

Book Reviews

New Issues for Phylogenetics

Molecules and Morphology in Evolution. Conflict or Compromise? COLIN PATTERSON, Ed. Cambridge University Press, New York, 1987. x, 229 pp., illus. \$49.50; paper, \$15.95. From a congress, Sussex, U.K., July 1985.

Systematics, a traditional bastion of classical morphology, has been deluged by new data from sources that were undreamed of a generation ago. Through a host of new techniques a huge body of molecular data has been amassed in an amazingly short time, and molecules now threaten to overwhelm morphology in phylogeny reconstruction. But contention persists over what some of the new methods measure and how they fit with classic methods and goals. As Patterson asks, "Have molecules superseded morphology as guides to the history of life, or are the two approaches sides of the same coin, with the same problems and limitations? Do molecules and morphology give the same picture of the history of life, or two more or less distorted views of the same picture, or two quite different pictures?" (p. 1). This well-conceived symposium takes stock of the situation.

For both morphological and molecular systematists who are trying to come to grips with each other's data and methods, this is the most accessible and informative volume yet published. It was designed to promote interdisciplinary understanding and succeeds to a large degree. Commendably, most of the contributors have included summaries of the data used to generate their phylogenies, and this alone will ensure the book's lasting utility.

In a fascinating introductory chapter, Patterson compares concepts of homology and phylogeny reconstruction in morphological and molecular systematics. Predictably, some of the conflict between schools lies more in their fundamental philosophies than in the nature of the data being analyzed. However, molecules have unique evolutionary properties that raise issues that have never confronted morphologists. For example, most molecular homologs exist in multiple copies per organism (homonyms), leading to a novel statistical view of molecular homology. Moreover, exon duplication and shuffling can result in the uniting of exons homologous with two or more different genes or proteins, and thus "partial homology" must also be considered. Morphologists are familiar with structures duplicated in ontogeny (serial homology), but gene dupli-

cation in phylogeny has spawned the uniquely molecular concept of *paralogy*, in which paralogous genes may have patterns of descent that are independent of patterns of species descent. Further differences emerge when the roles of pseudogenes, foreign genes, neutral genes, and clocks in phylogeny reconstruction are considered. These issues are explored in the subsequent papers.

Hominoid phylogeny is analyzed cladistically by Andrews using gross morphology, chromosome structural morphology, blood group morphology, protein distance data, amino acid sequencing, and DNA molecular evidence. Andrews argues that previous studies of protein distance data and DNA-DNA hybridization are phenetic and rejects them as representing viable phylogenetic techniques. Morphology and molecular data are congruent in indicating that *Homo* and African apes are more closely related to each other than to the orang. The position of chimps is equivocal, however; amino acid sequencing links them with humans, morphology links them with gorillas, and DNA sequencing has produced ambiguous results.

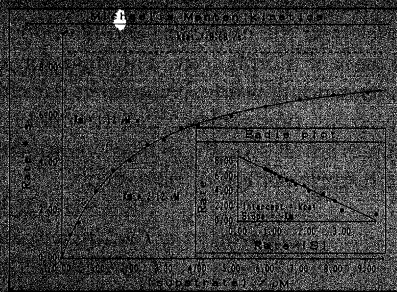
High-level mammalian relationships are cladistically analyzed by McKenna first using morphological data from living and

fossil mammals and then with amino acid sequences from myoglobin and lens alpha crystallin A. McKenna also rejects DNA hybridization and transferrin serology studies as "a dubious mixture of phenetic and cladistic methodology" (p. 57). Discrepancies in details of mammalian relationships arise from the different data sets, especially for aardvarks and pangolins. But McKenna finds basically the same tree topology for major taxa in which both molecules have been studied, and it agrees closely with his morphologically generated tree. He notes that Goodman and associates achieved similar results using cytochrome c, fibrinopeptides A and B, and alpha and beta hemoglobin. Laudably, McKenna's molecular-data summary tabulates all hypothetical substitutions instead of merely listing their number for each locus.

Ignoring Andrews's and McKenna's objections, Sibley and Ahlquist evaluate bird relationships using DNA-DNA hybridization distances. They view convergence as a fatal hazard for morphological systematics that obstructs elucidation of higher-level relationships among birds. For them, DNA-DNA hybridization "solves the problem of homology and thereby eliminates the possibility of convergence" (p. 100). Where mor-

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phology has provided "what is clearly a wrong answer . . . DNA revealed the surprising truth" (p. 118). Bird phylogeny is indeed problematic, but Cracraft, McKittrick, Olson, Raikow, and others have made enormously important morphological contributions that receive little recognition here, nor are other molecular data considered.

Tetrapod phylogeny is examined by Bishop and Friday. This topic is being hotly debated by morphologists, and no strong consensus is evident in this paper. Only myoglobin coding sequences were sufficiently sampled among tetrapods to permit molecular analysis. Maximum likelihood estimates group birds with mammals but leave the positions of turtles, squamates, and crocodilians uncertain. Because only two myoglobin sequences had been reported for birds and turtles and only one for squamates and crocodilians, Bishop and Friday urge caution in viewing their results.

High-level vertebrate relationships and the concepts of orthology and paralogy are explored by Goodman, Miyamoto, and Czelusniak. These authors summarize recent morphological debates on the monophyly of cyclostomes, on which fish-like vertebrate is the sister taxon of Tetrapoda, and on whether Lissamphibia is monophyletic. Using maximum-parsimony—maximum-homology methods, they analyze sequence data for myoglobin, alpha and beta adult hemoglobin, lens alpha crystallin A, cytochrome c, fibrinopeptides A and B, and ribonuclease. In contrast to published morphological systematics, this yields a monophyletic Cyclostomi, actinopterygians as the sister group of tetrapods(!), and an unequivocally monophyletic Lissamphibia. Contrary to Bishop and Friday, these and McKenna's findings support mammals as the sister group of all other amniotes. Unlike McKenna, they find monotremes, not marsupials, to be the sister group of placentals. Despite these few differences, they observe that "classical and molecular approaches yield basically the same picture or, rather complementary views of the same phylogeny. Each approach sees something about phylogeny that the other misses but each approach also sees many of the same features" (p. 141).

Bacterial phylogeny is discussed by Woese. Morphology has been poorly informative for bacteria, and as a result, according to Woese, "microbiology developed essentially without an evolutionary framework" (p. 178). He uses a modified distance measure of rRNA oligonucleotides to develop a network that recognizes two groups, Eubacteria and Archaeobacteria, each as distinct from each other as from Eukaryota. Thus, bacteria may not be monophyletic.

The simplicity of these organisms then affords Woese an opportunity to devise a provocatively simple relationship between their genome size and rates of evolution.

Fitch and Atchley use a known phylogeny for ten strains of inbred mice to assess the relative effectiveness of molecules, morphology, and life history traits in phylogeny reconstruction. Their molecular data are allelotypes for 158 genetic loci, morphological data consist of 14 measurements of the mandible of 10-week-old mice, and life history traits include growth curves, litter size, and so forth. Unweighted pair-group analysis, parsimony, EVOLVES, neighborliness, and distance Wagner methods were used on each data set. All tests on molecular data yield the true phylogeny, but none on morphology or life history traits do so. Although beginning with a known phylogeny might seem to be the ultimate test, Fitch and Atchley list a number of factors, such as the comparatively poor morphological data set, that constrain extrapolation of their results to other situations.

An intriguing picture develops in this volume in which molecular and morphological phylogenies sometimes agree and sometimes not. Different philosophies and methods complicate the comparison and may themselves be responsible for much of the conflict. Nevertheless, there is general agreement that both molecular and morphological phylogenetics face similar fundamental problems and that a "touchstone" has not been found. Most interesting of all, this symposium suggests that the apparent conflicts between molecules and morphology will eventually dissipate as we come to better understand the molecular and developmental basis of morphology. The stage for such understanding is now being set as data from molecular, ontogenetic, and morphological sources are all brought to bear on estimating the historic pattern of phylogeny.

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Lighthearted Nomenclature

Organic Chemistry: The Name Game. Modern Coined Terms and Their Origins. ALEX NICKON and ERNEST F. SILVERSMITH. Pergamon, Elmsford, NY, 1987. xii, 347 pp., illus. \$75; paper, \$29.50.

Organic chemists dealing with complex molecular structures nearly always avoid complicated IUPAC-approved names by using either acronyms or nonsystematic coined

names. This book—a first—is the lighthearted record of recently invented trivial names for organic structures, reactions, and techniques. Many older names of organic compounds, and those of elements, are given in two of several appendixes, but systematic IUPAC nomenclature is intentionally almost wholly ignored. Likewise nearly all of the immense array of natural product names, based on the names of the sources, is excluded. Compounds nicknamed for people are cited, but not the many reactions remembered for their discoverers or popularizers.

As well as being full of humor, the book is authentic, scholarly, and fully supplied with references chapter by chapter. Many of these are to private communications of stories that would otherwise never come to public attention. Nickon and Silversmith are obviously fascinated by names and name-calling, and they delight in reporting anecdotes industriously accumulated over 10 years about authors of names and their contributions, serious and otherwise. Indeed the book is as much about people as about chemicals, tracing the learned or whimsical origins of terms. The text is positively packed with pungent puns. The authors do not hesitate to stray from organic chemistry to include potential *Guinness Book of World Records* material on chemical publications (pp. 67–68) and complex compounds (pp. 149–151), hoax articles (pp. 76–78), and even a U.S. government logo (pp. 160–161). Names of minerals, subatomic particles, biological species, planets, and chemical elements are all noted, and the ubiquitous acronym is not immune.

Because the book is about names, it contains no more plot, or other nonarbitrary sequence of topics, than a dictionary, which after all does have alphabetical order. Chapters are carved out ingeniously; the first eight concern molecular structures imagined to resemble animals, headpieces, tools, buildings, containers, geometric figures, furniture, and food, but thereafter assignment to themes is still more tenuous. The book is ideal for pickup reading, since one can start and stop anywhere—if not seduced by the next interesting item.

I myself have collected about 100 shape-descriptive names, with brief references to their invention. With the usual classical-language-department help, I concocted the word "morphodelotic" (Greek, shape-descriptive) to describe such names; our authors would probably prefer "morphonym." I am relieved of wondering what to do with the collection by the appearance of this book, which is vastly more comprehensive and entertaining than any routine list. It is a pleasure to report that all but three of my hoard are included by Nickon and Silver-