Book Reviews

Forces and Strategies in Evolution

Sexual Selection and the Descent of Man, 1871–1971. BERNARD CAMPBELL, Ed. Aldine, Chicago, 1972. xii, 378 pp., illus. $14.75.

In 1871 under the title *The Descent of Man, and Selection in Relation to Sex* Darwin published a book that dealt with human evolution and with sexual selection, or two books bound together, one on each of these topics, or perhaps just part of a book, the rest appearing a year later as *The Expression of the Emotions in Man and Animals*. The event is commemorated here by 11 essays on the subjects considered in Darwin's classic.

The initial chapter, by Loren Eiseley, "The intellectual antecedents of *The Descent of Man*," describes the intellectual atmosphere in which Darwin's work appeared, the effects of previous works on human evolution by Huxley and others, and the reception it got. We who were raised on both Darwin and Newton may have difficulty appreciating the extent to which the stochastic and historical elements in Darwinism were seen to conflict with assumptions of orderliness in nature, as exemplified by Newtonian mechanics. I found Eiseley's discussion of this and other matters quite stimulating and informative.

George Gaylord Simpson's "The evolutionary concept of man" depicts man's phylogenetic place in nature as seen by paleontologists today. The picture given is more confident and detailed than what Darwin presented without fossil evidence, but shows no important conflict with Darwin's.

Bernard G. Campbell's "A man for all seasons" outlines how man's technological innovations, such as cooperative hunting, tools and weapons, fire, and clothing, enabled him to spread from a humid tropical place of origin to ever more climatically and ecologically varied habitats.

Theodosius Dobzhansky's "Genetics and the races of man" is a balanced discussion of variation among human populations. Among the variables discussed are mental attributes, but those seeking heated polemics on this issue will be disappointed.

Ernst Mayr's "Sexual selection and natural selection" introduces a series of chapters that relate to the "Selection in Relation to Sex" part of Darwin's work. It attacks with admirable clarity the tricky problem of deciding exactly what is meant by sexual selection.

Lee Ehrman's "Genetics and sexual selection" gives a valuable factual review of demonstrated instances of genetic influences on male competition and female choice in *Drosophila* and many vertebrates, including man.

Robert L. Trivers's "Parental investment and sexual selection" and Robert K. Selander's "Sexual selection and dimorphism in birds" form what may be the most permanently valuable part of the book. These chapters try for a comprehensive evolutionary explanation of the phenomena of comparative reproduction. An organism is represented, in effect, as a player in a game the object of which is to maximize the representation of one's genes (present fully in oneself and partly in offspring and other relatives) in the population to which one belongs. Sexual reproduction and family life are seen as a complex system of mutual exploitation, conflict, compromise, and cautious coalitions, with each player totally committed to maximizing its own score. Trivers emphasizes "that sexual selection favors different male and female reproductive strategies and that even when ostensibly cooperating in a joint task male and female interests are rarely identical."

Trivers's and Selander's approach is simply the Darwinian view of reproduction, but it is an approach that has been seriously neglected. The salmon's migration, the oriole's nest architecture, the seal's polygyny are so often treated by even serious scientists as mere wonders to be marveled at rather than as adaptations understandable in relation to other aspects of each species' way of life. These authors' efforts at explaining these relationships are about as successful as can be expected in a brief treatment of the world of diversity seen in the reproduction of even so limited a group as the birds. I would especially urge careful study of Trivers's graphic models of strategy optimization.

The final three chapters, John Hurrell Crook's "Sexual selection, dimorphism, and social organization in the primates," Robin Fox's "Alliance and constraint: sexual selection and the evolution of human kinship systems," and Ernst Caspari's "Sexual selection in human evolution," although stimulating and well written, strike me as the least successful part of the book. Primate watching has not produced the detailed information on reproductive behavior and social organization that bird watching has, and this undoubtedly made it difficult for Crook to be as convincing in explaining primate behavior as Selander is for birds.

Crook's and especially Fox's discussions seriously consider and partly support the view that it was sexual selection that caused the extraordinarily rapid development of man's brain. Man's intellect is attributed to the need for intelligent control of the male sex drive in relation to male status in a complex social environment. The absence of any clear difference in male and female distributions of intellectual ability is considered something of a problem but not contrary evidence.

The idea that selection for a certain kind of performance by one sex is not very likely to result in the necessary machinery's being equally developed by both sexes seems to have been first applied to human cerebral evolution by William Etkin in 1954 (*Amer. Natur.* **88**, 129–42). It is considered again in the chapter by Caspari, whose view of human evolution is more credible to me than Fox's. Yet I think that this chapter falls short of the same author's 1963 paper "Selective forces in the evolution of man" (*Amer. Natur.* **97**, 5–14), and nowhere does Caspari or any of the others deal with another decisive aspect of human mental development, its amazingly poor canalization. If the extraordinary development of human mentality was merely to enable it to function in a certain way in adult males, most adult males would be expected to have the requisite minimum for effective performance, but none should have much more.

I suggest that anthropologists, who are

mostly males, have tended to favor male-chauvinist theories. Anthropologists are all adults, and I suspect that they have favored adult-chauvinist theories also. Perhaps some young-in-heart female anthropologist could be persuaded to enlarge on G. E. Hutchinson's suggestion (*The Ecological Theater and the Evolutionary Play*, Yale University Press, 1965, pp. 91–94) that adult intelligence is an accidental and nonadaptive outcome of selection for minimal human intelligence arising as early as possible in childhood.

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A Theory of Biogenesis

Molecular Evolution and the Origin of Life. SIDNEY W. FOX and KLAUS DOSE. Freeman, San Francisco, 1972. xvi, 360 pp., illus. $16.

The title of this latest monograph on the beginnings of life suggests a general and balanced discussion of the subject as a whole. The book is better characterized as a detailed presentation of the thermal, or proteinoid, theory of origins embellished with only fragmentary excursions into other points of view. However, the authors' enthusiasm for the thermal theory is clearly based on the impressive body of experimental evidence reviewed in chapters 4 through 6. In fact, the chief merit of the book is that it presents in one continuous argument an array of carefully conducted, reproducible experiments spanning nearly the whole range of presumed prebiological events up to the appearance of microscopic structures. These "microsystems" exhibit a remarkable array of rudimentary analogs of cellular processes. In view of the considerable gap between the most complex microsystems and the simplest contemporary cells, however, the authors' direct application of such biological terms as "life-cycle," "replication," and "organism" to proteinoid microspheres is difficult to justify.

The authors stress the point that the heterogeneous, hypohydrous conditions often used in thermal experiments are more germane to prebiological evolution than the dilute aqueous model favored by other investigators. They point out that contemporary cells are not homogeneous aqueous systems but rather consist of numerous phase boundaries and hydrophobic regions. Convincing arguments are given that heat was a significant free energy source on the primitive earth (an idea which has been sharply criticized), and that specialized (for example simulated perivolcanic zones) rather than average geochemical conditions (for example the open seas) are preferable in origin-of-life research.

A major theme of the monograph is the extent to which nonrandom, internally directed ordering processes are detectable in the thermal experiments, especially in the pyrocondensation of amino acids. It is doubtful that such sequence ordering in the absence of nucleic acid represents prebiological accumulation of information as the authors imply. "Information" implies a choice among equally probable events, not simply the accumulation of order due to preferred chemical interactions. Of interest here are the recent results on primitive coding properties of microsystems containing synthetic homopolynucleotides (chapter 6). The authors claim that "conditions were found . . . which yielded for each of the four homocodonic amino acids . . . interactions suggestive of a stereochemical basis for the genetic code" (p. 231). This is sure to stimulate much critical discussion in view of the hitherto fruitless search for preferred direct interactions between amino acids and their respective codons.

An especially strong feature of this monograph is the authors' insistence on rigor in conducting and interpreting experiments. They aptly criticize claims of synthesis of biochemicals based on only a single analytical procedure and warn against premature judgments that go beyond the available hard data. Their discussion of the prebiotic synthesis of "micromolecules" (chapter 4) conforms admirably to their stated principles.

The high level of competence of chapters 4 through 6, which constitute the heart of the argument, is unfortunately not maintained in the rest of the text. Especially disappointing is the discussion of optical activity (chapter 8). The authors do little more than describe ways to resolve racemic mixtures. Much more can and should be said on this matter. The problem is not how stereoisomers might have separated on the primitive earth but how life came to "prefer" L- rather than D-amino acids and D- rather than L-sugars. This kind of cursory treatment of topics outside the thermal theory is one of the less appealing features of the book. Alternative pictures of biogenesis are often not adequately explored. The rich chemistry of ammonium cyanide, which includes the formation of dynamic microscopic units, deserves more extensive consideration as a major alternative model for protocell development.

In spite of its defects, this monograph is a major contribution to the literature of biogenesis. The sheer magnitude and scope of the laboratory evidence for the proteinoid theory of origins more than make up for the uneven quality of the writing.

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A Possible Phylogeny

Evolution of the Metazoan Life Cycle. A Comprehensive Theory. GÖSTA JÄGERSTEN. Translated from the Swedish edition (1968). Academic Press, New York, 1972. x, 282 pp., illus. $15.50.

No event exerted a more profound influence on all subsequent animal evolution than the origin of multicellularity. How many-celled animals originated and whether this step occurred one or more times and in one or more ways remain difficult and ever-debated questions that are perhaps, as John Corliss has said, "in the last analysis, quite unanswerable." Nevertheless, these questions continue to evoke interest among zoologists, and new evidence pertinent to the several competing theories of metazoan origin continues to accumulate, particularly as new sources (for example cell ultrastructure, comparative biochemistry, and genetics) are tapped.

In the 1950's the author of this book contributed a new theory of early metazoan phylogeny, based on Haeckel's 19th-century theory of origin via gastrulation of a flagellate protozoan colony. Jägersten proposed that metazoan origin was associated with the change from a pelagic *Volvox*-like colonial flagellate to a form which turned to life on or near the bottom, eventually crawling along with the aid of flagella. In connection with this change in habitat, it evolved an anterior-posterior axis of differentiation and a ventral side against the substratum. The ability to eat large food items would be advantageous to an organism with such habits, and the next stage was the arching up of the