Current Problems of Lower Vertebrate Phylogeny. Proceedings of the Fourth Nobel Symposium Held in June 1967 at the Swedish Museum of Natural History (Naturhistoriska riksmuseet) in Stockholm.

Review Author[s]:
David B. Wake

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CATALOGUE OF THE TYPE SPECIMENS OF MICROLEPIDOPTERA IN THE BRITISH MUSEUM (NATURAL HISTORY) DESCRIBED BY EDWARD MEYRICK. *Volume VI: Glyphipterigidae, Gelechiidae (A-C).*

By J. F. Gates Clarke. Trustees of The British Museum (Natural History), London. £15. vi + 537 p.; ill.; no index. 1969.

CATALOGUE OF THE TYPE SPECIMENS OF MICROLEPIDOPTERA IN THE BRITISH MUSEUM (NATURAL HISTORY) DESCRIBED BY EDWARD MEYRICK. *Volume VII: Gelechiidae (D-Z).*

By J. F. Gates Clarke. Trustees of The British Museum (Natural History), London. £15. iv + 531 p.; ill.; no index. 1969.

THE PTEROMALIDAE OF NORTH-WESTERN EUROPE (HYMENOPTERA: CHALCIDOIDEA). *Entomology Supplement 16.*

By M. W. R. de V. Graham. British Museum, (Natural History), London. £19 (paper). 908 p.; ill.; host and parasite indexes. 1969.

GALL MIDGES OF ECONOMIC IMPORTANCE. *Volume VIII: Gall Midges — Miscellaneous.*

By W. Nijveldt; foreword by C. B. Williams. Crosby Lockwood and Son, London. 45 s. 221 p. + 14 p. pl., midge index and plant index. 1969.

MOLLUSKS.

By Paul Bartsch. Dover Publications, New York. $2.00 (paper). ix + 111 p. + 37 p. pl.; ill.; subject index. [Reprinting of Part III, "Mollusks," from *Shelled Invertebrates of the Past and Present, with Chapters on Geological History,* by Bassler, Resser, Schmitt, and Bartsch, 1934, Smithsonian Institution Series, Volume 10.] 1968.

THE SHELL STRUCTURE AND MINERALOGY OF THE BIVALVA. *Introduction. Nuculacea–Trigonacea. Zoology Supplement 3.*

By J. D. Taylor, W. J. Kennedy, and A. Hall. British Museum (Natural History), London. £4 10s (papers) 125 p. + 29 p. pl.; ill. 1969.

THE ZOOLOGY OF TROPICAL AFRICA. *The World Naturalist Series.*

By J. L. Cloudsley-Thompson. W. W. Norton & Company, New York. $12.50. xv + 355 p. + 16 p. pl.; ill.; subject index. 1969.

In the Introduction to this book, Cloudsley-Thompson says that it describes ". . . the ecological and physiological adaptations of animals to the variety of environments found in tropical Africa." If such, indeed were the case, it would be a unique work. Yet, the first 185 pages constitute a zoological survey, organized by habitats, with only an occasional indication given as to the ecological or conceptual importance of the species mentioned. Furthermore, the writing at times seemingly defies logic. For example, the author states on page 88 that male giraffes ". . . appear to frequent more forested regions than females and may therefore be more susceptible to predators, *since* (italics mine) there is a preponderance of males to females at birth. As each male circulates among a great number of females, it is probably *advantageous* to the species that more males should be killed than females" (p. 88). The book also has more than its share of errors. Suffice it to mention here that: (1) the mole-rat (*Tachyoryctes*) and the flying lemur are both herbivorous, not insectivorous; (2) soil, not solar, temperatures are referred to on page 123; and (3) the fish *Protopterus* and *Polypterus* are transposed in Figure 23.

This book has several fine features, the most striking one being the enthusiasm and experience of the author. Obviously, he is well acquainted with a broad spectrum of animals, the problems they face, and some of the solutions that they have used. This is especially clear in the last half of the book, which is organized by chapters on the adaptation of animals to specific environments. Cloudsley-Thompson concludes his book with a chapter on "Man as an ecological factor," in which he gives a historical perspective to the effect of man on the fauna of Africa. He clearly states his concern for the future of its megafauna, concluding that "One of the major tasks of zoologists in tropical Africa is to find out as much as possible of the physiology and ecology of the natural fauna while there is still some of it left. It is impossible to forecast what information may be needed in the future" (p. 302). Obviously, as biologists and as humans sensitive to the quality of our environment, we have much work to do. This book should provide a stimulus to such work.

BRIAN K. MCNAB

AN ILLUSTRATED LABORATORY TEXT IN ZOOLOGY. *Second Edition.*

By Richard A. Boolootian and Donald Heyneman. Holt, Rinehart and Winston, New York. $5.95 (paper). xiv + 262 p.; ill.; subject index. 1969.

CURRENT PROBLEMS OF LOWER VERTEBRATE PHYLOGENY. *Proceedings of the Fourth Nobel Symposium held in June 1967 at the Swedish Museum of Natural History (Naturhistoriska riksmuseet) in Stockholm.*

Edited by Tor Ørvig. Interscience Publishers (division of John Wiley & Sons), New York, London and Sydney; Almqvist & Wiksell, Stockholm. $35.00. 539 p.; ill.; index of authors, genera, and species. 1968.

Recently the Nobel Foundation has co-sponsored symposia with several Swedish organizations, and the present volume is a record of the fourth, held in June, 1967. The distinguished Swedish paleontologists Erik Jarvik and Erik Stensiö assembled a group of active researchers on lower vertebrate evolution. The volume is heavily weighted toward paleontology, especially of Paleozoic fishes, but several papers on other disciplines, including cytology, appear. By and large these are important papers and the book is an excellent introduction to a vigorous area of science that has been shaken by lively controversies in recent years.

Throughout most of his long career, Stensiö has held that the hagfishes and lampreys have had quite independent origins. Here he summarizes his views, and adds an important new idea. Through the use of ontogenetic information, he attempts to prove that hagfishes and lampreys actually have paired nasal sacs, like all other living vertebrates. From this new base, he proceeds with his older views that two distinct lineages of ostracoderms with two kinds of snouts gave rise to lampreys and hagfishes, respectively. His paper is a useful summary of the basic features uniting and separating groups of living and fossil agnathans.

Ostracoderms receive the attention of two other authors. N. Heintz reports a pteraspidomorphan with an anterodorsally oriented mouth (all others are ventral), thus providing more evidence of the diversification of the group. Ritchie reports new information on the poorly known thelodonts, which further establishes their isolated phylogenetic position.

Discussions of the origins of vertebrate skeletal tissues are usually enlivened by controversy, and this volume adds four noteworthy contributions. Jollie surveys implications of acceptance of the delamination principle, which emphasizes the internalization of superficial tissue layers during phylogeny. Bone is viewed as having formed in vascular outer layers and cartilage in nonvascular, deeper layers. The diversity of structure among the earliest vertebrates is stressed, and Jollie sees a deep schism between gnathostomes and agnathans. In a concise and convincingly written review, Moss summarizes his general theory of biological mineralization and considers the origin of vertebrate calcified tissues in its light. He outlines the unique features of vertebrate mineralization processes that led to the origin of bony tissues, and the conditions which might have favored them. Vertebrate hard tissues are viewed as initially nonadaptive by Ørvig. He thinks an assimilation of odontodes (dermal teeth) and their secondary association with an underlying thick bony layer gave rise to the dermal skeleton, and that the various conditions in fishes evolved by way of "regressive" changes in this system. Scales of some Paleozoic sharks contain cells similar to odontoblasts, according to Zangerl. These cells may have been intermediate in character between odontoblasts and osteoblasts and Zangerl thinks that they may have formed a substance intermediate between bone and dentine. It is unfortunate that these four papers of direct relevance to each other appear with no attempt to bridge the obvious gaps that separate the various theories.

Events at the base of the gnathostome radiation receive the attention of several authors. Acanthodians are a controversial group of primitive gnathostomes which have been associated with primitive bony fishes in recent years. Miles stresses similarities in jaw structure to paleoniscoids and concludes that the hyomandibula is primarily an expander of the orobranchial chamber. He finds no complete spiracular gill slit in any primitive gnathostome, and seems to have disposed of Watson's Aphetohyoidea in a definitive way. But Nelson, dealing with the same general topic and even the same materials, emphasizes similarities of hyoid structure between acanthodians and cartilaginous fishes (elasmobranchiomorphs) rather than with primitive bony fishes. Nelson leaves open the possibility of the correctness of Watson's reconstruction of a complete spiracular gill slit in the group. Printed discussion on these points of controversy would have been a welcome addition.

A. Heintz criticizes Stensiö's classification of primitive gnathostomes on the basis of new information, and Stensiö, in response, admits defects and elaborates some features of a revised classification, since published in the *Traité de Paléontologie.*

The origins and relationships of the chimaerans (Holocephali) have long been obscure, and two papers touch on the problem. Bradyodonts, a primitive group of Paleozoic gnathostomes, have been considered chimaeran relatives by some workers, but Bendix-Almgreen denies a relationship. Patterson, however, views the question more broadly and in greater detail, and he includes bradyodonts in three orders of the Class Holocephali, placing a number of forms in the same order as the living chimaerans. Again, there is no printed discussion of these opposing viewpoints.

Basic osteichthyan radiations are considered by Schaeffer, Jarvik, and Denison. Schaeffer favors assigning equal rank to the actinopterygian, crossopterygian and dipnoan lineages, and thinks they

arose from a Silurian acanthodian group. Neurocranial structure in relation to modes of feeding and respiration is emphasized, and little evidence of close relationship of any two groups is seen. Denison, however, reports features of the earliest dipnoans which resemble those of rhipidistian crossopterygians. Jarvik differs sharply from both, and isolates the dipnoans from other fishes. He rejects both the categories Crossopterygii and Sarcopterygii, separating dipnoans, coelacanths and rhipidistians into quite separate lineages. He reiterates his view that *Polypterus* and allies should be separated from the actinopterygians, and questions the reality of the two great subdivisions of gnathostomes previously recognized by him, the teleostomes and the elasmobranchiomorphs. He tentatively suggests the possibility of dipnoan-holocephalan relationships. These three papers differ radically in several regards from each other, and Jarvik, in particular, has suggested major realignments. More data are needed to rationalize these different viewpoints.

Modern fishes are not ignored, and both Jessen and Nybelin examine features in the gular plates and dentition, respectively, of primitive fishes that may have relevance to an understanding of patterns of teleost evolution.

Head morphogenesis and its relationship to early gnathostome evolution is considered in two papers. Bjerring thinks the joint between the anterior and posterior parts of the crossopterygian braincase is a primitive gnathostome feature, representing a serial homologue of vertebral joints within a hypothetical second somite. On topographic grounds the basicranial muscle is considered to be the precursor of the polar cartilage, which Bjerring thinks has evolved independently many times. This contrived and speculative theory is typological in approach, and is unlikely to replace the more prevalent view that the braincase division has a functional explanation. Especially troublesome is the fact that the tenth cranial nerve innervates the basicranial muscle, supposedly derived from the second somite. The argument is based on the premise, following Jarvik, that rhipidistians are the most generalized of the known gnathostome groups.

Bertmar compares his studies of lungfish head morphogenesis with the recent work of Thomson and Fox. Hypothetical "preteleostome" and "preichthyes" patterns are advanced, and chondrification centers and vascular patterns are analyzed. Actinopterygian, dipnoan, and crossopterygian lineages are seen, with all tetrapods derived from the last. Urodele-dipnoan similarities are thought to result from parallelism. Typological reasoning is distressingly obvious, and speculations concerning homologies are not convincing. Little or no consideration is given to adaptive processes.

The transition from fish to amphibian and aspects of lower tetrapod phylogeny are discussed by several authors. Jarvik extends his early views to assert that the modern Amphibia are a triphyletic assemblage. Thomson addresses himself to two questions: are rhipidistians diphyletic, as Jarvik claims; and are living amphibians derived from quite distinct rhipidistian stocks? He answers "no" to both. In contrast to views of Holmgren, Thomson concludes that salamander limbs do not differ significantly from those of other tetrapods. He reviews some other types of evidence, and takes Jarvik to task for his dogmatic statements concerning the ancestory of modern amphibians. Thomson refrains, however, from supporting the view that all living amphibians form a natural group.

Lehman briefly criticizes the concept of the "Lissamphibia," arguing that neither vertebral nor dentitional evidence supports the view of Parsons and Williams that the modern Amphibia are a monophyletic group.

Theories concerning the evolution of cranial features in the fish-tetrapod transition are criticized from a developmental viewpoint by Devilliers and Corsin. They find current phylogenetic speculations to be simplistic, and think that complexes of factors influence changes in bone growth patterns. Cranial anatomy of modern amphibians is also the topic of a paper by Lebedkina, who stresses the importance of selection operative at one period of life, for example, the larval period, on the structure of the adults.

The development and evolutionary significance of the vomeronasal organ of frogs and salamanders are considered by Medvedeva, who supports earlier hypotheses advanced by her and by Schmalhausen.

Two papers concerning cytological topics are somewhat out of place in this volume. Szarski thinks cell size can provide information concerning past selective events. In a stimulating research paper, Olsson suggests that cells of the adenohypophysis which produce prolactin and related substances were derived from mucus-producing areas of the oral epithelium which became internalized. The cell masses have ducts or follicles in most primitive fishes, and this seems to support his view.

Only one paper on theoretical aspects of taxonomy appears, and it is a vigorous defense of Hennig's views. Brundin's paper is long on rhetoric, but short on methodology. He fails to discuss the major implications of adoption of the system. Brundin sees attention to sister group formation and true monophyly as being vital to the construction of a classification. These ideas seem to be

accepted implicitly by the Swedish school of paleontologists, as is clear in the concluding article of the volume, where Jarvik presents, in slightly modified form, his now familiar views on vertebrate phylogeny. It is now clear that the debates of the past 30 years have resulted in large part from the failure of participants to clearly state their goals, their theoretical premises, and their taxonomic philosophy and methodology.

The volume is attractively produced and excellently illustrated, but is badly over-priced. It is an excellent reminder that lower vertebrate phylogeny is a vigorous and exciting area of science. Vertebrate history is too often presented as a story with all the significant questions answered. This is the fault of many in the field, who deal too much with dogma, assertions, and pet theories, while ignoring the work of others. While these criticisms apply to some of the contributors of this volume, there has been an attempt to have different views represented, and the careful and objective reader will quickly sense the challenges remaining.

DAVID B. WAKE

CHECKLIST OF CANADIAN FRESHWATER FISHES WITH KEYS FOR IDENTIFICATION.

By W. B. Scott and E. J. Crossman. Life Sciences Miscellaneous Publications, Royal Ontario Museum, Toronto. $1.50. (paper). 104 p.; ill.; subject index. 1969.

THE CAECILIANS OF THE WORLD. *A Taxonomic Review.*

By Edward Harrison Taylor. University of Kansas Press, Lawrence. $25.00. xiv + 848 p.; ill.; subject index. 1968.

Naturalists were perplexed by the first limbless, long-bodied amphibians that reached Europe. Linnaeus grouped them with the snakes, but another student thought they were related to the lampreys. Since 1831, however, when a Dutch naturalist examined a juvenile caecilian from Java and found characters pointing to affinities with the salamanders and frogs, zoologists have recognized the Gymnophiona as one of the three surviving orders of the Amphibia.

Unlike salamanders and frogs, caecilians are largely restricted to moist, tropical environments, despite a wide distribution in portions of four continents and several islands, including Ceylon, the Seychelles, and the Philippines. Owing to their secretive habits, whether in terrestrial or aquatic habitats, caecilians are devilishly difficult to find. A fair percentage of the species is represented in collections by no more than one or two specimens. Largely for this reason systematists have shied away from comprehensive studies of the caecilians, and the habits and behavior of these odd amphibians have remained nearly as obscure as their ancestry. Anatomical studies reveal a curious mixture of primitive characters and adaptive specializations, but thus far paleontologists have shed no light on the origin or the affinities of the Gymnophiona.

The task of reviewing the relatively meager literature dealing with caecilians would not have been difficult, but E. H. Taylor's efforts to summarize our knowledge of the group extends far beyond this objective. He had examined virtually every caecilian extant in some 58 collections before he contemplated his review. An introductory section includes a resume of the literature and sections dealing with various features of the morphology of caecilians, their distribution, habitats, food, predators, and life histories. The bulk of the account, however, is devoted to keys, diagnoses, and descriptions, illustrated with drawings, photographs, and radiographs, followed by a 48-page bibliography and a systematic index.

Fewer than 60 species were known in 1920 when Taylor discovered an undescribed species in the Philippines. Before he undertook his revision of the order he had described 30 species, however, and he added descriptions of 35 more as he prepared his account. Thus 65 of the 158 species he recognizes were described by Taylor himself. He groups the species in 34 genera, only four of which contain more than six species. As viewed by Taylor, one genus contains 28 species, but no fewer than 12 are monotypic. Although earlier students of the Gymnophiona referred all genera to a single family, Taylor attempts to group them in three ill-defined families.

If this arrangement proves to be tenable, one of the families Taylor recognizes is restricted to South America, another has representatives in Africa and Asia, whereas members of the third occur in Asia, Africa, and in the Americas as far north as southern Mexico. As Taylor notes, disjunct ranges in some instances reflect the inadequacy of collections, but otherwise he makes little effort to account for bizarre distributions, although a few maps might have clarified his brief discussion. He observes that "by our present standards" no caecilian in the Western Hemisphere can be regarded as congeneric with any in Africa and Asia. Farther on, in a brief discussion of a family proposed for a Brazilian caecilian he states that the unusual characters the species shares with one in Africa "have arisen twice, and on two different continents," or we must assume that the two species "belong to a widely distributed genus, having a single survivor on each of two continents." Taylor evidently attributes the similari-