Vertebrate Morphology

Comparative Vertebrate Morphology. DOUGLAS WEBSTER and MOLLY WEBSTER. Academic Press, New York, 1974. xiv, 518 pp., illus., + plates. $14.95.

Analysis of Vertebrate Structure. MILTON HILDEBRAND. Illustrated by Viola and Milton Hildebrand. Wiley, New York, 1974. xviii, 710 pp., illus. $14.95.

Fifteen years ago comparative anatomy seemed moribund. The last few years have seen a drastic change in this pattern, and these two volumes, each the product of years of teaching experience and the collaboration of a wife-husband team, constitute a bench mark documenting the nature and direction of the change.

The "classical" course in comparative vertebrate anatomy suffered from a variety of problems. Some of these had little to do with the intellectual content of the subject. There was a well-founded rumor that medical school admissions boards paid particular attention to the grades obtained in comparative anatomy and organic chemistry. Consequently, all "premeds" knew that they must take the course and compete for grades. Many instructors, unfortunately, responded by shifting emphasis from concepts to facts, grading on a curve, and testing for the rote memorization of names for the multitudinous slips and processes of the elements into which animals could be dissected. Ultimately teachers of vertebrate morphology lost a clear conception of what should be studied and why it belonged in the curriculum.

Meanwhile, the discipline itself had become sterile. Vertebrate biology had actually gotten its start as a separate discipline during the last decades of the 19th century, when the data available became so many that no one could deal comparatively with the biology of all animals. Unfortunately there was a simultaneous and parallel series of dichotomies into functional and structural pursuits. First physiology and then experimental embryology became "independent," while structural studies gradually became restricted to the once-fruitful search for homologies among vertebrate organ systems. With some notable exceptions, this search was of a typological nature; the concepts of interspecies and of interspecific (as opposed to higher-level) structural diversity were ignored. The mapping of structural minutiae became an end in itself; approaches such as James Gray's experimental analysis of animal locomotion as a kind of behavior intimately reflecting animal structure remained peripheral. Böker's major attempt to organize structure with a functional approach ignored evolutionary concepts. A prevalent view characterized anatomy/morphology as an "independent" field of study that derived justification from its documentation of the evolutionary process by means of numerous, generally typological, structural sequences. Scalpel and microtome blade were its standard tools; injection media and x-rays served to map details of internal condition.

As a result of these unfortunate developments the course in comparative anatomy or vertebrate morphology became a "service" course that anyone could teach. Its instruction was relegated to the lowest-ranking faculty, and many colleges were dropping it altogether. Attempts were made to increase its respectability by merging its contents with those of courses in embryology. A one-year course was shrunk to a single semester and its laboratory from two to one afternoon a week. None of these attempts solved the basic problems. Many histologists, systematic zoologists, and paleontologists were hired to teach comparative anatomy. It is not surprising that most of their students turned to other fields.

Actually, significant morphological questions were arising in some of these other fields. Taxonomists mapped structural conditions in morphologically "uniform" groups and showed that the diversity was indeed significant. Paleontologists looked at Recent species as keys to the mode of life of forms known only from fossil remains. Ethologists and ecologists attempted to correlate structural differences with adaptive changes in behavior and mode of life history. All found that the heritage of a hundred years of morphological study, though voluminous, was inadequate. The facts tabulated in seven-volume handbooks were sufficiently detailed for broad comparison; they were not adequately correlated to the adaptive functions that the structures presumably enabled. These developments sparked a resurgence of comparative and functional vertebrate morphology not delimited by an anatomist's tools or reference frame but utilizing data from fieldwork and cinematography, electromyography, and cinefluoroscopy. Soon followed the formation of an active new subsection of the American Society of Zoologists and a series of attempts to update the teaching materials.

The question now became what to include in a course. A minimum of anatomical fact clearly belongs in the student's repertoire, both to facilitate evolutionary and functional discussions and to prepare many of them for the study of man. How much information about the groups of vertebrates and vertebrate origins and transitions is necessary? How much about development and organogenesis? How much about the way structures fulfill their biological roles? What is an appropriate sequence for presenting the material?

The Webster and Hildebrand books represent responses deriving from different approaches to and philosophies about vertebrate morphology. They are alike mainly in that each presents a new look at the subject. They offer different treatment of the material, emphasize different topics, and utilize different examples. Both books limit the treatment of embryology and emphasize illustration. Almost all figures are new or redrawn, and there are literally dozens of innovative approaches that will be useful even to those teachers who will adopt neither text.

Webster and Webster's solution has been to offer a single-semester course, restricting the mass of facts to key items about each organ system, its basic structural plan and major functional aspects. For each system there is a discussion, generally brief, of structural-functional changes between vertebrate classes. The most valuable part of the text is its up-to-date account of pattern and change in the vertebrate nervous system. The 25 percent of the text devoted to this and the clear perspective sketches of nervous pathways by themselves justify this text. The numerous photographs of structures and dissections are uniformly sharp and informative; some are printed too dark and the accompanying outline drawings are often not quite to the same scale. Some of the renderings of functional aspects are too simplified. These faults are compensated for by a beautiful series of diagrams, some in color, offering a phylogenetic branching sequence of several organs on polar coordinates.

The Hildebrand book has 40 percent more pages, but the type is larger and bolder. It could clearly serve as the basis for a two-semester course (or for a single-semester course by selective omissions). It has three sections treating, respectively, the phylogeny of verte-

brates (some 80 pages), the structural components of animals (350 pages), and structural adaptation (225 pages). On phylogeny (including morphological theory) Hildebrand presents significantly more detail than does Webster. The two books' coverage of morphology is roughly equivalent, with emphasis on different systems. Hildebrand's treatment of function represents an innovation in texts of comparative anatomy. It comprises chapters dealing with structural elements of the body, mechanics of support and movement, running and jumping, digging and locomotion without appendages, climbing, swimming and diving, flying and gliding, and feeding. Emphasis is on locomotor mechanisms, on biomechanics as a branch of functional anatomy. Other functional topics might have deserved equal attention but, in this format, only at the price of a loss of detail leading to memorization rather than understanding. Hildebrand illustrates many simple physical principles with biological examples. A few of these analyses will need to be refined. The illustrations (no photographs are used) are very clear, and their labels are well conceived; only some reptiles appear a bit stylized.

It is inevitable that a reviewer would detect minor errors and discrepancies in a first edition; these seem to be well within acceptable limits. One of the basic problems in this kind of book is the characterization of diversity. This has been solved with variable success. More important is the avoidance of simple statements untrue or misleading beyond the immediate context. Here Hildebrand does somewhat better than Webster and Webster, perhaps because his book had the longer gestation period. I do find it regrettable that neither book clearly emphasizes the importance of a selectionist approach. Too many phrases suggest that structure and function are perfectly matched, that structures have formed to permit the animal to perform actions; the innate imperfections of structures matched to a continuously changing environment are not communicated. Perhaps the course instructors will have to transmit this viewpoint; certainly these books will force the faculty into some supplementary study, which should open additional options and thus accelerate the process of change in the teaching of a once-staid subject.

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Environment and Speciation

Taxonomy and Ecology. Proceedings of a symposium, Reading, England, Sept. 1972. V. H. HEYWOOD, Ed. Published for the Systematics Association by Academic Press, New York, 1973. x, 370 pp., illus. $19.75. Systematics Association Special Volume No. 5.

Bridging the gaps that inevitably develop between subdisciplines of a science is worthwhile, but it is no easy task. The international symposium on relationships and some interdependences of taxonomy and ecology which resulted in the book under review was an attempt to bridge such a gap. The emphasis is heavily on botanical material, and the treatments of different aspects are uneven. Some authors miss the mark completely, there being only a faint tie-in or none at all with the stated subject of the symposium. More than infrequently there are divergent views on the same or overlapping subject matter. This undoubtedly reflects the different backgrounds of the authors and perhaps differences in their understanding of the subject itself. What has emerged in book form is a series of discrete-to-nearly-discrete chapters dealing with only a part of the subject matter that naturally falls under the title.

The most generalized chapters are those of Snaydon, on ecology, genetics, and speciation; of Ehrendorfer, dealing with the significance of major taxonomic characters and morphological trends in angiosperms; and of Heywood, treating the subject of ecological data in practical taxonomy. In other chapters, specific case histories in lichens and other cryptogams, in snails, and in *Columnea*, a genus of the family Gesneriaceae, give a focus for the role of ecological factors in speciation. Few biologists would dispute the idea that pressures exerted by the environment act as catalyzers of evolutionary divergence. That such pressures build up in diverse habitats and may be generated in specific environments is generally recognized. Less well understood is how affected genetic processes ultimately relate to the taxonomy of a given group.

A rapprochement between the practitoners of ecology and of taxonomy is called for in the opening chapter by Snaydon, but the author displays a rather biased understanding of taxonomy and therefore fails to carry such a rapprochement very far. In the final chapter, Heywood looks at ecology from the taxonomist's position and comes closer to a clear exposé of the interlocking features of the two fields. In another chapter of considerable interest, Thompson discusses seed germination in relation to ecological and geographical distribution. The seed and seed germination show a range of responses to the environment that are critical in the higher-plant life cycle. These provide important bases for differences in plant distributional patterns both local and regional. Some interesting information is presented by H. G. and I. Baker concerning the presence and probable significance of amino acids in the nectar of flowers. After showing that amino acids are present in sufficient quantities to be a sought-after nutrition source by appropriate insects, they provide data suggesting that individuals of more advanced families of flowering plants produce a higher concentration of amino acids in their nectar than do members of more primitive families. The evolutionary implications of increased amino acid supply in nectar are discussed.

Looking at the book as a whole, it is hard to see how it fully serves either the general reader of scientific material or the specialist interested in a narrow aspect of the subjects indicated in the title. Some chapters serve to review the literature of their topics but others are more nearly straight reports of the research of their authors. No topic is given coverage complete enough to provide a standard reference.

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Books Received

Acetylcholine. An Approach to the Molecular Mechanism of Action. M. J. Michelson and E. V. Zeimal. Translated from the Russian edition by E. Lesser and Mira Lesser. Pergamon, New York, 1973. xviii, 242 pp., illus. $25.50. International Series of Monographs in Pure and Applied Biology, Modern Trends in Physiological Sciences Division, vol. 38.

Active Psychotherapy. Harold Greenwald, Ed. Aronson, New York, 1974. xviii, 384 pp. $12.50.

Advances in Heat Transfer. Vol. 10. James P. Hartnett and Thomas F. Irvine, Jr., Ed. Academic Press, New York, 1974. xvi, 300 pp., illus. $32.

Advances in Nuclear Physics. Vol. 7. Michel Baranger and Erich Vogt, Eds. Plenum, New York, 1973. xvi, 330 pp., illus. $20.