BOOK REVIEWS

Estuarine Ecosystems: A Systems Approach. George A. Knox, 1986, CRC Press Inc., Boca Raton, Florida. Vol. I, 273 p.; Vol. II, 230p., US $330, ISBN 0-8493-6996-7 (Vol. 1); ISBN 0-8493-6997-5 (Vol. 2).

In his brief preface to Volume 1 the author states: "This book is an attempt to bring some order to the understanding of one of the most complex ecosystem types, estuarine ecosystems. Wherever possible the energy circuit language of symbols and diagrams developed by H. T. Odum has been used as a basis for understanding."

And, in the final paragraph of Volume 2 he concludes: "Natural systems are complex, but our understanding of the complexity is growing, Simulation modeling, if properly executed, has a significant contribution to make to such understanding of estuarine ecosystems. However, it must be stressed that modelling efforts must be backed by sustained and intensive investigations of the physics, chemistry, and biology of estuarine ecosystems. This needs to be complemented by experimental manipulations and microcosm experimentation. We need deeper insights into the theory of estuarine ecosystem function. The challenges that face investigators of these unique and highly productive systems can be most rewarding. In some small way I hope that these two volumes may stimulate research on the many and varied problems that have been raised" (p. 195).

There is not much to disagree with in this conclusion except to note that the particular scheme of modelling, at the analog stage of sophistication, is a highly subjective way of diagramming the state of affairs in nature. By drawing each line or "arrow," for one polygon to the other, an assumption has been made. Many of them are unverifiable and, as Tom Fenchel says, (in "Ecology-Potentials and Limitations: Ecology Institute, Oldendorf/Luhe, 1987, p. 17): "H. T. Odum's attempt to describe ecosystems largely in terms of energy flow is at best a descriptive approach, but strongly deceptive if used as a predictive or analytical tool." Furthermore, the more complicated these diagrams or models get, the more uncertain we must be about all the interactions and connections they suggest and the less can be said about what, if anything, might happen to the system if one of the postulated connections or interactions were demonstrated to be nonexistant or imaginary. I have irreverently called these diagrams or models "odumesques" in a somewhat erroneous evocation of arabesques, which involve complicated symmetrically interlacing patterns. In the chapter on "Principles of Ecosystem Modelling" in A. R. Longhurst's *Analysis of Marine Ecosystems* (Academic Press, 1981), W. L. Silvert refers to the Odum approach as "the first step towards complete simulation modelling," but he considers it nevertheless of limited value: "For those will-

ing to invest considerable time and effort into understanding these more complicated aspects of the energy circuit language many advantages are promised (Odum, 1976) but it is debatable if the increased rigor of the technique compensates for increased loss of communication with the experimental ecologist" (p. 678). It is appropriate in this context to remember the fate of C.G.J. Petersen's famous model of the Kattegat (in *Report Danish Biological Stations,* Vol. 23, 1915) in which the system is based on eel grass (which dies off annually), that was presumably eaten by snails and arthropods, in turn eaten by benthic or bottom feeding fish while "herring *etc.*" lived directly on plankton. The transfer from one trophic level to the next was estimated at about 10%, beginning with 24,000,000 tonnes of Zostera, 5,000,000 tonnes of "useless animals," 1,000,00 tonnes of fish food, resulting in 5,000 tonnes of plaice and 6,000 tonnes of cod. For years this scheme appeared in texts, and was represented in the Danish Aquarium on a large well chart in colors with the base a pretty bed of green eel grass. That chart has long since disappeared and no one now at the aquarium knows what happened to it. I saw it there in 1953. From about 1933 to 1944 there were eel grass die- offs on both sides of the Atlantic; it is still uncertain whether this was because of "disease" or temperature changes. In any event, disappearance of eel grass from large areas of Danish waters did not affect the fish stock because the fish did not eat the snails and the snails did not eat the eel grass but the detritus on the plants; the eel grass detritus and underestimated phytoplankton probably kept the system going, what did suffer was the black brant, the only known organism directly dependent on eel grass. Petersen never considered this bird in his model, for he was concerned with fish as the principal consumer level in his system. None of this detracts from Petersen's reputation as one of the great innovators and founders of fishery research, but does raise questions about his ability as a naturalist. Modellers should not forget this episode, and indeed several of these models attempt to include Zostera (without the black brant) or benthic vegetation, with an appropriate polygon for detritus, notably the *tour de force* of an idealized estuary model by H. T. Odum himself at a modelling symposium held in Portugal in June, 1973. (Published as a frontispiece in Jacques C. J. Nihoul, "Modelling of Marine Systems" (Elsevier, 1975). Possibly Knox got the idea of using his own model of a specific New Zealand estuary as a frontispiece for both of these volumes from Nihoul's book, although he does not cite it (an understandable omission in view of the publisher's peculiar style for citations; another significant reference possibly overlooked for the same reason is R. F. Dame's *Marine-estuarine Systems Simulation,* University of South Carolina Press, 1979). The two models are very much alike, as might be expected; both are difficult to follow because of the numerous lines and symbols. In fact, the models have become so complicated that they defeat the author's intent to convey understanding. They simulate a solitaire version of Hermann Hesse's glass bead game, that has become, in Idris Parry's words "sterile, an aesthetic ideal, an academic juggling of concepts." (*Animals of Silence*, Oxford, 1972, p. 33). Interest in this style of modelling has been waning for about a decade, and it has to be said that the exorbitant price of these volumes is in itself a deterrent to revived interest.

In my opinion ecosystems models of estuaries must somehow include tidal action in a much more obvious manifestation of energy circuits before they can be considered useful. It is not enough to simply add another geometrical figure labelled "tide" or whatever to the already intricate pattern of interconnected polygons, circles and curving lines. The estuarine model should be constructed in pairs, at least, as long as three dimensional representations are impractical.

Nevertheless, George Knox has written a thorough and useful review of the energy aspects of estuarine ecosystems, abundantly illustrated and butressed with tables, citing 1,098 references in Volume 1 and 644 in the second. There is some overlap. The references are arranged alphabetically, numbered seriatim and cited according to the numbers. This required, in the process of preparing the text, that the author has had to insert these numbers at a late stage of preparing his copy. They appear as almost microscopic numbers like exponents, often three or four of several digits in a cluster like rows of flyspecks. The reader is obliged to keep a magnifiying glass handy. The work is well indexed. The price is considerably higher than the two elegant folio volumes (with color plates), of the art of Cook's last voyage, and is possibly based on the minimum number of copies that could be sold to amortize the cost of publication. However this record price has severely limited acquisition by libraries with

limited budgets, and possibly has restricted convenient access to copy machines.

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Dissolved Oxygen in the Chesapeake Bay: Processes and Effects, Gail MacKiernan, Maryland Sea Grant Publication, College Park, Maryland, Publication Number UM-SG-TS-87-03, Free, No ISBN.

This volume is the produce of a seminar held in 1987 to consider the problems of oxygen depletion (hypoxia) in Chesapeake Bay. Many enclosed water bodies suffer from low oxygen levels, particularly during summer periods, when biological activity (*i.e.* oxygen demand) is highest, and water turnover rates are low. Although such conditions can occur naturally, they are often exacerbated by anthropogenic influences, particularly where and when BOD and COD are stimulated. The Chesapeake system, particularly in the lower reaches, shows a worsening trend over the last 25 years.

The volume is divided into three parts, the first dealing with recent trends, the second with the processes associated with dissolved oxygen and the third on the biological effects of hypoxia. Most authors stress the incompleteness of knowledge about the problem (a phenomenon that tends to increase in almost exponential proportion to the amount of data available), and there is an understandable caution about management strategies. The publication might have been strengthened by an integrated summary, especially if it signposted the way forward. As it is the volume rather fades away in the report of an inconclusive discussion (like so many conference resolutions). Notwithstanding this, it is an interesting contribution on a worldwide problem, and the editor should be congratulated on producing a concise, timely, and almost error-free text.

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Coasts, Hansom, J.D., 1989, Cambridge University Press, 100p., £5.25 ($9.95), ISBN 0 521 31377 5.

This book handles the theme "Coasts" in a very general way, involving almost all the subjects normally associated with coastal geomorphology from "recent" phenomena to the Quaternary. In the first four chapters the author exposes the reader to general ideas as to how the coast 'operates,' including both erosional or depositional processes. The main theme focuses on natural processes and resultant morphology. The following two chapters (5 and 6) are dedicated to particular aspects of the shoreline, namely coastal sand dunes and estuaries, with a slight, but efficient, characterization of this environment as to the important role in preservation of natural ecology.

The author adopts a different approach in the chapter on the problems of sea level rise. Although much of this material could possibly have been included in chapter two as it affects all the world's coasts, the author's choice is justified because of the increasing importance accorded to this particular subject over the last few years. Also by putting the sea-level information in a separate chapter it allows a little more exploration of the subject.

The last chapter (8) presents a different view of coastal problems, showing, in a clear way, the growing human occupation of the shoreline almost always without concern for the natural environment. In this chapter some negative attitudes of Man are discussed in relation to coastal environments for example, pollution. The book also presents some of the possible solutions for these problems. At the end of this chapter the reader should understand that there is no such thing as an ideal solution to, for example, the coastal erosion problem, largely because such problems are related to social-economic values that are not easy to deal with. I would have liked to suggest that this chapter be entitled "Coasts and Costs"...

The final evaluation of this book is obviously connected with the target readership, which the author has defined (in the preface) as "A-level students and introductory undergraduate courses." Bearing in mind this target readership, together with the idea to which the author also refers, "...to bridge the gap between the superficial level of general texts and the more detailed presentation in advanced texts and research papers" this is a well-written educational book, presenting in a concise way the theme, without, sometimes boring, scientific detail, but still using in a very accessible manner the author's scientific knowledge.

"Coasts" is recommended to those seeking something about the theme, who wish to have a more global view of the processes, morphology,