

tunity to hear the fantastic sounds that fill an African night.

The book is lavishly illustrated with excellent photographs which are reproduced clearly in authentic color on glossy paper. There are 135 color photographs of the 84 species and numerous black and white pictures depicting details of structure. I always thought a drawing could illustrate structure better than a photograph, but the quality of these illustrations has changed my mind. Most of the photographs were made by Mr. Carruthers, a naturalist and obviously a superb photographer. Even the field key to genera is illustrated with photographs of diagnostic details from living frogs, a most useful feature for the novice. Descriptions of the 23 genera include diagnostic characters, general description, and a picture of a typical form, as well as information about habits and habitat, sexual dimorphism, eggs, reproductive mode, and distribution and numbers of species. In addition to one or more color photographs and a range map for South Africa, each species is illustrated by black and white photos of the frog (life-size), its ventral surface, and diagnostic features of its feet. For most species, a sonogram of mating calls is also included.

Brief introductory sections discuss photography, sound recordings and sonograms, nomenclature, structure of a key, maps and the nature of species and subspecies. I found the well-illustrated discussion of the basics of acoustic biology extremely clear as are sections on reproduction, development, color, thermal and moisture requirements, and feeding. The appendix presents a tabular treatment of distinguishing features of pertinent subspecies. A 3-page glossary, a selected bibliography and a workable index complete the volume.

Although the book is presented as a field guide, I'm not sure that is a realistic description. I would never take my copy into the field—it is too beautiful and too large. But it is just the reference one needs to do field work. How I wish I had had such a volume when I went to Africa and tried to sort out for study the vast array of unknowns I found around me. Having such a thorough manual available should stimulate others to make much needed investigations of African Amphibia. More than most field guides, South African Frogs emphasizes the total biology of the species. Its overwhelming aspect is visual, and its attempt to tie in sound, reproductive behavior, and color,

those dominating features of anuran biology, have been achieved about as well as can be imagined on the printed page. Since Passmore's specialty is acoustic biology, he has given calls a prominent role in the book.

The book is primarily a guide to identification therefore only a few significant references are included. These planned omissions will disturb the specialist more than the amateur. A feature so striking as the green blood and green eggs of *Hyperolius pusillus* would have made a tantalizing inclusion which might have stimulated study on a little understood phenomenon. Three minor errors in the bibliography were the only inaccuracies I found in the entire book.

Combining the talents of Neville Passmore and Vincent Carruthers has produced a volume which doubtless would not have been possible for either alone. I hope their exceptional abilities continue to produce volumes the world can enjoy. This one is an absolute must for anyone interested in African Amphibia. And congratulations to the University of Witwatersrand Press for publishing such a high quality product at such a reasonable price.—MARGARET M. STEWART, *Department of Biological Sciences, State University of New York at Albany, Albany, New York 12222.*

Copeia, 1980(4), pp. 948-949
© 1980 by the American Society of
Ichthyologists and Herpetologists

BIOLOGY OF THE CYCLOSTOMES. M. W. Hardisty. 1979. Chapman and Hall: London. \$59.95. M. W. Hardisty has produced a timely and comprehensive summary of the biology of lampreys and hagfishes. Topics covered in the book include the relationships of lampreys and hagfishes, distribution, ecology and behavior, comparative biochemistry and physiology. Anatomical descriptions are also given of the skeleton and muscular system, nervous system and endocrine organs.

Hardisty's treatment of the anatomy of lampreys and hagfishes is somewhat uneven in depth of presentation and balance. The structure of the nervous system and pituitary is discussed in great detail while the structure of the musculoskeletal system is very brief. The reader is referred to more detailed anatomical treatises in the Preface (Pietschmann, 1934; Marinelli and Strenger, 1954), but this is hardly

adequate in light of the importance of the musculoskeletal system for hypotheses of cyclostome monophyly and lower vertebrate relationships. Myotomal muscle structure is discussed for 13 pages while no mention at all is made of cephalic musculature; a more balanced and descriptive approach to the musculoskeletal system and notochord would have been extremely useful.

Hardisty discusses previous hypotheses of the phylogeny of lower chordates in an early chapter but reaches conclusions of his own in a final summary section on evolutionary perspectives. Based on a number of characters, apparently including those of Løvtrup (1977), he concludes that lampreys are more closely related to gnathostomes than to the hagfishes. Hagfishes are thus the sister group to the lampreys plus gnathostomes, an assemblage which, including the heterostracans, has been called the Myopterygii by Janvier (1978). Thus, the Cyclostomata is a paraphyletic group. We cannot help but wonder how different this book would have been had it been arranged in line with the author's own phylogenetic conclusions. So arranged, the book would have made clear which aspects of "cyclostome" biology are probably primitive for vertebrates, which are unique to each of the lineages of jawless vertebrates, and which are unique to the lampreys plus gnathostomes. This information, so important to students of early vertebrate evolution, is buried in the descriptions of "cyclostome" biology.

The systematic analysis in the book is claimed to be phylogenetic (*sensu* Hennig, 1966), yet the author also cites Løvtrup (1977) for his methodology; we are not told how polarities were determined and outgroup comparison is never mentioned. It is also curious and disturbing that in the chapter which Hardisty seems to highlight, on comparative biochemistry and cytogenetics, the systematic analysis is almost entirely phenetic. The analytical method used is the difference index ($S\Delta Q$) of Marchalonis and Wellman (1971) rather than any of a number of phylogenetic methods available for such data. This unfortunate lapse, in addition to the somewhat confused phylogenetic analysis of non-biochemical characters, may cause some readers to question the author's important and somewhat controversial conclusions. Nevertheless, in spite of these difficulties, it would appear that Hardisty's conclusion about the paraphyly of the "Cyclostomata" is sound. A number of useful tables succinctly summarize compari-

sons between lampreys, hagfishes and gnathostomes.

Recent papers that have appeared since the publication of this volume include the review of lamprey neurobiology by Rovainen (1979) and a new study of the ammocoete feeding mechanism by Mallatt (1979).

In spite of our misgivings about certain sections of this book, the generally clear and complete survey of "cyclostome" biology and the extensive references (47 pages) will make this book extremely useful as a supplement for courses in fish biology, comparative anatomy and vertebrate evolution.

LITERATURE CITED

- HENNIG, W. 1966. Phylogenetic systematics. Univ. Illinois Press, Urbana.
- JANVIER, P. 1978. Les nageoires paires des Ostéostracés et la position systématique des Cephalaspidiomorphes. *Annl. Palaentol.* 64:113-142.
- LØVTRUP, S. 1977. The phylogeny of the Vertebrata. Wiley and Sons, New York.
- MALLATT, J. 1979. Surface morphology and functions of pharyngeal structures in the larval lamprey *Petromyzon marinus*. *J. Morph.* 162:249-273.
- MARCHALONIS, J. J., AND J. K. WELLMAN. 1971. Relatedness among proteins. A new method of estimation and its application to immunoglobulins. *Comp. Biochem. Physiol.* 38B:609-625.
- MARINELLI, W., AND A. STRENGER. 1954. Vergleichende Anatomie und morphologie der Wirbeltiere. Vol. 1. *Petromyzon fluviatilis*. Vol. 2. *Myxine glutinosa*. Deuticke, Wien.
- PIETSCHMANN, V. 1934. Acrania (Cephalochordata)—Cyclostomata—Ichthya, p. 127-157. *In: Handbuch der Zoologie*. W. Kükenthal and T. Krumbach (eds.). W. de Gruyter, Berlin, Vol. 6.
- ROVAINEN, C. M. 1979. Neurobiology of Lampreys. *Physiol. Reviews* 59:1007-1077.
- WILLIAM L. FINK AND GEORGE V. LAUDER, JR., *Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138.*

Copeia, 1980(4), pp. 949-950
© 1980 by the American Society of
Ichthyologists and Herpetologists

READINGS IN ICHTHYOLOGY. Edited by Milton S. Love and Gregor M. Cailliet. 1979. Goodyear Publishing Company, Inc., Santa Monica, California. xiv + 525 pp. \$16.95.—One of the difficulties encountered in teaching ichthyology is selecting an appropriate text. This can become a major concern if the course is