

## BOOK REVIEWS

**Culturing Nerve Cells. Edited by Gary Banker and Kimberly Goslin. 1991. The MIT Press, Cambridge MA. 453 p. \$55.00 cloth.**

To learn new experimental techniques that will require a significant investment of time and resources, the best policy is to arrange a working visit to a laboratory which routinely uses them. If such an opportunity is not available, the next best option is to have at one's disposal a book such as *Culturing Nerve Cells*. Chosen as the first volume in a series on cellular and molecular neuroscience, this book indicates the prominence that culture of neurons and related cells has achieved among the techniques adopted by neuroscientists in the interest of defining mechanisms involved in both neuronal development and function. Because relatively few of the increasing number of neuroscientists in the world have had formal training in neuronal cell culture, the editors of this volume provide a useful service by compiling a group of chapters that describe methods for a number of neuronal models with differing applications.

The style of the book is to provide not only methods for specific culture systems, but also the principles behind the techniques involved. The chapters are divided into three groups. The initial chapter, "Getting Started," is written directly to the reader, giving the rationale for the book. This is followed by four chapters under the category of "General Principles." Here the history of neuronal cell culture is summarized, followed by the rationale for neuronal cell culture, a general description of markers for neuronal and glial cells in culture, and a listing of commonly-used techniques for fixation and characterization of cells in culture. The major portion of the book is a collection of chapters on specific applications of culture techniques written in a personal, "hands-on" manner by specialists in the use of each system. In this way, it provides a much different perspective on neuronal cell culture than can be obtained by reading the methods sections of published papers from these same laboratories. Starting with methods for culture of neuronal subtypes from the peripheral and central nervous systems, the volume progresses through increasingly specialized preparations. These include co-cultures of neurons and either muscle or glial cells, one example of an established cell line, the PC12 cell, which is in common use for its neuronal-like properties after differentiation and, finally, to complex and relatively intact systems such as *in vitro* methods for study of myelination or organotypic slice cultures. In each case, not only the basics of culture methods are provided (detailed descriptions of dissection methods, media compositions, and the like) but also sections on troubleshooting problems and/or previous applications of the culture system. The layout of the book is superb, from the quality of the paper on which it is printed to the formatting of the pages with wide margins for note-taking. Most impressively, the photographs of cell cultures that are included in each chapter are of such quality that they, by themselves, serve as an indication of the validity of the use of neuronal

cell culture as an experimental tool.

The contents of this book define its purpose—it is, in fact, an elegantly-prepared methods manual which places equal emphasis on the principles behind the protocols. As such, one would not be inclined to sit and read it casually. A single pass through one of the sections on cell preparation, such as that of mixed glial cell cultures, would be enough to discourage leisurely reading of this volume. Rather, a curious reader would do better to focus on the introductory and applications subsections of each chapter in order to obtain a brief summary of the potential applicability of each culture model to their research goals. Having done so and identified a particular method for use, the degree of methodological detail then becomes welcome information to the researcher intent on establishing such cell cultures in his/her laboratory.

LINDA DOKAS

Departments of Neurology and  
Biochemistry and Molecular Biology  
Medical College of Ohio  
Toledo OH 43699

**Principles of Geology. Volumes II and III: A facsimile of the first edition (1832 and 1833). Charles Lyell. 1990 and 1991. The University of Chicago Press, Chicago, IL. 330 and 398 p. \$15.95 and \$17.95 paper.**

In Volume I of the *Principles of Geology* (reviewed in 1991, Ohio J. Sci. 91: 218-219), Charles Lyell provided a demonstration of actualistic uniformitarianism whereby the processes and functions of the present are used in reconstructing the history of the Earth from the geologic record. Volume I of this facsimile edition contains an extended introduction by Martin J. S. Rudwick, who rightfully terms the *Principles* "one of the most important books ever published in the earth sciences."

Although Lyell initially rejected organic evolution and a progression of life forms through time, he recognized biologic species as natural units of the organic world and discussed interactions between the organic and inorganic worlds in Volume II, including aspects of taphonomy, and thus effected a synthesis of geology and biology. Lamarckian transmutation of species is reviewed in Chapter 1, followed by a refutation of Lamarck's theory in Chapter 2, including the observation that species have remained unchanged throughout human history. Chapter 3 treats variability in species, and Chapter 4 the phenomenon of hybrids, with the conclusion (p. 65) that "species have a real existence in nature, and that each was endowed, at the time of its creation, with the attributes and organization by which it is now distinguished." Chapters 5-11 treat chorology, including biogeography, organic interactions, inorganic influences on biotic distribution, and extinction. Lyell accepted that each species comes into existence under favorable circumstances at a particular time and place, from which it spreads, but offered no explanation for origination. Furthermore, he deduced (p. 176) that "the species existing at any particular period must, in the course of ages, become extinct one after one," thus providing a basis for discriminating units of geologic time. There follow (Chapters 12-17) remarks concerning the effects of the organic world on the inorganic world,

including fossil preservation, and a discussion of coral reefs (Chapter 18). This volume lays a foundation for the use of fossils in biochronology.

In Volume III, Lyell discussed gradual mutations in the inorganic world and the reconstruction of Earth history. The Preface describes Lyell's travels examining Tertiary strata and his collaboration with M. Deshayes, who identified the Tertiary fossil molluscs. Chapter 1 contains a defense of the methodology presented in Volume I, and Chapter 2 contains historical information on the European Tertiary succession. Lyell then proceeded to methods of reconstructing Earth history, observing that marine species are more useful than terrestrial species because of their greater likelihood to be preserved and also noting that fossil correlations must be based upon a large number of species.

In Chapter 5, it is noted (p. 48) that marine molluscs are particularly valuable in biochronology because of their wide geographic range and their "superior duration of species," the second "probably a consequence of the former," and accurate identification of species is stressed. The identifications of Tertiary molluscs were provided by M. Deshayes. Lyell then introduced his subdivisions of the Tertiary, which he termed periods. These were the Newer Pliocene (in which the major part of the molluscs are referable to recent species), Older Pliocene, Miocene, and Eocene (in which very few of the molluscan species are extant). It was explicit that it later may be necessary to intercalate other units into this classification. The classification is based upon the percentage of still-living species in the strata, thus establishing the Principle of Lyellian Correlation. The results were based upon bulk faunas collected from many stratal units under superpositional control. This averaged out the facies problems inherent in the use of William Smith's Principle of Faunal (and Floral) Succession below the period/system level of refinement. The Lyellian principle is valid at the epoch/series level of refinement on a worldwide basis. Although generally valid, the principle must be used with caution. Because of differential geographic environmental changes and differential taxonomic responses to such changes, Lyellian percentages may vary geographically, taxonomically, and temporally. It should further be noted that Lyellian correlation, while providing a means of correlating units of time smaller than periods on a worldwide basis (because fossil species can be compared with living species anywhere in the world), does not provide a means of discriminating temporal boundaries. Lyell did not define boundaries between his subdivisions of the Tertiary nor provide means for the recognition of such boundaries. Such discrimination later was provided by Albert Oppel (1856-1858), who demonstrated the Principle of Oppelian Zonation based upon the temporal overlap of many species.

The remainder of Volume III is devoted to an elucidation of the Tertiary formations in Europe, as well as older units. The facsimile edition also includes plates of Tertiary molluscs; tables of formations and strata; appendices with M. Deshayes's tables of shells, results, and lists of species; a glossary; and a bibliography compiled by Martin J. S. Rudwick.

Substantive uniformitarianism is invalid. Species have evolved. The inorganic world of minerals and rocks follows "time's cycle," whereas the organic world tracks "time's arrow." There are exceptions to strict Lyellian correlation. Yet, Sir Charles Lyell truly is the father of modern actualistic geology. He provided a valid methodology for interpreting Earth history, thus making geology a science founded upon demonstrable principles.

DON C. STEINKER

Department of Geology  
Bowling Green State University  
Bowling Green, OH 43403

**Trilobites. Riccardo Levi-Setti. 1993. Second Edition. University of Chicago Press, Chicago, IL 342 p. \$45.00 hardcover.**

Trilobites are the most popular invertebrate fossils. In spite of this, Riccardo Levi-Setti's 1975 edition of this book long stood alone as the only widely available text on these fascinating animals. The second edition appears when there has been a boom in the number of books on trilobites (I am aware of three others published since the start of this decade), with which there can be comparisons. How does Levi-Setti's revised edition fit into this new market? The answer to that depends on the intended audience. In the preface Levi-Setti identifies two groups that he wishes to address: 1) "amateur collectors and . . . naturalists at large", and 2) "fellow scientists and students." To these groups he presents an atlas of photographs, and a "personal account of his involvement with trilobites." Although Levi-Setti is an amateur paleontologist, he is also a professional scientist, which gives him a uniquely qualified position to address so wide an audience.

The atlas section is the heart of the book. In the selection a premium has been put on aesthetic appeal, and hence some of the illumination techniques are different from those conventionally used in paleontological illustration. This has led to many strikingly effective plates, although specific details of morphology are often not as clear as in Harry Whittington's scholarly "Trilobites," published in 1992. The plates in both Levi-Setti's and Whittington's "Trilobites" are better than those in Milan Snajdr's "Bohemian Trilobites" of 1990 or Heinz Kowalski's 1992 "Trilobiten." The print resolution is higher in Levi-Setti's new edition than in the old, but the photographic quality of several of the new additions is slightly disappointing, particularly those that the author took when abroad. Apart from the absence of the soft-bodied nectaspids, and beautiful cyclopygids, the taxonomic coverage is quite comprehensive. There are several illustrations of the beautifully preserved spiny odontopleurides from Oklahoma and Morocco. These are a must for any trilobite atlas, and the photos do justice to the specimens. Most of the individuals illustrated are good choices, but there are exceptions (for example, there are many finer specimens of *Xystridura* than the one illustrated). Missing are examples of the variety of styles of exceptional preservation, and photographic documentation of ontogeny. The accompanying legends are generally brief notes on locality, age, and affinity. A surprise, hidden in one of these

legends (on pp. 174-175), is a description and illustration of a new Cambrian genus and species, *Piochaspis sellata*. It is very easy to miss this, and a separate appendix with a more detailed description and diagnosis would have been more appropriate.

For "amateur collectors and . . . naturalists at large" I view this book, in both editions, as something of a triumph. The photographs are generally excellent and Levi-Setti's personal style and enthusiasm spill out from the pages. Amateur friends comment that undefined technical terms occasionally slip in, but in general the book seems successful at presenting trilobites to a non-specialist audience. When the writing becomes more obtuse (in the long and well illustrated section on trilobite eyes) the text shows a passion for the subject that makes this fault forgivable. Drawbacks include the fact that the text coverage is highly selective. While vision and enrollment are considered in detail, other aspects of life habits receive short shrift. Areas like taphonomy, biostratigraphy, and evolution are virtually ignored. However, sometimes the author's professional detachment from paleontology allows him extra freedom. Although not agreeing with him, I liked his succinct description of why trilobites are considered primitive arthropods (p. 7). It is also refreshing to see the advent of the last major phase of trilobite ontogeny, "holaspis," boldly equated with the onset of adulthood (p. 12). Almost everyone believes it, but few come out and say so.

As a work to address "fellow scientists and students" I am less content. While admiring Levi-Setti for his contributions to the study of trilobite eyes, and for his eclectic interests, there are a number of areas where the text is misleading. For example, he states "new [thoracic] segments originate at the thoracic-pygidial boundary" (p. 12). This is misleading because Stubblefield showed in 1926 that all post-cephalic segments originate at the anterior of the terminal pygidial segment. Only after a series of molts are they released from the anterior margin of the pygidium. He also claims, erroneously, that the pygidia of members of the Olenellidae had only one segment (p. 11). There are other flaws that are more serious. Levi-Setti rejects cladistically-supported phylogenies of the trilobites such as those proposed by Fortey and Edgecombe in favor of a phylogeny proposed by Bergström. The character support for Bergström's phylogeny remains unexplained, and Levi-Setti is clearly uncomfortable with this, for he organizes the plates stratigraphically rather than systematically. This leaves the phylogeny section confused. Similarly, Levi-Setti details the results of Cisne's investigation of the pyritized *Triarthrus* from New York but ignores the substantial revision of that work by Whittington and Almond. Levi-Setti's perspectives on trilobite research are obviously influenced by his close professional friends. A suggestion for the third edition is to have the book reviewed by a wider selection of trilobite specialists, which might result in a more balanced text.

The author includes an appendix on his work with Bergström on *Paradoxides* from Manuels, Newfoundland. The specimens from those localities were illustrated in their paper of 1978 and many again figure in this book. Those photographs are superb! But I cannot let the

conclusions of that paper be reiterated without response. Bergström and Levi-Setti claimed that their work supported the Eldredge/Gould punctuated equilibrium model of speciation. Critical to their claim of punctuation is how these sub-species are defined. From the data presented in their paper it is impossible to determine whether the change is gradualistic and directional, or punctuated, because the sub-species definitions presented are arbitrary boundaries on a continuum of ratio values for two dimensions of the pygidia. Furthermore, why can't their "sub-species" simply be ecophenotypic morphs responding to the environmental fluctuations?

In conclusion, as a general introduction for "amateur collectors and . . . naturalists at large," you can't do better than Levi-Setti's book. As a contribution to trilobite science it has less merit, although there are some flashes. In that area Whittington's book stands tall above all rivals. But I think there is still scope for more texts on trilobites! All the recent books lack a vision of where trilobite studies are, or could be, heading. Surely the most scientifically interesting things about trilobites are those questions for which they provide the best data source. Almost all of the lively debate about the Cambrian radiation is currently focused on exceptionally preserved soft-bodied animals such as those from the Burgess Shale. But we can learn little about the evolutionary history of these fossils by very nature of the fact that their preservation is exceptional. Trilobites, which occur throughout the Paleozoic, have far more complete record of their evolutionary history which can be examined at a whole range of taxonomic scales. By looking for connections across different scales, we may hope to dissect the detailed anatomy of the Cambrian radiation. Hence, I am confident that there is still scope for a book on trilobites that looks to the fresh horizons of evolution and phylogenetics, and turns away from the retrospective. But each book clearly has its own niche and, as cladists say, you can't plesion all of the people all of the time.

NIGEL HUGHES

Department of Paleontology  
Cincinnati Museum of Natural History  
Cincinnati, OH 45202

**Biology of the Reptilia: Sensorimotor Integration. Volume 17, Neurology C. Edited by Carl Gans and Philip Ulinski. 1992. University of Chicago Press, Chicago, IL. 781 p. \$92.00 cloth, \$42.50 paper.**

The diversity of the sensory and motor systems of reptiles has captured the interest of neuroscientists for many years. A variety of neurobiological features unique to reptiles, including visual adaptations to various habitats, the evolution of infrared detection among different snakes, and adaptations to limblessness or to an aquatic environment, are covered in this book. This collection of chapters, covering a wide range of topics about sensory and motor processing in the reptilian nervous system, is written by recognized investigators in their fields. The chapters are very comprehensive and well written and summarize a variety of topics that have too frequently been ignored.

Chapters 1-4 are concerned with the processing of visual information. The first chapter, a survey of retinal structure, has synthesized a considerable amount of information on the reptilian retinal structure. One of the strengths of this chapter is that it points out questions that remain to be answered as well as those that have already been answered. Chapter 2 reviews the function of the turtle retina, including some of the specialized physiological, neuropharmacological, and psychophysical features present in turtles. One of the highlights of the third chapter, about retinal projections in reptiles, is a fascinating discussion of the ways that the brains of various reptiles have adapted to microphthalmia and the evolutionary significance of these adaptations. The fourth chapter describes the pathways through which visual and other sensory information may affect motor pathways. This section is beautifully illustrated with the timeless drawings of neurons by Ramon y Cajal and detailed drawings of neuronal morphology by the authors. The processing of infrared information, a unique adaptation of some snakes, is reviewed in Chapter 5. The structural and functional adaptations of this system are compared to the trigeminal sensory system in different radiations of snakes. The author considers arguments for and against possible homologies among these systems. Chapter 6 surveys the literature about the structure and function of the peripheral sense organs of the reptilian musculoskeletal system. Chapter 7 provides a comprehensive overview of neuronal morphology of the reptilian cerebellum and its projections, a topic that is long overdue for a review. Finally, Chapter 8 compares the distribution of numerous neuropeptides in a variety of reptiles and should serve as

an easily accessible source of references to anyone interested in comparative neuroanatomy.

The information in this book is very detailed making it impractical for use in most classes, but it should be very helpful as a reference to graduate students and researchers whose interests are covered in the various chapters. Indeed, one of the strengths of this book is that many of the authors make a concerted effort to point out directions in which further research is needed. My only criticism of the book is that the title *Sensorimotor Integration* suggests a focus on the interactions between the sensory and motor systems, but this interaction is rarely dealt with. Instead, most chapters are either about sensory or motor information processing, but not both. However, the topic of sensorimotor integration is difficult to address even in other vertebrate classes where it is being studied intensively, and this separation of topics largely reflects our current knowledge of sensorimotor integration in reptiles. Perhaps this book will initiate research that will address this topic and ultimately will produce a sequel. Meanwhile, this book has achieved the purpose of bringing two obviously related topics together under a single cover.

*Sensorimotor Integration* is recommended as an extremely useful reference to the comparative neuroanatomist's library, including those with even a marginal interest in reptilian neurobiology. It is particularly useful because reviews of the subject matter chosen for this book are long overdue.

LAURA L. BRUCE

Department of Biomedical Sciences  
Creighton University  
Omaha, NE 68178