Book Reviews

Evolutionary Mechanisms

Evolution Today. Proceedings of a congress, Vancouver, Canada, July 1980. GEOFFREY G. E. SCUDDER and JAMES L. REVEAL, Eds. Hunt Institute for Botanical Documentation, Carnegie-Mellon University, Pittsburgh, 1981. iv, 486 pp., illus. Paper, $18.

This volume is a collection of invited papers from the congress symposia of the second International Congress of Systematic and Evolutionary Biology. Ten of the original 12 symposia are represented (missing are those on community structure and coevolution and on the origin of land plants), but only two (those on arctic biology and reproductive strategies) are complete. Five of those published are missing at least half of the original contributions, including some of those that are potentially of the widest interest (for example, that of G. L. Bush on models of sympatric host-race formation and speciation). Even R. C. Lewontin's provocatively titled "How representative is allozyme variation of evolution?" is missing—a pity, since this is one of the most widely used approaches to evolutionary questions and Lewontin himself is largely responsible for that fact.

The volume at hand presents 39 original contributions that, in the words of the editors, "cover a broad spectrum of systematic and evolutionary biology, and outline many of the current concepts being debated at the present time." Not unexpectedly, there is little connection among the symposia, even when individual papers treat similar topics.

The symposium Arctic Refugia and the Evolution of Arctic Biota is a welcome revival, complementing the current rapture with tropical forest refugia. Discussion by Murray on vascular plants, Danks on insects, and Hoffmann on mammals leads to the recognition of two types of refugia, fixed and shifting, a view with relevance to ongoing discussions of vicariant versus dispersalist schools of biogeography.

The symposium Evolution of Reproductive Strategies contains five papers, including one by Chaloner and Sheerin on the evolution of disseminule size in land plants (a general trend toward increase in size, providing for a longer growth period prior to the necessity of manufacturing food or for more effective use of dispersal agents); an installment in Solbrig's continuing series on *Viola*, this one describing the direct relationship between reproductive effort and the degree of environmental disturbance; and a paper by Geist on ungulates, which concludes that convergence and parallelism apply to reproductive patterns as well as to morphological traits.

Evolutionary Epigenetics presents an excellent argumentative review of the thought of a school that clearly separates processes involving adaptive morphological change in the formation of higher taxa (macroevolution) from those operating at the level of infraspecific or, possibly, specific differentiation. This symposium contains the most nontraditionalist views and constitutes the most controversial set of papers at the meetings. Løvtrup argues that morphogenetic changes of evolutionary importance are not accomplished through the accumulation of micromutations, but rather through cell or tissue interactions during embryological differentiation (termed epigenetics). He concludes, therefore, that most current molecular population genetic studies have little significance for the study of evolution, an outlook at great variance with that of Wake in his review in the symposium Allozymes and Evolution. Horder advocates the idea that developmental processes can be understood functionally from the standpoint of structural genes and their immediate means of activation and repression; models with elaborate sequences of regulators involving "developmental programs" are unnecessary. Indeed, he argues that the number of decision-making steps programmed into an egg to produce the complex adult need not be more than the number of cell types, on the order of 100. Finally, Rachootin and Thomson, in bridging the chasm between classical genetic and epigenetic theories, view natural selection as operating on development processes rather than on specific traits, which are end products of these processes. Thus, genetic revolutions are seen in terms of the establishment of new, stable developmental patterns, and the specter of Richard Goldschmidt is resurrected.

Though one message of epigenetics is that molecular approaches to genome organization will not lead to an understanding of the evolution of form and function, this view is clearly not held by participants in this very active field. Indeed, Doolittle (Macromolecular Mechanisms in the Evolution of Eukaryotic Cells) pleads with his fellow molecular biologists to concern themselves with the "why" rather than the "how" of gene regulation and expression patterns. He believes, for example, that highly and middle repetitive DNA's are products of intragenomic (nonphenotypic) selection, playing roles in speciation and modulation of recombination frequency and thus in the promotion of genetic variability. Whitt (Allozymes and Evolution) develops a model of gene regulatory evolution based on multilocus isozyme systems, which he considers the component of gene evolution responsible for most adaptively significant differences among species. Finally, Dover and his colleagues (Comparative Study of the Genetic Material, DNA), in their analyses of sequence rearrangements in highly repetitive DNA "families," argue that nucleotide sequences may periodically undergo amplification followed by transposition, generating major DNA or chromosomal rearrangements and providing for punctuational episodes of speciation and adaptive change. Again, Goldschmidt is revisited, but from a molecular rather than a developmental standpoint.

In a continuation of this vein, the symposium Evolution of Colonizing Species asks questions about the common genetic features of successful colonizers (Brown and Marshall), how much genetic change is actually necessary to promote colonization (Carson and Ohta), and the constraints on the evolution of life-history traits of colonizers (Stearns and Crandall). Brown and Marshall identify six characteristics of colonizing species, including greater phenotypic plasticity along with the more traditionally recognized reproductive modes and levels of genetic variability. "Phenotypic plasticity" is a term used to identify any environmentally induced change in a phenotype. Advocacy of its evolutionary importance, probably unbeknownst to the authors, provides a commonality with the epigenetics theme of Løvtrup. The single most significant finding of the volume, to my mind, is the one by Car-

son and Ohta that as little as a single-gene, two-allele system may control oviposition behavior in the *Drosophila grimshawi* complex of Hawaii. Though the example is of an allopatric situation, it does provide evidence for the sympatric host-race shift model of G. L. Bush. And, of equal importance, it shows that much of the polarization of genetic and epigenetic views for evolutionary change may be more semantic, or an artifact of perspective, than real. Clearly, such single-gene changes can have significant secondary influences on aspects of morphology and behavior and thus have epigenetic consequences.

This is a successful volume. As in any such effort, neither the editors nor the symposium organizers have control over the specific contents and quality of the individual contributions. Nevertheless, the papers either present in-depth reviews or novel findings of considerable interest to a wide range of evolutionary biologists. The shelf life of the book will be limited owing to the currently intense investigations in most of the areas represented, but these papers will stand as a statement of our knowledge as of 1980.

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Grand Unified Theories

The Second Workshop on Grand Unification. Ann Arbor, Apr. 1981. JACQUES P. LEVEILLE, LAWRENCE R. SULAK, and DAVID G. UNGER, Eds. Birkhäuser, Boston, 1981. x, 322 pp., illus. $19.95.

The full importance of an experiment in physics is usually not realized until after it has been completed and sometimes not until years later. This is not the case with the proposed measurement of the lifetime of the proton, predicted to be of the order of 10^{31} years. One can safely say that if the proton does decay with the proposed lifetime the consequences are known to be of truly fundamental importance. Beyond the aphorism of Glashow that "diamonds are not forever" and the consequence that the matter in the universe will in approximately 10^{31} years have decayed into photons and neutrinos are some startling consequences for our views of elementary particle physics. These include the idea that a so-called grand unification holds, namely that the weak, electromagnetic, and strong forces are different manifestations of one underlying basic type of interaction and that in fact they were identical in strength during the very early history of the universe. If the proton is soon seen to decay, it is very likely to be viewed as the most important single experiment in physics in the past 20 years, once the far-reaching consequences are grasped.

The theoretical research on grand unified theories (GUT's) and the experimental efforts to measure the proton lifetime have acted to join together physicists with common interests. The contents of this book of proceedings reflect the special nature of the work. Experiments must be done deep underground to eliminate cosmic ray background (looking at 10^{31} protons for one year to measure one event is no mean feat) so the experimental papers are reports of work done either in mines (Miyake and Narasimham, Steinberg, Shupe, Wilson, and Sinclair and Jones) or in tunnels (Fiorini and Barloutaud). The papers provide detailed descriptions of the apparatus and the results the authors hope to achieve.

The theoretical papers, on the other hand, dwell mainly on the unification of the basic forces, with forays into cosmology. The latter subject is particularly relevant, since the GUT's predict that the three basic forces of nature began to enter onto their divergent paths early in the history of the universe, approximately 10^{-35} seconds after the big bang. The consequences of GUT's for cosmology and vice versa are pursued in the contributions of M. S. Turner and M. Yoshimura. The latter focuses particularly on how GUT's provide a scenario for the calculations of the ratio of the matter in the universe to the total entropy of the blackbody radiation.

Detailed papers that spell out the predictions for protein decay lifetime and decay modes particularly clearly are those by Langacker and Marciano. The volume also includes more speculative contributions on new theoretical subjects, in particular technicolor and supersymmetry, by Srednicki and Dimopoulos and Georgi.

The first paper in the book is an amusing set of conjectures by Glashow about a universe in which most neutrinos are unstable and have decayed away into massless spin zero particles. A summary, by Weinberg, discusses anticipated theoretical and experimental results.

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Migration

Animal Migration. Papers from a symposium, Lancaster, England, Dec. 1979. D. J. AIDLEY, Ed. Cambridge University Press, New York, 1981. viii, 264 pp., illus. Cloth, $39.95; paper, $19.95. Society for Experimental Biology Seminar Series, 13.

This symposium and the resultant volume had two aims. The first was to survey some particular aspects of migration in a manner suitable for nonspecialists in the field, and the second was to illustrate the range of current studies. The book succeeds better with respect to the former than the latter. All the contributions are straightforward, clear, and free of specialist terminology, but the scope is somewhat narrow, and I found myself frequently noting cases where comparisons with a more catholic array of studies or organisms would have added both illumination and generality. What is apparent from the studies reported is that much more is known about birds and insects than about fish and whales. Partly this results from the technical difficulties of studying the latter, but it is also obvious that more conceptual sophistication has been applied to terrestrial migrants. There is no coverage of the interesting diversity present in daily or seasonal migrations of Crustacea.

Analysis of migration can be broken down into proximate and ultimate (evolutionary) questions, and some of the relevant issues are succinctly summarized by Aidley in his opening chapter. Ultimate causes are, of course, much less amenable to analysis than proximate, and that fact is illustrated by the relative paucity of treatment of the latter here. Southwood does survey the ecology of insect migration, and O'Connor attempts a statistical comparison of migrant and nonmigrant British farmland birds. Unfortunately, O'Connor's conclusions are confounded by taxonomic and other variables. His group of 31 "residents" ranges from ducks to finches but includes no sylviid warblers; of the 11 migrants, however, seven are warblers. O'Connor concludes that migrants exploit resources unexploited by residents, but somehow I doubt that warblers and ducks exploit the same resources anywhere. There is also uncritical acceptance of *r-K* selection theory. On the applied side of migration ecology, Joyce contributes an excellent chapter, with examples from synoptic surveys in eastern Africa, on the relevance of sound ecological thinking to the control of migrant and other crop pests. It should in