

BOOK REVIEW

Collin Patterson (ed.), *Molecules and Morphology in Evolution: Conflict or Compromise?* Cambridge University Press, Cambridge 1987, 229 pp., hardback \$ 49.50, paperback \$ 15.95.

The tree of life as we know it is a monument to the labors of generations of anatomists and paleontologists. Darwin, like his predecessors and successors, based the classification of organisms and the principle of descent with modifications chiefly on morphological criteria. The subsequent harvest of cytological, physiological and biochemical information was by and large accommodated in the morphological framework without seriously challenging either its concepts or its conclusions.

But now the entire subject is being transformed under the impact of molecular biology. A little over two decades ago, E. Zuckerkandl and L. Pauling pointed out that biological macromolecules embody in their very structure a record of their history. With the passage of time, as mutations and other events progressively alter the sequence of nucleotides in DNA, the sequences of RNA and proteins specified by homologous genes become increasingly dissimilar. The extent of the divergence can be assessed quantitatively, either by hybridization or by sequencing. The results supply a statistical measure of the degree of kinship between any given set of gene products and, by inference, between the organisms in which these genes reside. Molecular criteria thus provide an entirely independent basis for deducing lines of evolutionary descent. The new methods have generated a flood of data and some altogether novel insights, but they have also raised fundamental questions. Are there hidden assumptions and undiscovered fallacies that make the conclusions drawn from molecular data less objective and less reliable than they appear to be? And whose claims shall we accept when morphologists and molecular biologists disagree?

These issues are what this book is about. *Molecules and Morphology in Evolution* consists of a collection of essays, many based on oral presentations at a congress held in 1985, that cover areas where morphological and molecular findings are to some degree in conflict. In his introductory chapter, Colin Patterson lucidly explains how morphology and molecules came to be rival guides to phylogeny. Being myself but an educated layman in this field, I found his historical and conceptual survey invaluable. Patterson's article achieves the stated objective of the volume 'to enlighten the uninitiated and to interest and persuade the skeptic'; what follows is more technical, sometimes excessively so. P. Andrews reviews human phylogeny, concluding that the balance of the evidence favors the early separation of humans from apes over the alternative, championed particularly by molecular anthropologists, that humans diverged from chimpanzees as little as five million years ago. M. McKenna, reconstructing the phylogeny of mammals, finds the morphological and molecular evidence to be generally compatible. The same is true of birds, but C. G. Sibley and J. E. Ahlquist argue persuasively that in several disputed cases DNA hybridization

data tip the scales: New World vultures are related to storks, not to hawks. Tetrapod relationships (M. J. Bishop and A. E. Friday) remain in doubt, but M. Goodman, M. M. Miyamoto and J. Czelusniak conclude from a wide-ranging research program that a unique and satisfying scheme of vertebrate phylogeny can be deduced by combining classical and molecular approaches. C. R. Woese explains how molecular techniques provided the first rational phylogeny of the bacteria, and re-examines the venerable issue of tempo and mode in evolution from a new perspective. His is truly a signal achievement: it is given to few men to discover new kingdoms! The book concludes with a remarkable contribution by W. M. Fitch and W. R. Atchley, who used both molecular and morphometric data to reconstruct the descent of laboratory mice. In this instance, the true phylogeny is known; one is impressed to learn that several molecular approaches independently generated the correct tree, whereas morphometry never came close. But the authors are at pains to emphasize that the apparent superiority of molecular methods may prove to be illusory.

I came away with a strong sense of the power of molecular technology, which requires biologists to reassess some cherished beliefs. The most profound revision to date is undoubtedly due to Carl Woese, who would replace the unitary tree of life by a triad of eubacteria, archaebacteria and eukaryotes. There is little doubt that, when molecules and morphology come into open conflict, it is wise to bet on the technician in the white coat. But this book does not encourage molecular machismo. Molecular phylogeny, like all scientific endeavor, is beset with subtle difficulties: gene duplication, gene conversion, pseudogenes and lateral gene transfer (not to mention the mysterious differences in the rates of evolutionary divergence) give molecular phylogeneticists good reason to prize the doubt. And when all is said and done, the object of the enterprise is not just to find the one true tree but to understand how organisms came to be, with their unique quirks of form, function and behavior. So let us cherish our naturalists, for they remember what the question was.

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