I was immensely charmed by the quotations used by the author to introduce each chapter, and cannot resist the temptation to end with Pope's oft-quoted but nonetheless profound dictum:

> A little learning is a dang'rous thing;
> Drink deep, or taste not the Pierian spring:
> There shallow draughts intoxicate the brain,
> And drinking largely sobers us again.

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Fresh Water and Ocean

Aquatic Chemistry. An Introduction Emphasizing Chemical Equilibria in Natural Waters. WERNER STUMM and JAMES J. MORGAN. Wiley-Interscience, New York, 1970. xvi, 584 pp., illus. $24.95.

The teaching of the chemical aspects of rivers, lakes, and oceans has normally been part of some general course in limnology, oceanography, or geochemistry. With the recent upsurge in interest in the natural environment, however, many colleges and universities have started formal courses in freshwater chemistry and in marine chemistry. Logically a need arose for a comprehensive textbook on aquatic chemistry. Many excellent texts on limnology and oceanography are available, such as the monographs of Hutchinson and of Sverdrup, Johnson, and Fleming. Hem has recently updated his Geological Survey Water Supply Paper on the study and interpretation of the chemical characteristics of natural waters. But a thorough introductory textbook on the physical chemical principles underlying the evaluation of either freshwater or marine chemical data was lacking until the appearance of Stumm and Morgan's book.

As the authors point out, this book is not intended as a survey of the field of knowledge in aquatic chemistry, but rather as an introduction to the quantitative description of the measured data in terms of physical chemical phenomena. For this reason great attention has been given to chemical equilibria in aqueous electrolyte solutions. The reader will find chapters on acids and bases, dissolved carbon dioxide, precipitation and dissolution, coordination chemistry, oxidation and reduction, and the solid-solution interface, the last treating not only adsorption phenomena but also ion exchange. The text is well written, and the illustrations are abundant and clear. The level of the book is such that it should present no difficulty to chemistry students in their senior year or to first-year graduate students.

Many of the topics discussed in this book—for instance, the use of the master variables pE and pH—have been extensively treated in the literature. It is, however, of great use to have these various topics combined in one monograph that is clearly designed to collect and explain them in particular relation to problems arising in aquatic chemistry. There is one topic that I would have liked to see discussed in this book, and that is the use of isotopes and radioactive tracers in studies of the aquatic environment; stable isotope ratios and their fractionation factors especially are of great importance in understanding processes occurring in the various parts of the hydrosphere. Also, the chapter on the solid-solution interface could have been stronger if ion exchange were related somewhat more directly to problems of bottom water interchange and to the ground water problem.

The chapter on chemical thermodynamics assumes that the reader has had exposure to a rigid course in thermodynamics. If so, he will find this chapter a most useful resume; if not, he can skip the chapter without necessarily losing touch with the rest of the book.

The use of logarithmic diagrams or Bjerrum plots as discussed in the chapter on acids and bases should be advocated. Such diagrams provide a clear insight into the chemical speciation in a particular body of water as a function of pH or pE.

In the chapter on dissolved carbon dioxide, carbonate alkalinity is defined in terms of the carbonate ion concentration, which in freshwater chemistry is probably the correct definition. In marine chemistry, however, carbonate alkalinity is defined quite differently, as the sum of the equivalents of both carbonate and bicarbonate ions in the solution. In general the discussions of the various topics are geared more to freshwater chemistry than to marine chemistry. Nevertheless, chemists in the two fields will find much common ground in this book.

The chapter on metal ions in solution and the possible complexes these ions can form with various anions is well written. It becomes clear that one can very often discuss the concentration of trace metal ions in terms of complexes with inorganic ligands without having to invoke a deus ex machina in the form of "organic" complexes.

The chapter on chemical modeling is interesting and should serve as a stimulus to investigators who want to relate their results to the geochemical environment. Besides, with modeling one can often come to a better understanding of some geochemical cycles or can find obvious defects in particular proposed cycles.

In general the book presents an array of topics that will be of great use in the teaching of a course in hydrogeochemistry. The book may have some ill-chosen examples, but it also provides very valuable lists of references for further reading. I do not think a course in aquatic chemistry can be taught on the basis of this book only, but it should provide one of the underpinnings of such a course. It is hoped that the publisher will soon make available a paperback edition so that the student will have easier access to this valuable book.

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Deposits

Desert Sedimentary Environments. K. W. GLENNIE. Elsevier, New York, 1970. xvi, 222 pp., illus., + maps. $20. Developments in Sedimentology, vol. 14.

The stated aims of this book are to enable the reader to recognize ancient desert sediments and to differentiate between aeolian and water-laid deposits. The author achieves both of these objectives. Chapters 4 through 9 are concerned with the description and genesis of sediments deposited in various modern desert environments: wadis and river valleys, lakes, dune fields, and the littoral fringes. Glennie is obviously at home with these matters and brings to bear firsthand knowledge, wide experience of desert sediments, a keen eye, and a lively mind. After each discussion of present-day desert conditions, modern and ancient desert sediments are compared in order to demonstrate how old sedimentary formations can be interpreted in light of modern deposits. Criteria whereby to identify desert sedi-

ments in drill cores follow, reinforcing the chapters concerned with surface and near-surface exposures. These chapters, together with the discussion of red beds, combine a summary of previous ideas with admirable close description and assessment of the field evidence. Glennie's approach is critical and stimulating, and several unorthodox ideas are advanced in explanation of desert forms and sediments. The writing is in the main clear, though in some places the reviewer found a staccato style and disconnected sequences disconcerting.

Every book is to some extent a personal statement which reflects the experience and interests of its writer. This is at once a strength and a weakness. Glennie is familiar with desert sediments, and we all benefit by his experience. On the other hand, and despite the general title of the book, observations and discussion concern mainly the Old World deserts of which Glennie has firsthand knowledge; southern Africa, Australia, and to a lesser degree the Americas are neglected. Similarly Glennie's excursions into geomorphology are in some instances unfortunate. For instance, at the beginning of chapter 3 he bluntly states that "in the arid environment of a desert running water plays only a small part in the processes of erosion," a statement scarcely in keeping either with the observations and conclusions of many geomorphologists or with the extended treatment accorded fluviatile and other water-laid sediments in the book under review. There are several significant omissions, apart from those stemming from the deficiencies of reference to the New World arid zones. The treatment of alluvial fan deposits is inadequate, and the work of Brown (1952) concerning the antiquity and origin of alluvial fans in Arabia is not mentioned. In discussing the possible role of vortices in the formation of longitudinal dunes Glennie does not cite the ideas of Bagnold (1953) and Féderovitch (1956), which anticipate the theme developed in this book. Travertine is not mentioned, though it surely should be in connection with the inversion of relief associated with calcified river channel sediments; and the work of Miller (1937) should also be cited in this connection. Gilgai and pediments are not discussed, and there is an unfortunate misprint (forest, instead of foreset, laminae) in the table of contents.

Nevertheless, the considerable virtues of *Desert Sedimentary Environments* easily outweigh these and other blemishes. Beautifully produced and copiously illustrated, the book should find a home in the libraries of many geologists and geomorphologists interested in the arid lands.

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Books Received

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Acoustical Holography. Vol. 3. Proceedings of a symposium, Newport Beach, Calif., July 1970. A. F. Metherell, Ed. Plenum, New York, 1971. xvi, 400 pp., illus. $19.50.

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Environment and Man. Richard H. Wagner. Norton, New York, 1971. xiv, 492 pp., illus. $7.50.

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(*Continued on page 1168*)