book, but a consequence of the fact that the bulk of experimentalists in recent years have chosen to study the chick limb. Nevertheless, I find the authors' opinions about the drawbacks of working with amphibian embryos curious. They think it is a disadvantage that amphibians regulate for limb parts that are removed, since this obscures the effects of the absence of the parts. Quite to the contrary, it can be argued that in order to elucidate the control of patterning and the nature of positional information in limbs it is necessary to look at forms that regulate for tissue removal and rearrangement and rather dangerous to extrapolate from data obtained from forms that do not.

By and large the authors do a good job of presenting the known facts about limb development as well as the results of experiments. Although it makes the book less tidy, in most instances they wisely refrain from presenting an overall interpretation of their own. The limited attempt they make at the end of the book to develop some general principles is not particularly successful, and their closing statements about the possible role of compartments (analogous to those demonstrated in insects) in vertebrate limbs do not add anything and are in fact misleading. The chapter on limb regeneration presents a reasonable if brief summary of what is known, although it overlooks some important work, most notably that of Tassava and his colleagues on the relationship of injury, epidermis, and nerves to blastemal cell cycles.

The least satisfactory part of the book is the chapter on pattern in the limb. This is unfortunate, since this is a subject of growing interest in limb development, and it is also the one that causes the most confusion to those outside the immediate discipline. The chapter does not work well because the formula that is successful for the rest of the book, an almost neutral reporting of facts, is not successful in dealing with a subject about which there are contradictory and partially overlapping ideas and because the authors fail to distinguish clearly between morphogenesis and pattern formation. Morphogenesis is generally considered to be distinct from pattern formation, in fact to be an expression or an interpretation of it, in much the same way in which cellular differentiation is not pattern formation but a consequence of it.

The treatment of limb evolution and adaptive radiation side by side with limb development is the strongest feature of the book. The opening page of the book pays homage to Darwin's appreciation for the fascinating ways in which limb structure has been modified during evolution. It is probably variety in limb structure more than in any other structure that has enabled the vertebrates to diversify into so many different habitats. The book does an excellent and appropriately cautious job of tracing the ancestry of the vertebrate limb and its various modified forms. Of more than historical interest is the authors' contention that some of our views of limb development have been subtly influenced by long-discarded notions of ontogeny recapitulating phylogeny. One could wish that the authors had explored the lingering but vaguely defined notion that urodeles are somehow a separate tetrapod line. This possibility is mentioned several times in the book, and it is high time that the strengths and weaknesses of this view were brought out and evaluated.

Overall the book is very readable, and it has some amusing imagery, such as a description of *Pteranodon* as having "all the easy grace of a partially furled umbrella." It will be valuable to students and researchers in the fields of limb development and evolution. And maybe as a result of the ideas in these two fields being juxtaposed in a book primarily about limb development the long-recognized parallel between ontogeny and phylogeny, which over the last hundred years has been used in various ways to bolster evolutionary theory, can now be viewed from a different angle. Maybe this book will stimulate developmental biologists to take from phylogeny what they need to understand ontogeny.

SUSAN V. BRYANT
Department of Developmental and Cell Biology, University of California, Irvine 92717

Rodents and Evolution

Les Rongeurs et l'Evolution. J. CHALINE and P. MEIN. Doin, Paris, 1979. xii, 236 pp., illus. Paper, 118 F.

Traditionally in the study of nonhuman fossil vertebrates the spotlight has been on large or unusual taxa or new evidence bearing on the origin of some group. When an example of an evolutionary trend in fossil mammals has been selected for a textbook, it has almost invariably been that of the horse (and still is: see *Evolution of the Earth* by R. H. Dott, Jr., and R. L. Batten, third edition, McGraw-Hill, 1981). But in potential for supplying data about the patterns and processes of evolution in the geologic record it is becoming increasingly clear that fossil rodents have much more to offer. The numbers of living individuals and species are said to exceed those of all other orders of mammals taken together. Though earlier collections gave little indication that such diversity would ever be found in the geologic record, more meticulous surface coverage and employment of hydraulic screening operations are gradually resulting in larger statistical samples of small mammal populations than have been attained for large forms. For much of the Cenozoic, rodents are forming the bulk of these assemblages.

The authors of this fascinating book about the evolution of rodents have been important contributors to rodent paleontology in Europe. Their book is a carefully integrated and in part tutorial work that starts with a discussion of the circumstances under which rodents become fossilized and ends with a critique of the present controversy about the mode of evolution. Three separate bibliographies, on methods and taxonomy of Recent rodents, evolutionary history of the rodents, and modes of speciation, are included. A thorough glossary is also provided.

The range of subject matter is surprisingly wide for a book of this size. In addition to the major themes of evolutionary history and modes of evolution, the book includes shorter treatments of such topics as concepts of the species, the diversity of adaptations in rodents, and biometric techniques. The structures that have played important roles in the study of the relationships and evolution of rodents are carefully explained and illustrated. The role of chromosome evolution, a matter rarely treated in the paleontologic literature, is given special attention. The abundant evidence of evolution in the rodents, especially the voles, from the Pleistocene makes possible the integration of karyotypic or biochemical with dental data in interpreting speciation and changing geographic distributions.

The longest chapter describes the major events in the evolutionary history of the higher taxa, usually down to superfamily but sometimes to family or even genus. The origins and phyletic relationships, characteristic features, and morphologic evolution are briefly but clearly outlined. Illustrations of skeletal structures, especially the critical dental patterns, as well as sketches of Recent representatives, are abundantly supplied. The treatment of groups is uneven, with greatest emphasis placed upon those with important European records, but bias is inevitable owing to the magni-

tude and complexity of the potential subject matter. An enclosed time-stratigraphic chart shows the European mammal ages, which, unlike the biostratigraphic framework for any other part of the world, are documented through much of the Tertiary by rodent zones. A discussion of the still debated origin of the South American rodents presents recent data and arguments, and the significance of Li Chuan-kuei's important evidence bearing on the origin of the Rodentia, a long-standing puzzle, is reviewed.

An overall objective of the book, culminating in the final chapters, is appraisal of the modes of evolutionary change. The authors summarize chronologic successions of rodent species that have been described here and there in recent years by a number of authors (Chaline, A. J. Van de Weerd, J. J. Jaeger, M. Vianey-Liaud, J. M. Rensberger). These lineages exhibit successions of dental modifications with transitions frequently small enough to indicate a continuum of populations yet with endpoints different enough to signify distinct species or genera. The levels of difference in some parts of these lineages are comparable to differences between subspecies of living rodents; in some transitions there is little or no change, in others clearly directed change. In certain Pleistocene forms with modern survivors, such differences may be directly compared with magnitudes of variation in biologic species and subspecies and interpreted in consonance with karyotypic data. Vianey-Liaud's late Eocene to late Oligocene succession of 11 assemblages of the theridomyid *Issiodoromys* has seven transitions involving varying rates of size increase believed to be linked with climatic changes. I was somewhat disappointed that Chaline and Mein generally leave to the reader the task of extracting from the original studies the details of the temporospatial distributions of the fossils discussed. Although I understand the economy of this decision, readers wanting to evaluate many of these examples will be unable to do so.

The authors view equilibrating anagenesis, that is, the acquisition of small increments of change that adapts the species to varying environments or new situations, as the dominant mode of evolution. It is this mode, they suggest, that is also responsible for the rapid divergence of new species following cladogenesis (speciation). They describe a number of examples of cladogenesis in Pleistocene rodents and observe in almost every case the influence of geographic separation. They also point to the interesting case of *Mus poschiavinus*, the tobacco mouse, which, amid the range of *Mus musculus*, apparently is genetically isolated because of chromosome fusions. However, the authors admit that even here the speciation may alternatively be the result of temporary isolation of a population segment during a Pleistocene climatic change.

The record of rodent evolution is interpreted to be "complex cladogenesis, with differential anagenesis." With its stress on the role of anagenesis, this interpretation clashes with that of N. Eldredge, S. J. Gould, and S. M. Stanley, who interpret the sudden geologic appearances of many new species as representing genuinely sudden biologic events that punctuate long periods of stability. Chaline and Mein conclude that one's interpretation is largely determined by one's choice of examples, that those taken from studies embodying a typological concept of the species and not utilizing a stratigraphic scale many times finer than the scale of events that are to be resolved will invariably lead to a punctuated model. Regardless of what the outcome of this controversy may be, it has promoted a new vigor among paleontologists and an increased attention to the finer details of the fossil record.

This book is partly a response to this stimulus, but, even more important, it represents the overdue introduction of fossil rodents as a significant tool for the analysis of evolutionary events. It is written to a wide audience of life scientists. G. G. Simpson once commented on the inherent difficulty of studying and interpreting fossil rodents, with the demand for special knowledge and techniques. *Les Rongeurs et l'Evolution* seems to transcend many of these difficulties, and I strongly recommend it.

JOHN M. RENSBERGER
Department of Geological Sciences, University of Washington, Seattle 98195

Books Received

Applied Regression Analysis. N. R. Draper and H. Smith. Wiley, New York, ed. 2, 1981. xvi, 710 pp., illus. $24.95. Wiley Series in Probability and Mathematical Statistics.

Arctic Animal Ecology. Hermann Remmert. Translated from the German. Springer-Verlag, New York, 1980. viii, 250 pp., illus. Paper, $24.80.

Aromatic Nitration. K. Schofield. Cambridge University Press, New York, 1981. viii, 376 pp., illus. $67.50.

Aspects of Contemporary Complex Analysis. Proceedings of a NATO Advanced Study Institute, Durham, England, July 1979. D. A. Brannan and J. G. Clunie, Eds. Academic Press, New York, 1980. xiv, 572 pp. $103.50.

Aspects of Nonverbal Communication. Walburga von Raffler-Engel, Ed. Swets and Zeitlinger, Lisse, Netherlands, 1980. viii, 380 pp., illus. $42.

Atlas of Blood Cells. Function and Pathology. D. Zucker-Franklin, M. F. Greaves, C. E. Grossi, and A. M. Marmont. Edi.Ermes, Milan, and Lea and Febiger, Philadelphia, 1981. Two volumes. xxxii, 660 pp. + index. $139.

Atlas of Human Limb Joints. Jacques Guyot. Translated from the French. Springer-Verlag, New York, 1981. x, 252 pp., illus. $146.30.

Atmospheric Pollution. Its History, Origins and Prevention. A. R. Meetham, D. W. Bottom, S. Cayton, A. Henderson-Sellers, and D. Chambers. Pergamon, New York, ed. 4, 1981. xii, 232 pp., illus. Cloth, $38; paper, $15.

Augmentin. Clavulanate-Potentiated Amoxycillin. Proceedings of a symposium, July 1980. G. N. Rolinson and A. Watson, Eds. Excerpta Medica, Amsterdam, 1980 (U.S. distributor, Elsevier North-Holland, New York). viii, 310 pp., illus. $56.

Biology of Plants. Peter H. Raven, Ray F. Evert, and Helena Curtis. Worth, New York, ed. 3, 1981. xviii, 686 pp., illus. $23.95.

Biomechanics of the Locomotor Apparatus. Contributions on the Functional Anatomy of the Locomotor Apparatus. F. Pauwels. Translated from the German by P. Maquet and R. Furlong. Springer-Verlag, New York, 1980. viii, 518 pp., illus. $175.90.

Cheirolumbar Dysostosis. Developmental Brachycheiry and Stenosis of the Bony Vertebral Lumbar Canal. A. Wackenheim with collaboration of E. Babin and five others. Translated from the French by M. T. Wackenheim. Springer-Verlag, New York, 1980. viii, 102 pp., illus. Paper, $34.30.

Chemical Applications of Atomic and Molecular Electrostatic Potentials. Reactivity, Structure, Scattering, and Energetics of Organic, Inorganic, and Biology Systems. Proceedings of a symposium, Houston, Mar. 1980. Peter Politzer and Donald G. Truhlar, Eds. Plenum, New York, 1981. x, 472 pp., illus. $55.

Conception in the Human Female. Robert G. Edwards. Academic Press, New York, 1980. xvi, 1088 pp., illus. $112.

Conceptions of Space in Social Thought. A Geographic Perspective. Robert David Sack. University of Minnesota Press, Minneapolis, 1981. xiv, 232 pp., illus. Cloth, $27.50; paper, $9.95.

Consultation in Schools. Theory, Research, Procedures. Jane Close Conoley, Ed. Academic Press, New York, 1981. xviii, 316 pp. $26. The Educational Technology Series.

Contemporary Animal Learning Theory. Anthony Dickinson. Cambridge University Press, New York, 1981. xii, 178 pp., illus. Cloth, $27.50; paper, $9.95. Problems in the Behavioural Sciences.

Contemporary Astronomy. Jay M. Pasachoff. Saunders, Philadelphia, ed. 2, 1981. xiv, 546 pp., illus. + plates + appendices. $23.95.

Contemporary Microbial Ecology. Proceedings of a symposium, Coventry, England, Sept. 1980. D. C. Ellwood, M. J. Latham, J. N. Hedger, J. M. Lynch, and J. H. Slater, Eds. Academic Press, New York, 1980. xviii, 438 pp., illus. $41.

Contemporary Suburban America. Peter O. Muller. Prentice-Hall, Englewood Cliffs, N.J., 1981. xiv, 218 pp., illus. Paper, $9.95.

Contemporary Theories and Systems in Psychology. Benjamin B. Wolman in collaboration with Susan Knapp. Plenum, New York, ed. 2, 1981. xii, 640 pp. Cloth, $42.50; paper, $17.95.

Contemporary Theories of Schizophrenia. Review and Synthesis. Sue A. Shapiro. McGraw-Hill, New York, 1981. xii, 292 pp. $18.95.

Continuum Mechanics. A. J. M. Spencer. Longman, New York, 1980. viii, 184 pp., illus. Paper, $13.50. Longman Mathematical Texts.

Data Base Administration. Jay-Louise Weldon. Plenum, New York, 1981. xii, 250 pp. $22.50. Applications of Modern Technology in Business.

Data File Programming in BASIC. Leroy Finkel and Jerald R. Brown. Wiley, New York, 1981. x, 338 pp. Paper, $9.95. A Self-Teaching Guide.

Diagnosis and Treatment of Upper Gastrointestinal Tumors. Proceedings of a congress, Mainz, Germany, Sept. 1980. M. Friedman, M. Ogawa, and D. Kisner, Eds. Excerpta Medica, Amsterdam, 1981 (U.S. distributor, Elsevier North-Holland, New York). xviii, 538 pp., illus. $95. International Congress Series 542.

Energy Economics. Growth, Resources and Policies. Richard Eden, Michael Posner, Richard Bending, Edmund Crouch, and Joe Stanislaw. Cambridge University Press, New York, 1981. xiv, 442 pp. $34.95.

Energy Methods in Electromagnetism. P. Hammond. Clarendon (Oxford University Press), New York, 1981. xiv, 180 pp. $55. Monographs in Electrical and Electronic Engineering.

Energy Policy in Perspective. Today's Problems, Yesterday's Solutions. Craufurd D. Goodwin, William J. Barber, James L. Cochrane, Neil de Marchi, and Joseph A. Yager. Brookings Institution, Washington, D.C., 1981. xxii, 728 pp. Cloth, $29.95; paper, $14.95.

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