Book Reviews

Themes in Embryology

A History of Embryology. T. J. HORDER, J. A. WITKOWSKI, and C. C. WYLIE, Eds. Cambridge University Press, New York, 1986. xxiv, 477 pp., illus. $99.50. British Society for Developmental Biology Symposium 8 (Nottingham, April 1983).

As Joseph Needham notes in the preface to this volume and the editors mention in their introduction, the only surveys of embryology are Needham's classic *History of Embryology* (1934), which covered developments until the early 19th century, and several subsequent historical studies, all of which stop at the end of the 19th century. It is unfortunate, therefore, that *A History of Embryology* is not the work that completes the historical treatment of the field by synthesizing the 20th-century developments. Instead, the volume, which emerged in revised form from a symposium of the British Society for Developmental Biology, is a collection of 15 idiosyncratic papers clustered loosely about two chronological themes, classical experimental embryology from 1880 to 1940 and post-war developments in embryology. The six papers in the first section are primarily historical in focus, whereas the nine in the second section "abandon any attempt at historical sequence" and address contemporary issues.

There are some notable successes in the volume. Frederick Churchill's paper on August Weismann is first-rate. Churchill masterfully argues that Weismann's germ-plasm theory not only was remarkable for challenging inheritance of acquired characters, it also led Weismann to view heredity as the source of variation, an idea not shared by many of his colleagues but critical for later Mendelian theories of inheritance. Jane Maienschein details the American reaction to the work of Wilhelm Roux and Hans Driesch, especially in terms of the debate over preformation versus epigenesis. Her paper is also important because it touches upon the unique cell-lineage work pioneered in the United States by the students of W. K. Brooks and C. O. Whitman. In a collaborative study, T. J. Horder and P. J. Weindling resurrect the life and work of Hans Spemann, a figure often mentioned but rarely discussed in detail. In their treatment of Spemann and his idea of the "organizer" they self-consciously separate the study into an "internal" approach, dealing with Spemann the scientist, and an "external" approach, dealing with Spemann the man. Unfortunately, this distinction, no longer an overt issue among historians, creates more of a distraction than the authors intend. Robert Olby shows the importance of instrumentation in 20th-century molecular approaches to embryology. His argument deserves close attention because of its emphasis on the role of tools and techniques in scientific discovery. In a too-brief paper, Eric Davidson illustrates how many of the current ideas of genomic activity can be traced to the suggestive experimental work of Theodor Boveri. Davidson's brevity here can be forgiven, however, as his *Gene Activity in Early Development* (second edition) remains the most satisfying treatment of the historical development of ideas relating the role of the cytoplasm and the nuclear material in embryological events.

The editors scored another series of successes in the valuable chronological outline of important events in the history of embryology, the outline of major background concepts in generation and heredity to the end of the 19th century, and the excellent segues for the historical papers in the first section of the volume. The volume concludes with an extensive section of selected references to resources in the history of embryology. Though most of the material is familiar to historians of science, the section should be an invaluable resource for scientists with an interest in deepening their historical appreciation of embryology.

But a number of problems plague the volume. Many of the deficiencies may be those inherent in a compilation, but many others could have been avoided by more careful editing and, perhaps, the addition of a professional historian to the editorial staff. Most shocking are the number of grammatical errors, misspellings, and typographical mistakes. In addition, several of the papers are diffuse: Garland Allen's work on T. H. Morgan bogs down in semantic wrangling over mechanistic materialism, dichotomies in biology, and economic and social modeling applied to the scientific community; J. A. Witkowski's interesting study of Harrison is fragmented by needless subdivisions; and Neil Tennant's potentially exciting discussion of reductionism and holism loses the reader by using too much jargon familiar only to professional philosophers. Finally, the editors should have cautioned the scientists contributing to the volume not to write studies that were essentially literature reviews. Several chapters lack any interpretation of the science; this is a lack that may limit the audience of the volume. Nevertheless, the volume will serve as an important contribution to and foundation for the awaited history of 20th-century embryology.

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Human Genetic Diversity

Genetic Variation and Its Maintenance. With Particular Reference to Tropical Populations. D. F. ROBERTS and G. F. DE STEFANO, Eds. Cambridge University Press, New York, 1986. xii, 286 pp., illus. $39.50. Society for the Study of Human Biology Symposium 27 (Rome, April 1985).

This volume contains a selection of the papers presented at a symposium sponsored by the International Union of Biological Sciences. The first section is composed of eight papers, starting with an overview by Roberts entitled "Genetic polymorphisms—a widening panorama." He notes the astonishing rate of increase in the number of polymorphisms, beginning with the discovery of ABO blood groups at the turn of the century. Several graphs highlight the accelerating growth in number of biochemical markers as new techniques appeared. Other papers describe HLA variation, chromosome polymorphism, restriction fragment length polymorphisms (RFLPs), and variation in mitochondrial DNA. In the early days the data were biased in favor of polymorphic loci, since these were the ones most easily studied. Better methods increased the number of detectable alleles at some loci, but added more data on less variable loci so that the estimates of average heterozygosity were reduced. The study of RFLPs shows greater variability, since the whole genome—much of it without known function—rather than just the translated part is sampled. The results largely duplicate those found in other species. My main criticism of this section of the book is that the authors do not appear to have taken into account the ascertainment bias involved in estimating polymorphism and heterozygosity from RFLP data. This bias arises from the fact that cleavage sites are about twice as likely to be discovered in a polymorphic sequence as in a monomorphic one (Ewens *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **78**, 3748 [1981]; Engels, *ibid.*, 6329 [1981]; Hudson, *Genetics* **100**, 711 [1982]); hence, the amount of variability is overestimated.

A second group of nine papers gives more attention to possible mechanisms. The critical role of malaria is emphasized. Hemoglobin S (Hb S) exists in three distinct, geographically separated haplotypes in central and western Africa, suggesting three independent origins. The very low frequency of Hb S in southern Africa argues that these populations migrated southward before malaria was the scourge that it became in more recent times. Not only do sickle cell trait, thalassemia, and glucose-6-phosphate dehydrogenase play a role in malaria resistance,

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,