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

of roots, the second with physiology, and the third with root nodule and mycorrhizal associations. Attention is given to the quiescent center and to cytokinin synthesis in roots and its possible role in differentiation and cell cycle dynamics, reflecting current interest in these topics. The part that deals with morphology also has interesting chapters on root branching, budding, tree root systems, and the organization of aquatic and aerial roots. The part that deals with physiology is especially valuable in summarizing recent advances in this area. Clear evidence is presented for the presence and acropetal transport of indoleacetic acid in roots. The acropetal movement of [1-^{14}C]-indoleacetic acid as measured in roots of *Zea mays* is strongest in the first millimeter at the tip and rapidly diminishes only 6 millimeters away. Some basipetal movement was also noted for each root section analyzed.

In the chapter on root geotropism L. J. Audus gently lays to rest the Cholodav-Went theory concerning geotropic response in roots and summarizes the evidence for root tip inhibitors. Not all will be convinced. Evidence on the role of amyloplasts as statoliths in the root cap is strong, however. Amyloplasts are readily redistributed in the cell by gravity, and roots with root caps removed lose all sensitivity to gravity, although normal elongation continues. It can be shown, further, that the renewal of gravity sensitivity is correlated with root cap regeneration and an increase in the formation of starch grains. In one study the number of starch grains in cells of the quiescent center increased more than 40-fold in the first six hours after decapping. Although these organelles may be sensitive to gravity, how its effect is transmitted to the cell is still not fully understood.

The last part of the book is entitled Roots in Relation to Soil Microflora. The focus in the chapters on nodules is principally developmental, and there are shorter chapters on mycorrhizal associations.

In view of the many ideas and new approaches suggested, some readers may be disappointed that the editors have not included their own comments or perhaps some of the discussion from the symposium. Small matter, however. *The Development and Function of Roots* will be a very useful reference for both students and researchers. It provides a synthesis of past results in the light of recent (1974) findings and it points to the many interesting questions still to be answered.

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BOOKS RECEIVED

Living Your Dying. Stanley Keleman. Bookworks, Berkeley, Calif., and Random, New York, 1976. x, 166 pp. Paper, $3.95.

The Magic Theater. The Psychology of Adjustment. Ernest J. Kinnie and Jacqueline Kelley. Harper and Row, New York, 1976. xviii, 328 pp. Paper, $5.95.

The Making of Human Agression. A Psychological Approach. Herbert Selg, Ed. Translated from the German edition (Stuttgart, 1971). St. Martin, New York, 1976. vi, 202 pp. $7.95.

The Middle East. A Geographical Study. Peter Beaumont, Gerald H. Blake, and J. Malcolm Wagstaff. Wiley, New York, 1976. xviii, 572 pp., illus. Cloth, $25.50; paper, $14.95.

Motion Sickness. J. T. Reason and J. J. Brand. Academic Press, New York, 1975. xii, 310 pp., illus. $24.25.

The Nature and Properties of Engineering Materials. Zbigniew D. Jastrzebski. Wiley, New York, ed. 2, 1976. xviii, 634 pp., illus. $19.95.

Neuronal Mechanisms of the Orienting Reflex. Papers from a symposium, Moscow. E. N. Sokolov, O. S. Vinogradova, A. Pakula, and A. L. Yarmizina, Eds. Translated from the Russian edition (1970) by E. N. Sokolov. Norman M. Weinberger, Ed. Erlbaum, Hillsdale, N.J., 1975 (distributor, Halsted [Wiley], New York). x, 302 pp., illus. $17.50.

Neurotransmitter Balances Regulating Behavior. Edward F. Domino and John M. Davis, Eds. NPP Books, Ann Arbor, Mich., 1975 (order from P.O. Box 1491, Ann Arbor 48106). xii, 240 pp., illus. $12.50.

Nitrogen Fixation by Free-Living Micro-Organisms. Papers from a meeting, Edinburgh, Sept. 1973. W. D. P. Stewart, Ed. Cambridge University Press, New York, 1976. xxii, 472 pp., illus. $37.50. International Biological Programme 6.

On Perception. Hans Wallach. Quadrangle (New York Times), New York, 1976. xviii, 490 pp. $15.

Origins of Intelligence. Infancy and Early Childhood. Michael Lewis, Ed. Plenum, New York, 1976. x, 414 pp. $17.50.

The Patchwork Mouse. Joseph Hixson. Anchor/Doubleday, Garden City, N.Y., 1976. xii, 228 pp. $7.95.

Perceptual Psychology. A Humanistic Approach to the Study of Persons. Arthur W. Combs, Anne Cohen Richards, and Fred Richards. Harper and Row, New York, 1976. xvi, 492 pp., illus. Paper, $9.95. Revision of *Individual Behavior*.

Petroleum Discoveries and Government Policy. An Econometric Study of Supply. Dennis N. Epple. Ballinger (Lippincott), Cambridge, Mass., 1975. xvi, 140 pp., illus. $15.

Petroleum Economics and Engineering. An Introduction. Hussein K. Abdel-Aal and Robert Schmelzlee. Dekker, New York, 1976. viii, 422 pp., illus. $29.50. Chemical Processing and Engineering, vol. 6.

Phase Diagrams. Materials Science and Technology. Vol. 4, The Use of Phase Diagrams in Technical Materials. Allen M. Alper, Ed. Academic Press, New York, 1976. xviii, 310 pp., illus. $28. Refractory Materials, vol. 6.

Photographic Information Recording. Photographische Informationsaufzeichnung. H. Frieser with contributions by Klaus Biedermann. Halsted (Wiley), New York, 1975. xxiv, 592 pp., illus. $67. The Focal Library.

Physical Geology. Principles, Processes, and Problems. Charles J. Cazeau, Robert D. Hatcher, Jr., and Francis T. Siemankowski. Harper and Row, New York, 1976. x, 518 pp., illus. $13.95.

Picture Processing and Reconstruction. Sheldon S. Sandler. Lexington (Heath), Lexington, Mass., 1975. xx, 164 pp., illus. $19.95.

Plastics Technology. Theory, Design, and Manufacture. William J. Patton. Reston Publishing Co. (Prentice-Hall), Reston, Va., 1976. xiv, 274 pp., illus. $15.95.

Possible Relationships between Solar Activity and Meteorological Phenomena. Proceedings of a symposium, Greenbelt, Md., Nov. 1973. William R. Bandeen and Stephen P. Maran, Eds. National Aeronautics and Space Administration, Washington, D.C., 1975 (available from the Superintendent of Documents, Washington, D.C.). x, 264 pp., illus. Paper, $4. NASA SP-366.

Primitive Internalized Object Relations. A Clinical Study of Schizophrenic, Borderline, and Narcissistic Patients. Vamik D. Volkan. International Universities Press, New York, 1976. xxiv, 344 pp. $13.50.

Principles of Digital Computer Design. Vol. 1. Abd-Elfattah M. Abd-Alla and Arnold C. Meltzer. Prentice-Hall, Englewood Cliffs, N.J., 1976. xviii, 606 pp., illus. $18.50.

Principles of Earth Science. Arthur N. Strahler. Harper and Row, New York, 1976. xii, 434 pp., illus. $14.95.

The Principles of Inorganic Chemistry. William L. Jolly. McGraw-Hill, New York, 1976. viii, 376 pp., illus. $16.

Psychoanalytic Theory. An Exploration of Essentials. George S. Klein. International Universities Press, New York, 1976. x, 330 pp. $17.50.

An Outline of Structural Geology. Bruce E. Hobbs, Winthrop D. Means, and Paul F. Williams. Wiley, New York, 1976. xx, 572 pp., illus. $16.95.

R. D. Laing. The Man and His Ideas. Richard I. Evans. Dutton, New York, 1976. lxxviii, 170 pp. Cloth, $12.95; paper, $3.95. Dialogues with Notable Contributors to Personality Theory, vol. 10.

Regional Development in Western Europe. Hugh D. Clout, Ed. Wiley, New York, 1976. xii, 328 pp., illus. Cloth, $22; paper, $11.95.

Review of Child Development Research. Vol. 5. E. Mavis Hetherington, John W. Hagen, Reuben Kron, and Aletha Huston Stein, Eds. University of Chicago Press, Chicago, 1976. x, 616 pp. $17.50.

The Saccharine Disease. Conditions Caused by the Taking of Refined Carbohydrates, such as Sugar and White Flour. T. L. Cleave. Keats Publishing, New Canaan, Conn., 1975. xvi, 200 pp., illus. Paper, $4.95.

Science Policies of Industrial Nations. Case Studies of the United States, Soviet Union, United Kingdom, France, Japan, and Sweden. T. Dixon Long and Christopher Wright, Eds. Praeger, New York, 1975. xvi, 236 pp. $17.50. Praeger Special Studies in International Politics and Government.

Scientific Instruments. Harriet Wynter and Anthony Turner. Scribner, New York, 1976. 240 pp., illus. $27.50.

Sister Kenny. The Woman Who Challenged the Doctors. Victor Cohn. University of Minnesota Press, Minneapolis, 1976. x, 302 pp. + plates. $16.50.

Sophus Lie's 1880 Transformation Group Paper. Translated from the German by Michael Ackermann. Comments by Robert Hermann. Math Sci Press, Brookline, Mass., 1975. xxiv, 564 pp. Paper, $28. Lie Groups, vol. 1.