and production