

GENETICS, PALEONTOLOGY, AND MACROEVOLUTION, by Jeffrey Levinton, 1988. Cambridge University Press, New York. 637 pp. \$37.50.

In 1949, Jepsen, Mayr, and Simpson edited a volume entitled *Genetics, Paleontology, and Evolution*. That book, coming at the start of the "Modern Synthesis" in evolutionary biology, attempted to provide an integrated, synthetic view of biological patterns and processes and a continuity of explanation at several levels of organization: from genetic to larger scale ecological and evolutionary phenomena. While the results of the Princeton conference that gave rise to the 1949 book exhibited a fair degree of unity of viewpoint on major issues in evolutionary biology, the last 20 years have been notable for the persistence of widely divergent viewpoints on both the important questions to be asked in evolutionary biology and the nature of adequate answers to those questions.

Jeffrey Levinton has attempted in this new book to provide again a more integrated view of patterns and processes in genetics, paleontology, and evolution. His goal is to provide an approach, or blueprint, for studying macroevolution and to attempt to synthesize recent results from genetics, population biology, morphology, and evolutionary biology into a reasonably coherent whole. The book has a broad base. It begins with a discussion of macroevolution in general, and then proceeds to discuss systematics, gene structure and evolution, speciation, development, morphology, and taxonomic patterns in the fossil record.

There are quite a few things that I very much like about Levinton's book. First, he appropriately emphasizes the study of genealogical patterns as fundamental to the analysis of evolution in his second chapter: "Systematics is the linchpin of macroevolutionary studies." While far more could have been said on this issue, it is refreshing to see such a clear and unequivocal statement at the start of the book and the commitment of one chapter to systematic matters. Unfortunately, many other investigators who have discussed "macroevolution" have not appreciated the critical significance of systematic data for framing and testing their hypotheses.

Second, Levinton emphasizes the importance of measuring performance and of having explicit criteria for comparing the effectiveness of structures, allozyme variation, and other aspects of the phenotype. This is not often easy to do, but remains a fundamental component of any attempt to assay fitness.

Third, several issues are treated very well. Topics that I found to be particularly well-explained include the paradigm method in paleontology, preservational biases in the fossil record, genetic regulation and polymorphism, the idea of developmental constraints, the lack of evidence for the founder effect as espoused by Mayr, and the importance of documenting conservatism in organismal structures and functions.

Fourth, Levinton is forthright and clear in letting his views be known and in adducing evidence for them. You may not

always agree with his position, but you will know where he stands. For example, consider Levinton's treatment of punctuated equilibrium. He titles the section discussing gradualism (as depicted by Gould and Eldredge), "Phyletic Gradualism: The Making of a Strawman," and he argues strongly against many of Gould's interpretations of the fossil record. Others may not agree with his definition of the process of macroevolution to be "the sum of those processes that explain the character-state transitions that diagnose evolutionary differences of major taxonomic rank," but his position is clear and can be accurately characterized and debated.

Fifth, the book is well organized and covers a considerable variety of material. The flow of chapters is logical, each chapter ends with a "Main Points" section that summarizes Levinton's views, the book has a glossary, good author and subject indices, and an extensive and useful bibliography. The dearth of illustrations and relatively poor quality of the laser-printed text do not detract significantly from the book.

I would thus highly recommend this book for graduate and advanced undergraduate seminars in evolutionary biology. There will be ample material for discussion, recent controversies and topics are covered well, Levinton's personal views are clearly outlined, and the book provides a good introduction to a broad literature.

While I feel that this will be a useful book for the above reasons, there are several issues and topics that I feel did not receive the attention they deserve. Despite all the issues covered in the book, I still do not feel that any "synthesis" is at hand on crucial questions in evolutionary biology. As one reads the book, it is easy to get lost in the broad review that Levinton provides us on topics such as speciation, gene structure and regulation, taxon richness, allometry, punctuated equilibrium, and developmental programs, and to emerge feeling that there is some unity and conceptual integrity to the topics presented. While I firmly believe that no one of these areas stands in conceptual isolation, I do not think that a grand synthesis is at hand. I did not finish the book with the feeling that a coherent research plan had been outlined for the study of evolution, or that a blueprint for studying macroevolution had been provided.

In my view, there are several key questions that need to be addressed in any general treatment of genetics, paleontology, and evolution. While this book addresses pieces of these questions, the organization is more along the lines of reviews of successive topics, and several general issues are not highlighted to the extent that one might wish in a general monograph of this type.

Are there any general historical patterns (or "laws") to the transformation of form? Just how predictable is the transformation of biological design given certain constructional principles and developmental and functional interactions? While this question has only begun to receive attention in

evolutionary morphology, the issue of historical regularity of change has been debated extensively by historians and deserves increased focus from evolutionary biologists. We need research programs that address the importance of intrinsic and extrinsic constraints on form in a testable manner, and that will enable us to assess the extent of historical regularity to the transformation of design.

How do complex *functions* evolve, and what is the extent of congruence in the transformation (both ontogenetic and phylogenetic) of morphology, functions, and roles of structures? There is currently considerable emphasis on the analysis of patterns of character distribution that involve structural features (such as bone articulations, muscle insertions, DNA base and amino acid sequences) but very little effort has been devoted to historical patterns of function and role. In the *Origin of Species* Darwin highlighted the importance of change in function as a mechanism for the generation of complex systems, yet this issue has received relatively little attention since.

What is the relationship between patterns of genetic correlation, population structure, ecology, and the distribution of characters on cladograms? How and why do characters have the distributions they do? Despite many excellent investigations in population biology, quantitative genetics, functional morphology, ecology, and systematics, we still have little appreciation for the factors underlying the generation of novelties and homoplasies and for the factors that influence their distribution on cladograms. Of course, at one level, the phenomena of heredity and adaptation to the environment "explain" synapomorphies and homoplasies. But this is only understanding at the most general level, and a more complete picture of the generation and maintenance of characters awaits future research programs.

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BOOKS RECEIVED

LATE QUATERNARY PALAEOENVIRONMENTS OF SOUTHERN AFRICA, by Janette Deacon and N. Lancaster, 1988. Oxford University Press, New York. viii + 225 pp. \$65.00. An overview of paleoenvironments of Southern Africa from 130,000 BP to the present emphasizing the geomorphology of desert environments and the archeology of Stone Age communities.

ORANG-UTAN BIOLOGY, edited by Jeffrey H. Schwartz, 1988. Oxford University Press, New York. vi + 383 pp. \$79.95. A volume containing 25 papers, only six of which deal to any great degree with fossil material: "History, morphology, paleontology, and evolution" by J. H. Schwartz, "Phylogeny and skull form in the hominoid primates" by B. T. Shea, "Basiscranial and facial topography in *Pongo* and *Sivapithecus*" by B. Brown and S. C. Ward, "Comparative and evolutionary aspects of the permanent dentition" by D. R. Swindler and A. F. Olshan, "Body composition and limb proportions" by M. E. Morbeck and A. L. Zihlman, and "Positional behavior, adaptive complexes, and evolution" by R. H. Tuttle and G. W. Cortright.

MORPHOGENESIS AND EVOLUTION, by Keith Stewart Thomson, 1988. Oxford University Press, New York. 149 pp. \$29.95. A lengthy discussion of developmental biology in an evolutionary context, with concentration "on the later morphogenetic phases of development and their relationship to the processes of introduction of phenotypic variation at the level of the individual organism."

SCIENCE AS A PROCESS: AN EVOLUTIONARY ACCOUNT OF THE SOCIAL AND CONCEPTUAL DEVELOPMENT OF SCIENCE, by David L. Hull, 1988. The University of Chicago Press, Chicago. xiii + 586 pp. \$39.95. A philosopher and historian of science, "Hull argues that conceptual change in science is a matter of both cooperation and competition" and "challenges the view that truth for truth's sake is the operating principle in science."

A HANDBOOK OF BIOLOGICAL ILLUSTRATION, Second Edition, Frances W. Zweifel, 1988. The University of Chicago Press, Chicago. xvi + 137 pp. \$27.00, cloth; \$9.95, paper.

EXTINCTION AND SURVIVAL IN THE FOSSIL RECORD, edited by G. P. Larwood, 1988. Oxford University Press, New York. x + 365 pp. \$90.00. A volume containing 15 papers, four of which deal with fossil vertebrates: "Extinction and survival of the jawless vertebrates, the Agnatha" by L. Beverly Halstead, "Mass extinctions in the fossil record of reptiles: paraphyly, patchiness, and periodicity (?)" by M. J. Benton, "Extinction and survival in birds" by D. M. Unwin, "Extinction and the fossil mammal record" by R. J. G. Savage.

ENCYCLOPEDIA OF HUMAN EVOLUTION AND PREHISTORY, edited by Ian Tattersall, Eric Delson, and John Van Couvering, 1988. Garland Publishing, New York. xxxvi + 603 pp. \$87.50. Brief alphabetical listings of terms and topics in paleoanthropology and archaeology; includes other fossil and recent primates in addition to hominids.

WICHITA FALLS—LAWTON SHEET (Alfred Sherwood Romer Memorial Edition), by T. F. Hentz and L. F. Brown, Jr., 1987. In Geological Atlas of Texas (V. E. Barnes, project director). University of Texas at Austin, Bureau of Economic Geology. LITHOSTRATIGRAPHY AND PALAEOENVIRONMENTS OF UPPER PALEOZOIC CONTINENTAL RED BEDS, NORTH-CENTRAL TEXAS: BOWIE (NEW) AND WICHITA (REVISED) GROUPS, by T. F. Hentz, 1988. University of Texas at Austin, Bureau of Economic Geology, Report of Investigations no. 170, 55 pp. Stratigraphy and paleoecology of the late Virgilian, Wolfcampian, and early Leonardian age continental and paralic rocks of north-central Texas. Particularly relevant for students of Late Pennsylvanian and Early Permian vertebrates, this map and report cover much of the area originally worked by Cope, Case, Romer, and others.