social learning theories of imitation and reinforcement stressed by Bandura and Mischel, the authors draw upon Kohlberg's theory on the central role of developing cognitive structures. Each theory is seen to have its place, often in combination, blended to account for the facts at hand. It is refreshing to see diverse perspectives used in this way to construct explanations of delimited phenomena. But some theorists will be troubled by this work's eclecticism, and it remains for future studies to reveal which of the authors' many constructions are correct.

The authors call for a liberalized reinterpretation of the specific tasks of sex-role socialization. The knowledge base is shown to justify past and projected future reductions of sex-role specialization within our society. Quite properly the authors emphasize the importance of developing many similar competencies in both sexes as well as preventing or neutralizing sex-role differentiations known to be dysfunctional. Research has an important role to play in documenting the future course of these secular trends.

Certain issues dealt with informally in this volume might well become central topics in future works. More systematic attention could be given to variations in sex-role differentiations (and their socialization) among cultures, social classes, and ethnic groups. There is also continuing interest in how the residuals of traditional norms continue to operate within modern society, however subtly. One promising approach to this issue can be seen in the authors' sensitive treatment of situational factors as elicitors of sex differences in behavior. In addition, traditional patterns of sex-role specialization are increasingly perceived as options rather than as requirements. Greater attention could be given to the psychological and sociological implications of these choices, and to the circumstances under which this kind of voluntarism reverts back to necessity. In examining such questions developmentally, box-score tallies of average differences between the sexes on psychological attributes would be supplemented and perhaps even supplanted by other kinds of evidence, including experimental and naturalistic findings on how gender alters functional relationships between critical experiences and behavior at various periods of the life cycle.

This work exposes but does not fully resolve a basic theoretical problem for the psychology of sex differences. Theories of socialization postulate general mechanisms of cultural transmission from society to child. A major reason for investigating the origins of behavioral sex differences has been to test one or another general theory of the socialization process. Prominent theories have not stood up well in this respect, however. Behavioral differences between the sexes appear to be so limited, so dependent upon subtle features of the eliciting context, and so specific to certain age periods, and to have such diverse patterns of determinants, that no existing theory of cultural transmission can possibly handle the explanatory burden. While it was once widely believed that social learning mechanisms would explain major features of early socialization, that hope remains unfulfilled in this area. And since much of sex-role development appears to involve qualitative shifts in psychological organization, rather than cumulating behavioral changes with age, the idea of a society continuously inducing its children and youth to adopt a common core of sex-differentiated norms becomes highly questionable.

When one considers that many traditional lines of sex-role specialization are breaking down in modern society, it comes as no surprise that reliable sex differences in behavior are so difficult to establish, or that sex-differentiated socialization practices during childhood are so limited in scope, or that functional relationships between these two classes of variables generally are so weak. To be sure, traditional sex-role differentiations continue to pervade our society, but strong evidence for their direct and continuous transmission from one generation to the next is quite rare. The weak transmission processes which remain in this area appear to be the vestiges of past eras, when behavioral specialization by gender did serve vital functions for society.

Actually, such difficulties in establishing strong connections between childhood experience and later behavior extend well beyond the area of sex-role development, raising even broader questions about the nature of socialization processes. Many students of human development have moved beyond the idea of society shaping its young in its own image and are investigating how the individual actively transforms cultural patterns throughout the life cycle. As this volume partially documents, the child's own developing dispositions and capacities (biologically primed tendencies, cognitive processes, linguistic skills, and so on) markedly influence how the child selects, organizes, and acts upon cultural messages and how, in turn, socializing agents respond to the child. This shift in thinking about socialization could revitalize theoretical interest in the psychology of sex differences.

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Differentiation

Cell Patterning. Proceedings of a symposium, London, May 1974. Associated Scientific Publishers (Elsevier, Excerpta Medica, North-Holland), New York, 1975. viii, 356 pp., illus. $26.95. Ciba Foundation Symposium 29 (new series).

This volume consists of contributions to a symposium on pattern formation in a variety of animal systems. The papers include both reviews of and new information on the genesis and control of patterns in material ranging from ciliate protozoa to insect embryos and epidermal cells to the vertebrate retina. Some of the most interesting ideas come to light in the general discussions following each paper. About one-third of the space is occupied by these discussions, which form a disconnected discourse in which the current issues and ideologies of developmental biology contend.

Many authors interpret their observations in the framework provided by Wolpert's theory of positional information. According to this model, each cell in a developing system acquires a unique positional value that determines its fate at differentiation. Chemical gradients provide a parsimonious means of generating positional information, and a number of contributions illustrate the operational criteria currently used to detect them. Hunt shows by transplantation experiments that specification of the major axes of the *Xenopus* retina can take place outside the orbit. Thus the spatial cues from which the retina derives polarity come from a global system that pervades the embryo. Other evidence for gradients comes from the mirror image patterns observed by Bryant in experiments with regenerating *Drosophila* wing disk fragments and from Sander's review of his work on ligated insect embryos. Although convincing gradient models can be devised to account for particular results, they are not susceptible to direct test as long as the outcome of differentiation is the only means of assaying gradient level. Unfortunately, an account of current progress in the chemical characterization of gradients active in regeneration in *Hydra* is not included.

If the information passed between cells is as simple as position in a coordinate system, then the mechanisms mediating its interpretation as a pattern of gene activity must be quite complex to account for the variety of response. The most promising attack on this problem is at present genetic, and it is best developed in *Drosophila*. Two papers by Garcia-Bellido and Kauffman exemplify this approach at its most incisive. These authors argue from differ-

ent data to the conclusion that gene activity in differentiation is controlled by a hierarchy of binary switches in which particular genetic loci play a decisive role. Mutants at these loci have homoeotic effects, and their influence is spatially restricted by the same clonal boundaries that define compartments. Kauffman's formalization of this model as an "epigenetic code" is stimulating and raises many new questions concerning the mechanism of translation.

The book achieves a nice balance between theory, experiment, and interpretation. Avoiding a molecular approach, it nevertheless points a way toward one. It will be of interest to geneticists and practicing developmental biologists, and for the most part its ideas will be accessible to advanced undergraduates.

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Silurian-Devonian Paleobiology

Evolution and Extinction Rate Controls. ARTHUR J. BOUCOT. Elsevier, New York, 1975. xvi, 428 pp., illus. $42.50. Developments in Palaeontology and Stratigraphy, 1.

A. J. Boucot is widely known for his prolific studies of Silurian and Devonian brachiopods. From his long experience with these fossils he has developed the hypothesis that rates of evolution are governed primarily by population size. The larger the population the slower the rate of evolution, whether it is assessed by phyletic, cladogenetic, morphologic, or (what Boucot chiefly employs) taxonomic criteria.

In order to support and elaborate this hypothesis, Boucot explores the brachiopod associations and distributions of the Silurian-Devonian interval. He has written a sweeping description of their ecological and biogeographic units, with special attention to their changing patterns through time. These data are summarized in maps and figures that include a number of range charts containing phylogenetic interpretations. Rates of extinction and diversification and changes in levels of taxonomic diversity are calculated on a stage-by-stage basis. Appendices contain such systemic descriptions and stratigraphic notes as are necessary to document new or unusual taxonomic practices. The treatment is worldwide in scope, although restricted to level-bottom, nonreef associations. Well over half the book is devoted to these matters.

Thus we are provided with a large-scale account of biotic patterns during about 100 million years of Paleozoic time. Silurian-Devonian time embraces some important events in the history of marine invertebrates. Two major waves of extinction occur, one near the end of the Silurian and quite an extensive one near the end of the Middle Devonian. These have never been well explained, but Boucot makes it clear that the second, at least, is associated with a decline in the number of provinces. Also during this time interval, North America and northern Europe were joined after having been separated by an ancient ocean. Boucot has chosen not to consider the effects of continental drift; consequently, distributional data are discussed in terms of modern geography, and the environmental effects of drift are not explored. However, the data will be of use to those wishing to attempt reconstructions with paleogeographic verisimilitude. In any event, the major conclusions drawn from these data are that widespread brachiopod species (assumed to have large populations) tend to persist longer and to evolve more slowly than more narrowly distributed ones (assumed to have small populations).

The remainder of the book is devoted chiefly to factors that control population size, to problems of population size estimates for fossil species, and to factors that might affect evolutionary rates. Discussions are drawn partly from Silurian-Devonian situations and partly from theory, and the theoretical discussions are based chiefly upon recent papers that have been particularly influential or controversial. The topics they take up include the effects of nutrients, biomass, diversity, trophic position, competition, and predation upon evolutionary rates. The discussions are heavily weighted against hypotheses that interpret evolutionary rate regulation in terms other than population size. Thus the stimulating models of Bretsky and Lorenz on mass extinctions are especially singled out for criticism, and the model of the peripheral origin of novel morphologies presented by Eldredge and Gould is reinterpreted as a case of the rapid evolution of small as compared to the slow evolution of large populations.

In the end, this portion of the book is unsuccessful. The most we are left with is the probability that widely distributed taxa usually endure longer than more narrowly distributed ones. We are never presented with a mechanism to account for this difference. Boucot asserts that biologists have developed evidence that evolution proceeds more rapidly in small than in large populations. He mentions the rapid speciation of taxa isolated on islands, presumably attributing this chiefly to their small population sizes rather than to effects of the isolation of founder populations in novel environments. Whether island species continue to evolve rapidly is not considered, fluctuations in population sizes are not considered, and the classic treatments of population size effects by Sewall Wright are not mentioned. So far as I am aware, biologists have not in fact presented evidence that populations of the rather large sizes represented by Boucot's "small" populations, which may have distributions that are subcontinental in extent, do evolve faster than even more extensive populations.

Why then do the more narrowly ranging taxa have shorter fossil records? Is it because more restricted taxa are least likely to be discovered in fossil form and therefore tend to have shorter recorded durations? Or do taxa with widely distributed populations tend to be more flexibly adapted, so that they weather environmental changes that carry off narrowly adapted forms with smaller ranges? Such questions are still open. This book is not satisfying as a treatment of evolution and extinction rate controls. Nevertheless it can be especially recommended for its broad coverage of the interesting Silurian-Devonian level-bottom benthos.

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(Continued on page 177)