so do membrane-associated traits, exemplified by elliptocytosis. Once again I am impressed with the foresight of J. B. S. Haldane, who four decades ago suggested that malaria has been a major selective force in human populations and accounts for the high frequency of hemoglobin disease in several parts of the world.

Two papers discuss the Black Carib populations in Latin America and show the power of simultaneous use of historical data and genetic analysis. The final section of the book is a heterogeneous collection of four papers on dermatoglyphics, color vision, nutrition and body size, and the use of genetic isolates for genetic research.

As is usual in symposium volumes, the individual papers are uneven in quality and interest. They range from straightforward descriptions of methods and presentation of data to more speculative pieces. Probably only people in the field will want to read them all, but most students of human evolution will find items of interest. Some of the papers suffer from the rapid increase in knowledge since the symposium was held.

I want to register my appreciation that, unlike some symposium volumes, this book has an index. I found myself using it frequently, and other readers will probably do the same.

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The Calcichordate Theory

The Ancestry of the Vertebrates. R. P. S. JEFFERIES. British Museum (Natural History), London, 1986. viii, 376 pp., illus. £50.

Since 1967, Richard Jefferies of the British Museum has been arguing in a long series of taxonomic and general papers that an unusual group of relatively rare early Paleozoic fossil echinoderms (called stylophorans, or in his terminology calcichordates) are the direct ancestors of vertebrates. Jefferies has convinced a few echinoderm paleontologists that his calcichordate theory is correct, but most vertebrate morphologists or paleontologists still subscribe to Garstang's proposed derivation of vertebrates from the paedomorphic larval stage of a tunicate. Jefferies has now written a lengthy book reviewing all of the arguments for (and many of those against) his calcichordate theory.

Jefferies is a leading proponent of the application of cladistic analysis to fossils to obtain information for phylogenetic reconstructions. He discusses this methodology in chapter 1, where he also gives a brief summary of previous work on calcichordates. The anatomy and embryology of living deuterostomes (hemichordates, echinoderms, acraniates, tunicates, and vertebrates) are exhaustively reviewed in chapters 2 through 6. Jefferies then describes the skeletal morphology and reconstructed internal soft parts of the two groups of fossil calcichordates, the somewhat older and more primitive cornutes in chapter 7 (based on seven genera) and the somewhat younger and more advanced mitrates in chapter 8 (based on eight genera plus *Pikaia*, a probable acraniate from the Middle Cambrian Burgess Shale). In chapter 9, he combines the information from previous chapters to produce phylogenetic charts for cornutes ("stem chordates") and for mitrates ("primitive crown chordates") plus a cladogram showing that different mitrates were ancestral to living acraniates, tunicates, and vertebrates. The last chapter reviews (and attempts to refute) other theories about the origin of chordates (those of Løvtrup, Garstang, and Northcutt and Gans) and two other interpretations of calcichordate anatomy (Ubaghs's aulacophore theory and Philip's stele theory), in both of which the calcichordates are considered to be true echinoderms not closely related to vertebrates.

Jefferies's book is well written, well illustrated, and useful in many places, especially the reviews of the anatomy and embryology of the various deuterostome groups, the exposition of cladistic methodology and its use in analyzing calcichordate relationships based on skeletal morphology, and the discussion of competing theories about calcichordates. But Jefferies is not completely successful in demonstrating that his calcichordate theory is correct, the main reason for writing this book. His reliance on Haeckel's law to test relationships, the dominance of recapitulation over paedomorphosis in most cases, and the fact that he does not always use the rigorous cladistic methodology presented in chapter 1 are worrisome. His identification of the large pyramid-covered opening in *Cothurnocystis* and other calcichordates as the mouth (pp. 197–198) may not be correct. Nearly identical pyramid-covered openings in other echinoderms are known to be the anus, and this conclusion also applies to some advanced mitrates where the same opening is covered by a single large flat plate that is movable or hinged. If this opening is the anus and not the mouth, then everything is backwards and the calcichordate theory breaks down immediately. Each lineage of mitrates leading to acraniates, tunicates, and vertebrates loses its plated skeleton in the transition (and vertebrates develop an entirely new bony skeleton), a rather unlikely series of events considering that other mitrates with their typical echinoderm-type plated skeletons continued on for millions of years longer in the fossil record. Also at this transition, there are major differences in appearance between the latest mitrate ancestor and Jefferies's "hypothetical animal s" (p. 341), representing his earliest crown vertebrate.

In conclusion, this book is a very good summary of the calcichordate theory for the origin of vertebrates and the main data supporting it, but I am still not convinced that Jefferies has found the correct solution to this important and controversial problem.

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American Chemistry

Essays on the History of Organic Chemistry in the United States, 1875–1955. DEAN STANLEY TARBELL and ANN TRACY TARBELL. Folio, Nashville, TN, 1986. x, 434 pp., illus. $19.95.

This book is a giant first step toward the development of a full history of organic chemistry in the United States. The authors undertook the monumental task of reviewing American contributions to the literature of organic chemistry from 1875 to 1955 and distilling their reading into a series of essays, each of which can stand alone but which together give a fairly complete picture of the growth of American organic chemistry.

The book is arranged according to four time periods and further divided according to subject areas. The authors were, fortunately, not totally constrained by either the time periods or the research areas, and there is frequent overlap, which makes for a more readable and more interesting text. The time periods are: before 1875; from 1875 to 1914 (the beginning of World War I); from 1914 to 1939 (the beginning of World War II); and from 1940 to 1955. The areas of interest covered for each period include synthesis, structural studies and stereochemistry, natural products, and physical organic chemistry, but there are also several chapters on special topics. Early chapters on the American background prior to 1875, Johns Hopkins University and Ira Remsen, and chemical laboratories, chemical instruction, and chemical journals, which outline the context in which American organic chemistry developed and set the stage for the discussion that follows, can be read by almost anyone. Most of the book, however,