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Reproductive Success: Studies of Individual Variation in Contrasting Breeding Systems by T. H. Clutton-Brock

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consciousness, even vertebrate life in general, would be unlikely to reappear on the "second take."

Evolution is then no "ladder of progress," no "cone of increasing diversity." It is, for Gould, a tale of maximal organic disparity of plan followed by decimation, and explosive diversification of a few remaining stocks. In evolutionary history there is chance, order and direction—but no progress, no predictability, no perfectibility.

If Gould is correct, it is not clear what the scientific implications of this must be for the practice of paleontology and evolutionary biology. But the implication for a wider range of human concerns must be profound. Gould's argument is a stunning refutation of the complacent humanist conviction that "evolution" can serve as a scientific underpinning for some doctrine of cosmical emergent complexity, and can support an ideology of progress culminating in intelligent life. Evolutionary theory, understood in terms of radically contingent survival not based on functional superiority, is no longer a secularized mirror image of the creationists' argument from design. This new reading of the history of life supports neither a hypothesis of economical design nor one of determinate expression of underlying laws.

The book offers more than a spirited defense of this hypothesis. It provides a detailed look at the actual paleontological work (in the 1970s and early 1980s) that provides the basis of this new interpretation of the history of life. It makes an attempt to explain why Walcott "shoe-horned" all these disparate plans into a small number of surviving lineages—especially in his allegiance to the metaphor of the "cone of diversity." The work is graced by a large number of wonderful illustrations of the Burgess organisms, drawn by Marianne Collins.

Like Gould's previous works—particularly *Ontogeny and Phylogeny* and *The Mismeasure of Man*—*Wonderful Life* is committed to the dissemination of scientific thinking and the evidentiary details of scientific work to a broad nonspecialist public. It explores the implications of this work and deliberately provokes controversy on issues worthy of general consideration. The issue here—the implications of the paleontological record for the nature of history—are certainly worth that consideration.—Mott T. Greene, *University of Puget Sound, Tacoma, WA*

Reproductive Success: Studies of Individual Variation in Contrasting Breeding Systems. T. H. Clutton-Brock, ed. 538 pp. University of Chicago Press, 1988. \$75. cloth, \$29.95 paper.

This volume illustrates some important tensions between the conceptual and the empirical realms of evolutionary biology.

Field biologists have nearly perfect data, but do not yet know how to analyze them completely. Because the data are not quite perfect, they are not in harmony with our emerging concepts of fitness and selection. The situation is not comfortable, but it is ripe with opportunity. We need better data, but it is equally true that we need better conceptual tools.

The intellectual contribution of this book is notable because in it 54 writers show that the fitness of individuals can be assessed in natural populations of many vertebrates and arthropods. This message extends the legacy of David Lack's work on birds in the 1940s and 1950s. Chapter after chapter shows how Lack's program can be applied to achieve outstanding data on the survivorship and reproductive success of individuals in nature.

The self-conscious pursuit of lifetime fitness has been slow to catch on because fitness has almost universally been perceived as a property of genotypes rather than as a phenotypic property of individuals. Both perspectives are valid, and have their uses, but it is the phenotypic view (stressed by Crow and Haldane) that holds the most promise for field biologists. By taking a phenotypic view of fitness, the results of field studies can be meshed with multivariate theories of evolution that are grounded in quantitative genetics. By stressing the genotypic perspective, and the attendant difficulties of measuring the fitness of genotypes, writers from Fisher to Lewontin inadvertently cast a malaise over those conducting field studies because field workers feared they had gathered the wrong kind of data.

Under a more pluralistic view of fitness, the data in T. H. Clutton-Brock's volume are just right for many purposes. They can be used to compute variance in fitness, and hence the opportunity for phenotypic selection. Fitness variances can then be compared between males and females within a population or among populations and species. Critics have complained that fitness variance merely places an upper limit on selection. That upper limit may not be informative, but only time will tell.

The volume also highlights the primitive state of the tools available for analyzing multiple episodes of selection. Careful field work can yield estimates or enumerations of fitness components for individuals such as survivorship, number of mates and number of offspring per mate. But even when there are only three such multiplicative fitness components, as in the analysis done by Brown in this volume, the results become almost hopelessly baroque. The study yielded 11 covariance terms plus three variance terms! Crow's proposal is simpler (See *Evolution and Animal Breeding*, W.G. Hill and F. C. Mackay [eds.], C.A.B. International, Wallingford, U.K., 1989, pp. 89-95) but it is fair to say

that we still need more elegant analytical tools. It would also be instructive to see the same data set analyzed with alternative methodologies.

We also need more complete data. Although most contributors to the volume have data on fitness components as well as on lifetime success, data on phenotypic traits such as body size, horn length, running speed, etc. were not included. Thus nearly all contributors stopped short of measuring selection on important traits. Nobody looked for stabilizing or correlational selection.

Nevertheless, the enumeration of lifetime fitness is the most intimidating hurdle in the race to measure total selection. We now see how that hurdle can be cleared, and we can, at last, view the rest of the course. This book also gives a clearer view of conceptual hurdles to come. Must we tally fitness from zygote to zygote or is there an evolutionary theory that meshes with an adult-to-adult fitness currency? How can we account for the many potential impacts of parents and relatives on survivorship and reproductive success? The volume opens a dialogue that should advance both the concepts and conduct of evolutionary biology.—Stevan J. Arnold, *Ecology and Evolution, University of Chicago*

Planet Under Stress: The Challenge of Global Change. C. Mungall and D. J. McLaren, eds. 337 pp. Oxford University Press, 1990. \$22.95.

It has become abundantly clear in recent years that world society is approaching a major discontinuity as we enter the 21st century. An exponentially growing world population, which is expected to double in the next 50 years, and a world economy that should grow five to 10 times in the same interval, are placing planet Earth under stress. One issue at stake is the resilience of the biosphere to accept without a major perturbation the rapidly increasingly loading of growing industrialization. A second issue is the degree to which the "carrying capacity" of the biosphere can be developed at a rate sufficient to meet the needs of another five billion individuals during the next half-century. These are issues with which the world scientific community is beginning to come to grips. This is a proper response, since it is the advances in understanding and utilization of matter, energy, life processes and information that have brought us to this critical juncture in human affairs.

It is highly appropriate, therefore, that these issues be addressed by the prestigious Royal Society of Canada. Few other organizations combine so harmoniously the natural and the social sciences. The preface to this volume by Digby J. McLaren, president of the society, is a little