the length of the chromosome, that is, the biochemical basis for banding, including characterization of the various heterochromatins; mapping of gene loci to specific chromosomes in the mouse and man; the impact of banding on medical cytogenetics; the importance of chromosome identification by banding patterns in experiments with somatic cell hybridization; the comparative study of banding in the analysis of the evolution of species, including primates; and the use of automated (computerized) systems for chromosome identification.

This book indicates quite clearly that cytogeneticists are happily at work with their new battery of techniques, each banding his "thing." Many new and interesting findings can be expected for several years to come. Then, after the field becomes calm again (or maybe even before), we can expect another surge forward when someone learns how to make chromosomes of somatic cells undergo a meiotic division in vitro, how to produce giant-sized polytenic chromosomes in vitro, or perhaps how to cause chromosomes to behave in some completely novel (but informative, naturally) way.

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Earth History and Biosphere Dynamics

Evolutionary Paleoecology of the Marine Biosphere. JAMES W. VALENTINE. Prentice-Hall, Englewood Cliffs, N.J., 1973. xvi, 512 pp., illus. $16.95.

"I should like to maintain that times of eruptive evolution may well be . . . related to important events in the physical history of the earth." This statement, made in 1949 by Preston Cloud, is in the tradition of many generations of paleontologists who have sought to explain the panorama of the fossil record in terms of unifying themes in earth history. Where in the late 1940's diastrophism was discussed as the controller of periodicity in the history of life, now continental drift and sea floor spreading have been rapidly incorporated into a model of biosphere dynamics. James W. Valentine's ideas on these matters have excited paleobiologists as if a light bulb such as one sees over cartoon characters had suddenly been lit. While Valentine's book is a useful and informative textbook of evolutionary paleoecology, it surely is most notable for its imaginative, if somewhat speculative, analysis of the history of life as being regulated by the many phenomena associated with plate tectonics.

One of the major themes of the book is that the history of life may be studied at many levels, which can be arranged in a hierarchy (community, province, biosphere), but that studies at a given level can be made without exhaustive knowledge or investigation of all the lower ones. Thus we can study the evolution of faunal provinces without a consideration of all the component species. The evolution of a province may be explained in terms of the changes in its component communities. This may sound like a truism, but it does much to dispel a common tendency in paleontology to regard with skepticism all generalizations that are made when all the details of lower levels of the hierarchy have not been worked out. We must not ignore the possibility that the available data are less than ideal, or even poor in some cases. But it is equally unacceptable to ignore the structure of the biosphere and to refuse to generalize theory from available data. Paleoecological efforts of the past decade largely have demonstrated that the present is the key to the past. Valentine, by contrast, has commendably examined the procession of life and told us that the past is the key to the present. He leaves us with the conclusion that the history of life cannot be understood without an extensive knowledge of earth history. The present is merely a point in a shifting equilibrium state that is governed by many crustal and climatic processes.

In the latter part of his book Valentine proposes a model that unifies modern ecological theories of the maintenance of diversity patterns and community structure with the dynamic rearrangement of the continents that has taken place in geologic history. The proposed alterations of climatic patterns, oceanic circulation, environmental stability and heterogeneity, and geographic isolation form a cogent model that is potentially testable with more refined data than are now at hand. In brief, Valentine proposes that periods of assembly of continental blocks are periods in which shallow marginal marine climates are controlled by continental interiors, nutrient availability is unstable, and there is little opportunity for evolutionary divergence; therefore we have low diversity. Conversely, times of fragmented continents are characterized by the control of shallow marine realms by ocean currents, which ameliorate climate (maritime climate), evolutionary divergence and provinciality, and less fluctuation in nutrients in shelf waters; therefore high diversity develops. Rates of sea floor spreading can also be related to transgressions and regressions of the ocean. Thus fluctuations in diversity over geologic time can conceivably be explained with reference to the degree of fragmentation of continental blocks.

At first glance, the data seem to bear out Valentine's thesis. The end of the Permian is a time of lowered diversity, continental assembly, and concomitant extinction. With subsequent fragmentation in the Mesozoic and Cenozoic, standing diversity steadily increases to a present-day maximum. Unfortunately the Paleozoic is not well enough understood as yet to show whether or not the theory holds up. The theory has been criticized mainly because the available data on standing diversity show a suspicious correlation with the volume of sedimentary rock existent for a given geologic system. Another disturbing aspect of the theory is that diversity almost seems like something that can be turned on and off like a faucet. Valentine gives no account of the evolutionary dynamics that would be involved in generating provinces of high diversity during times of fragmentation. It seems that a consideration of the data presented in the past few years by Stehli, Eldredge, Gould, and others might go a long way toward integrating models of the ecological regulation of diversification and the evolutionary dynamics of the diversification process. Without such an integration, we fall into the same trap as the modern ecologist who regards ecosystems as having had no previous history that contributes to present-day patterns.

These criticisms only further serve to suggest that Valentine has presented an imaginative and inspiring framework for future research. I must add parenthetically that those who have read Valentine's recent research papers will find here a more unified exposition of his ideas, but nothing dramatically different or more detailed. This section of the book therefore is of primary interest to those who are unfamiliar with Valentine's ideas.

The first seven chapters of the book are devoted to an introduction to the methodology involved in the study of the paleoecology of the function of extinct organisms, population structure, and community ecology. Also present are three helpful introductory chapters explaining some principles of evolution, genetics, and ecology and giving a good introduction to marine science. They are of generally high quality, though I found the explication of population growth and selection coefficients somewhat unclear and much of it unnecessary for the discussions that followed. The discussions of paleoecology are well balanced between introductory principles and extensive, if somewhat selective, use of examples chosen from the literature. One thing lacking is a presentation of the elegant multivariate techniques (factor analysis, Markov chains) that have been developed in recent years to reconstruct properties of ancient environments, as opposed to their use in the classification of communities and provinces.

Perhaps the most effective contribution of the book is Valentine's attempt to unify the history of the biosphere and to decompose it into an organized structure that may be studied at different scales of time, space, and taxonomy. This approach can only have a salutary effect upon present and future students of paleoecology. The book is at once a textbook and a treatise on the principles of the study of the history of life. These two purposes occasionally work against each other but generally result in a stimulating and interesting presentation. Valentine certainly justifies his statement, "The fossil record deserves to be taken very seriously."

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How People Move

How Man Moves. Kinesiological Studies and Methods. SVEN CARLSÖÖ. Translated from the Swedish edition (Stockholm, 1972) by William P. Michael. Heinemann, London, 1973 (U.S. distributor, Crane, Russak, New York). viii, 198 pp., illus. $10.75.

Scandinavians have long maintained an interest in the scientific investigation of exercise, sports, gymnastics, and other movements. Sven Carlsöö has continued this tradition. The English translation and expansion of his book *Människans rörelser* should be read by all interested in just what occurs in our muscles and joints when we sit still or move about.

After an all-too-brief introduction to the development and organization of movement, a clear account is given of the sophisticated application of strain gauges in dynamometers, force plates, and accelerometers to measure what happens outside the body. What goes on inside, and in particular which muscle does what and when and how effectively, is described from experiments with surface and internally injected electrodes which together with the appropriate electronics can detect and display the electrical activity as single motor units become recruited until the firing of all the fibers occurs in maximal activity. Although, surprisingly, which muscles are actively engaged when a person is walking normally has not been fully established, the rise and fall of the activities of 60 of them (30 on each side) are described in fascinating detail. To swing one arm upward uses 18 muscles, but a golf swing requires 46, all working together in (one hopes) an exquisitely coordinated fashion.

All sorts of interesting things can be found in this remarkable book. For instance, there are quantitative studies of the chance of slipping on different surfaces and the angle of the step that can prevent this. Most people know by experience that, in general, very tiny steps are safest, but this book records careful measurements under many conditions. There are even studies of the most efficient way to lift bread in a factory. Under the words "How Man Moves" on p. 166 is a picture of a working woman, and whereas on p. 90 the line drawing of the figure at a typewriter is clearly a male, the evidence given on p. 179 was obtained from women. This shows that in high-speed typing the nervous system cannot optimize properly, so that when using an electric typewriter rapidly, the finger muscles perform approximately 100 times more work than is necessary.

Clearly in this book, as on many other occasions, to quote the old saying, "man" embraces "woman." But why leave this to the imagination in a book on How People Move?

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Behavior

Habituation. HARMAN V. S. PEEKE and MICHAEL J. HERZ, Eds. Academic Press, New York, 1973. Two volumes. Vol. 1, Behavioral Studies. xii, 290 pp., illus. $15. Vol. 2, Physiological Substrates. xii, 216 pp., illus. $22.50.

These volumes reflect the considerable attention habituation has recently attracted from scientists of varying backgrounds, including ethologists, psychologists, and neurophysiologists. Habituation has been most simply defined as a waning of the response elicited by a repeated or constant stimulus, with the proviso usually added that this waning not be the result of altered properties of sensory receptors or effectors (such as adaptation, damage, or fatigue). Because it is stimulus-specific, persists over time, and is mediated by the central nervous system, habituation is often considered a primitive form of learning. Frequently, the rationale given for studying habituation is that the results may be applicable to more complex forms of learning not as amenable to detailed analysis.

Peeke and Herz have collected articles that represent quite well the interdisciplinary nature of research on habituation. The topics include the relation of habituation to conditioning, habituation at different phyletic levels both in the laboratory and in natural settings, and mechanisms of habituation in intact animals as well as in "model systems" such as the feline spinal cord. The range of subjects is such that even those whose primary research interest is in some aspect of habituation will find much that is new to them. Of particular interest in this regard is the chapter by Pakula and Sokolov, which describes a great deal of work, generally unavailable in English, on neuronal mechanisms of habituation in gastropods.

Two features of these volumes, however, may significantly detract from their potential usefulness, particularly for the nonspecialist. First, many of the chapters, which from their titles might be expected to be general surveys, are instead detailed descriptions of previously published experiments performed in the authors' laboratories. Such chapters may be interesting to the specialist, but they often present a biased view to the general reader. One of the several exceptions is Graham's scholarly review of habituation of responses mediated by the autonomic nervous system.