# Book Reviews

## Geologic Time

**A Geologic Time Scale.** W. B. HARLAND, A. V. COX, P. G. LLEWELLYN, C. A. G. PICKTON, A. G. SMITH, and R. WALTERS. Cambridge University Press, New York, 1983. xii, 132 pp., illus. Cloth, $24.95; paper, $8.95. Cambridge Earth Science Series.

In 1669, Nicholas Steno formulated some deceptively simple principles that remain today the keystones of modern stratigraphy. They describe the initial conditions of sedimentary deposition and include superposition (in any stratigraphic succession, the youngest strata are on top), original horizontality (strata are deposited horizontally or nearly so), and lateral continuity (strata originally continue in all directions until they either terminate against the boundaries of the depositional basin or thin to zero). When, in the early 19th century, William Smith and Georges Cuvier added the principle of faunal succession, thereby providing the means for correlating discontinuous geologic formations, the basic tools for dividing geologic time into a logical and worldwide scheme were complete.

It is unclear to whom the credit should go for making the first attempt at formulating a geologic time scale. Perhaps to Giovanni Arduino, an inspector of mines, who, in 1759, divided the rocks of Tuscany into three successive groupings he called Primitive, Secondary, and Tertiary. In the past two centuries, the time scale has evolved as the rocks of the earth have slowly revealed their secrets to painstaking analysis. The scale has become more complex, accurate, and useful, but Arduino wouldn't recognize it. The only term to survive from Arduino's groupings is "Tertiary," which designates a sub-era among a hierarchy of more than 150 eons, eras, periods, epochs, and ages into which geologic time has now been divided.

This book, by a committee of authors, is the latest in a succession of efforts to produce a standardized worldwide geologic time scale calibrated in years. Producing a time scale is not a simple task, for it entails the merger of two quite different sorts of time scales, each based on a wealth of complex data. The chronostratigraphic scale is a scheme of hierarchical divisions ultimately based on the sequence of rocks and the fossils they contain as observed in the field. It is a nonlinear, relative scale and exists by convention because it has proven to be extremely useful in deciphering the earth's history. The terminology and structure of the major parts of this scale have been agreed upon for many years, but there are still a number of alternative proposals concerning some of the details. Herein lies the authors' first task—to suggest the best, or perhaps the least unsatisfactory, of the many possibilities.

The chronometric scale is linear and represents a periodic repetition of equal divisions of time, that is, years (or, as the authors point out, standard seconds—but that is a little picky for geologic time), projected into the past. This scale is based on radiometric dating, which utilizes the predictable decay of naturally occurring, long-lived radioactive isotopes in rocks.

The trick is to match a standardized chronostratigraphic scale to the chronometric scale and produce a geologic time scale with a sensible and useful structure, calibrated in years before the present.

The goal of this book, as with any effort to produce a time scale, is to present a working document that is a reasonable synthesis of the available data. In this the authors have succeeded admirably. They have recommended a useful chronostratigraphic scale and have used the available data from radiometric dating to calibrate it in years. The result is scholarly and comprehensive. The time scale will be extremely useful to those who work with geologic time, but it is not the best part of the book.

Whether it was their intention or not, the authors have gone beyond the mere construction of a geologic time scale and produced a compact and authoritative tutorial that will benefit anyone with even a casual interest in geologic time. Unlike most volumes on time scale, which are usually of interest only to the specialist, this one is actually readable. The first three chapters, which are the meat of the book, contain about as good a summary of the philosophy, problems, terminology, and calibration of the time scale as I have ever seen, and in only 51 pages. Every aspect of the time scale is explained in a concise, crisp style. Charts and figures abound. There are a large figure that compares the principal time scales produced over the past five decades and individual figures that show the relevant relationships for each period of geologic time.

Radiometric ages can rarely, if ever, be obtained exactly on a rock unit that represents a major boundary between divisions of geologic time. Usually they occur above and below, and it has been customary simply to estimate the best age for the boundary. For this time scale, however, the authors have applied a statistical technique that provides a quantitative estimate of the age of a boundary and of the error. The result may not be much different or even more accurate than previous scales, but somehow the process is more satisfying.

One of the most significant developments in geophysics over the past two decades was the discovery of the geomagnetic-polarity–reversal time scale and its application to sea-floor spreading, plate tectonics, and stratigraphy. This important subject deserves a prominent place in any treatment of the geologic time scale, and the authors have not been remiss in this regard. Included is an excellent summary and update of the reversal time scale for the past 160 million years, and this information is carefully correlated with the geologic time scale.

Specialists who prefer to pore over a detailed analysis of each and every radiometric datum that goes into a time scale will be disappointed. The authors have used, as their source of data, six previously published compilations. For all but a few readers, however, this is a strength rather than a weakness. The authors have wisely directed their energies to synthesizing and analyzing the body of available data and have let others do the culling. The result is that the reader is spared the nit picking and brought immediately to the heart of the subject. Besides, the references are complete, so anyone interested in individual data will have no trouble locating their source.

Geologic time scales are never permanent, and this one will be superseded.

But it may be a long while before anyone succeeds in organizing such an enormous amount of relevant information into such a useful and compact volume.

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## Recognition Behavior

**Comparative Social Recognition**. PATRICK COLGAN. Wiley-Interscience, New York, 1983. xvi, 282 pp., illus. $37.50.

"Social recognition" refers to an individual's ability to discriminate important social attributes of other individuals or groups: species identity, social group membership, sex, genetic relatedness, and social and reproductive status, among other traits. Research on these abilities has a long and checkered history that reflects the importance of the topic and its multidisciplinary attraction. With the publication of *Comparative Social Recognition*, there is now available an encyclopedic description of the literature (largely animal studies) on social recognition.

This book poses the general question, "What processes are operative in what species to produce what recognition behavior?" (p. vii). In grappling with answers, Colgan considers (i) the role of different sensory systems, (ii) how discrimination abilities (based on learning, including habituation and imprinting) develop, and (iii) the relationship of social recognition to central issues in evolutionary biology. Some of these issues include the genetic basis of recognition, intra- and interspecific communication, living in social groups, competition and dominance, and aspects of reproductive behavior such as assessing and choosing mates. The book is "comparative" in that each chapter is taxonomically organized, reviewing the capabilities of various groups (invertebrates, amphibians, reptiles, birds, and so on) to make social discriminations.

The importance of Colgan's subject to both proximal (immediate causation) and ultimate (evolutionary adaptation) studies of behavior is revealed by some exemplary questions: What is the role of crickets' songs in species identification and speciation? Although kin might be identified as familiar rearing associates (siblings = nestmates, for example), are relatives encountering one another for the first time recognizable? What sensory systems are used by different taxa to distinguish sex, reproductive condition, and competitive and individual identity? How do phenotypes experienced by individuals during development affect their later preferences for social partners, including mates? If ecological factors have been critical in the evolution of social systems, how might these factors also account for the evolution of different recognition systems?

Clearly, the major strength of the book is that it surveys and summarizes an enormous body of widely scattered research (there are approximately 1400 reference citations in the 188 pages of text). Because of the vastness of the topic, most readers will find some omission that perplexes them (for me it was M. Leon's work on dam-offspring recognition in rats), but no single source provides as thorough a review as this book. Unfortunately, however, Colgan rarely goes beyond cataloguing studies to critique them, to analyze theoretical issues, to consider methodologies, or to develop a comprehensive framework within which research might proceed.

Let me suggest some sample topics that beg to be treated in a book such as this one. First, the meaning of "recognition" must be faced squarely (Colgan treats this matter in one paragraph), given that some investigators eschew the term completely whereas others use it regularly and interchangeably with "identification" and "discrimination" (as I have for convenience). Although most behavioral scientists infer recognition (substitute some other term if you like) on the basis of observable differential responses to stimuli, the word has a variety of different connotations. Also worthy of treatment are the experimental designs and techniques used to study recognition. For example, when a subject exhibits discrimination by showing a preference for one of two stimulus animals (a commonly used paradigm), might not all three individuals actually be subjects? When the primary sensory system mediating recognition is investigated by ablating that system, what control group or groups can be tested to distinguish the specific impairment of one system from a more widespread, systemic effect? Finally, what kind of data distinguish the identification of classes of individuals (siblings versus cousins, for example) from true individual identification (sib A versus cousin B)?

The comparative analysis of recognition abilities and mechanisms, the study of the physiological and sensory bases of these mechanisms, and deciphering the relationship of phylogeny, ontogeny, and social organization to recognition collectively highlight the importance of social recognition to behavioral analyses. This book gives us an easy-to-read overview of the diverse and voluminous research that deals with recognition. In doing so, it also lives up to its label supplied by Colgan, an "aperitif volume." What we need now is for an intrepid soul to present a theoretical infrastructure that will foster more interdisciplinary thinking, generate testable hypotheses, and uncover some generalizations that have not yet emerged.

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## A Cultural Chronology

**Ceramics, Chronology, and Community Patterns**. An Archaeological Study of Moundville. VINCAS P. STEPONAITIS. Academic Press, New York, 1983. xxii, 378 pp., illus. $46. Studies in Archaeology.

It has been almost 20 years since the cultural process clarion was sounded in New World archeology, calling most of a whole generation of archeologists to join in the search for explanations of cultural evolution. Outfitted with righteous fervor, the scientific method, and modern multicausal negative and positive feedback loops, they turned away from the pathways of culture history. Their goal was not mere description of temporal change in prehistoric material culture and lifeways but rigorous and convincing explication of how and why human cultural systems, in general and in particular, evolved more complex organizational structures.

Two decades of intense focused research in various parts of the world, from Iran to Hawaii, have clarified a number of relevant variables in cultural evolution (among them population growth and aggregation, administrative centralization, increasing energy input, environmental and cultural circumscription, specialization of production, and exchange), which have in turn been tied together in different cause-and-effect networks in a number of quite elegant processual models.

It has proven quite difficult, however, to determine how closely these theoretical models reflect prehistoric reality. To test them archeologically requires the ability to measure accurately sometimes subtle changes in variables through time and to establish which variables change first in rapidly responding cultural systems. The establishment of temporal pre-