Book Reviews

Ecology: Progress and Self-Criticism

Unifying Concepts in Ecology. Papers from a congress, The Hague, Sept. 1974. W. H. VAN DOBBEN and R. H. LOWE-MCCONNELL, Eds. Centre for Agricultural Publishing and Documentation, Wageningen, Netherlands, and Junk, The Hague, 1975. 302 pp., illus. Dfl. 75.

These are the 23 invited papers of the First International Congress of Ecology. Speakers from 12 nations (and as many disciplines) were challenged to find unity under the conference title, "Structure, Function, and Management of Ecosystems." Another 40 of the 800 who attended participated in discussions, summaries of which are also included in the volume. The contributed papers have been published separately (also by the Centre for Agricultural Publishing and Documentation) as the *Proceedings* of the congress.

Unifying concepts are sought in two domains. One includes all kinds of ecosystems: terrestrial and aquatic; natural, disturbed, and man-made. The other includes all the subdisciplines: plant, animal, and microbial ecology; most of renewable resource management; portions of many environmental sciences. The ideas discussed bear little resemblance to the content of a standard ecology course of a decade or more ago. This book succeeds very well in providing a cross section of the current state of the art of the study of ecosystems.

Iconoclasts will be delighted. The thesis that diversity contributes stability to ecosystems is attacked by E. P. Odum, G. H. Orians, R. Margalef (Spain), and R. H. May. Others variously modify and reuse the concept. But the search for unifying concepts is not furthered; these authors propose at least three alternative views of relationship between diversity and stability.

F. H. Rigler attacks the concept of trophic levels and any other concept that cannot be made operational (all ecosystems include species that do not fit into single trophic levels). Others note difficulty with the vagueness of such terms as "diversity" and "stability" or "efficiency" and "productivity." Rigler emphasizes the need in science for falsifiable hypotheses, and the unease that follows shows in several places in the book. This kind of self-criticism is needed. A present tendency in ecology to call a hypothesis a theory, or to give credence to concepts through repetition, has led to confusion between what is verified and what has only been postulated. The kinds of recantation shown at this conference are healthy.

Empirical ecology is making solid progress. Extensive fieldwork forms the basis of about half the papers. Several of the studies reported on were part of the International Biological Program, which ended in 1974. Especially in papers such as those by D. E. Reichle *et al.*, S. S. Schwarz (U.S.S.R.), O. W. Heal (United Kingdom) *et al.*, L. Ryszkowski (Poland), and J. Jacobs (West Germany), the authors try to derive principles by generalizing from data. The paper by Jacobs is refreshing in its lack of preconceived judgment and its willingness to look at all the possible results of a given environmental change. Throughout the book the emphasis on energy is greater than it should be, although other factors such as water, nutrients, climate, and soils are better appreciated and understood than is usual in the literature.

Spatial differentiation is recognized in several papers as an aspect of ecosystems that is too often ignored. No breakthroughs in ways to cope with this difficult subject are presented, however.

The papers were presented in five morning sessions. The first three are devoted to natural systems, with emphasis on energy flow, nutrient cycling, productivity, diversity, stability, and system structure. The fourth session considers disturbed ecosystems, and the last turns to ecosystem management.

The base of data and experience for these last two sessions is surprisingly good, considering that few ecologists were involved with these subjects a decade ago. We are reminded that people are part of, not apart from, ecosystems, and also shown that irreconcilable conflicts of interest grow each year with population growth. C. S. Holling and W. C. Clark (Canada) argue for a new science of ecological management/engineering. Applied science traditions in fisheries ecology and insect pest ecology (I would add soil, forest, and wildlife ecology) offer a sound empirical base, and theoretical ecology suggests concepts of ecosystem structure susceptible to management. In particular, Holling and Clark argue for less attention to small perturbations and more study of large ones to develop a better understanding of ecosystem resilience. Such understanding, they feel, offers guidelines for management strategies and environmental design. Altogether, the papers of these last two sessions are responsive to public need, with a sense of competence and responsibility that is a welcome change from the rhetoric of environmental activism.

This first conference of its kind was sponsored by INTECOL (International Association for Ecology), itself formed in 1967 as the section for general ecology in the International Union of Biological Sciences. A second congress is scheduled for 1978.

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Locomotion in Fluid Media

Swimming and Flying in Nature. Proceedings of a symposium, Pasadena, Calif., July 1974. THEODORE Y.-T. WU, CHARLES J. BROKAW, and CHRISTOPHER BRENNEN, Eds. Plenum, New York, 1975. Two volumes. Vol. 1, xxii + pp. 1–422, illus. $39.50. Vol. 2, xvi + pp. 423–1006, illus. $39.50.

Largely as a result of the efforts of Theodore Wu, a large portion of the people currently concerned with the biophysics of locomotion in fluids gathered for the symposium that generated these volumes. For a field as clearly definable as this one proved to be, it is curious that such a meeting had never before occurred; the written record shares with the meeting that uniqueness and from it derives most of its virtues. First among these is illustration of the variety of approaches to a common set of problems—at once impressive, stimulating, and bewildering. Contributions range from moderately quantitative natural history to complex theoretical analyses, from thoughtful reviews to current research re-

ports, and, in systems considered, from bacterial flagella to dolphins and ornithopters. They include physical and mathematical models as well as reports of kinematic, biomechanical, and hydrodynamic investigations. And, as might be expected, they show a concomitant diversity in degree of relevance to what some might perceive as biophysical reality. At some points the living world seems to serve as a stimulus for the genesis of physical theory rather than as the target of its application.

The diversity of backgrounds of the contributors exacerbates many of the deficiencies common in the printed output of symposia. The papers speak many languages. The participants reportedly had problems communicating, and few readers will totally escape bafflement. The biologically trained will wonder about Stokeslets and vortex sheets, the physically adept about the shapes and proclivities of the beasts lurking beneath the Latin binomials. But most readers will find the general lectures of interest and value, in particular that of Brokaw and Gibbons on the mechanics of cilia and flagella, those of Blake and Sleigh on ciliary hydrodynamics, of Lighthill, of Weis-Fogh, and of Tucker on flight, and of Bone and of Newman and Wu on fish swimming. Each has clarity, simplicity, and perspective, together with a well-selected bibliography. The bibliographies (which include titles of all papers) should prove quite useful, since the literature germane to the field is terribly scattered and uneven.

I am struck by the natural division of the volumes between cellular phenomena (volume 1) and vertebrates and insects (volume 2). If these papers reflect current concerns, then an enormous void exists, one filled in nature by a vast diversity of actively swimming aquatic invertebrates, some (squid, for example) large but most of sizes and speeds in between those of the fashionable animals. According to one report here, a copepod can accelerate to 200 body-lengths per second, probably the present record for any swimmer. Clearly there are some accomplished and sophisticated organisms still escaping serious scrutiny.

The principal weaknesses of these volumes are matters of editing and production. Occasional statements that appear unreasonable go unchallenged, a disservice in an area where misinformation often becomes widely accepted. Inadequacies in figure legends and the axes of graphs are frequent. The subject index is too abbreviated to be particularly helpful. Errors of spelling and citation abound. More stringent guidelines for format and for uniformity of symbols and units would have been useful. And it might have been of interest to provide some information on the background of the participants. Finally, is it now impossible to get for $80 a book with proper superscripts and subscripts for formulas, with a clear separation of figure legends from text, and without the unhandy bulk of a two-volume typewritten manuscript?

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Land Snail Biology

Pulmonates. Vol. 1, Functional Anatomy and Physiology. VERA FRETTER and J. PEAKE, Eds. Academic Press, New York, 1975. xxx, 418 pp., illus. $35.

The Pulmonata are the subclass of the Gastropoda that includes all the nonoperculate land snails and slugs and a few families of freshwater, brackish-water, and marine snails and limpets, nearly all of which respire at least in part with a "lung." The land snails are of physiological interest because they are the only mollusks that have successfully forsaken aquatic habitats. This book, a sequel to *Physiology of the Mollusca*, edited by K. M. Wilbur and C. M. Yonge (two volumes, Academic Press, 1964 and 1966), is a quite well integrated series of eight up-to-date review articles on this and other aspects of the biology of the Pulmonata. (By contrast, the projected contents of volume 2—on systematics, evolution, zoogeography, ecology, and economic problems—are highly heterogeneous.)

It has long been known that the Pulmonata are derived from a marine group or groups, but there have been conflicting opinions about whether they came from the Opisthobranchia or directly from the more primitive Prosobranchia. In the introduction, Fretter favors a prosobranch (mesogastropod) origin. She states that terrestrial pulmonates probably came from the sea via estuarine and freshwater habitats (where the primitive pulmonates still live). In the chapter on water relationships, J. Machin cautions against using physiological data to ascertain whether this is so. Anomalously, F. Ghiretti and A. Ghiretti-Magaldi state that freshwater pulmonates "show various degrees of readaptation to aquatic life."

Although rich in species, pulmonates have a much narrower range of morphological diversity than the other two gastropod subclasses. Instead, they have had to evolve special physiological and behavioral adaptations to live progressively farther from the sea—even under extreme desert conditions. Pulmonate "lungs" contain varying proportions of water and air. Except when in deep water, the freshwater groups mainly have air. Thus in this respect they are preadapted to become terrestrial. In his review, Machin demonstrates how physiologically well-adapted some of the pulmonates have become to a terrestrial life insofar as the conservation of water is concerned. In their brief review on respiration, Ghiretti and Ghiretti-Magaldi reveal how surprisingly little is yet known about this subject. C. J. Duncan reviews the structure and function of the complex hermaphroditic reproductive system. Some of the marine species still have planktonic larvae; in the terrestrial pulmonates larval characters have had to be suppressed.

The other chapters review attributes and processes common to most animals. The greatest advances in knowledge are demonstrated in the chapters on the nervous system and endocrinology. The remaining chapters are on locomotion, the alimentary canal, and embryological development. Most major aspects of the functional morphology and physiology of pulmonates are skillfully considered or are mentioned somewhere in the book. There are references (regrettably lacking article titles) at the end of each chapter, and the volume concludes with systematic and subject indexes (the fact-filled introduction was not indexed and should have been).

This is the best book on scientific malacology to be published in several years. It will be of interest not only to malacologists, physiologists, endocrinologists, and embryologists but to biologists interested in ecophysiological adaptations.

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How Roots Work

The Development and Function of Roots. Papers from a symposium, Petersham, Mass., Apr. 1974. J. G. TORREY and D. T. CLARKSON, Eds. Academic Press, New York, 1975. x, 618 pp., illus. $32.25.

This collection of papers presented at the third Cabot symposium is an outstanding book. The first of its three parts deals with the organization and structure