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Book Reviews

Steele, E.J.: Somatic Selection and Adaptive Evolution on the inheritance of acquired characters. London: Croom Helm 1980. 91 pag., 6 figs., 3 tabs. Hard bound £ 8.95.

In this interesting and provocative book the author has reopened the discussion about the mechanisms of the evolutionary process. After a consideration of contemporary ideas in immunology, virology and molecular biology he wants to revive Lamarck's much discredited theory on the inheritance of acquired characters. In his opinion some essential paradoxes in immunology and virology can only be satisfactorily resolved by the rejection of Weismann's doctrine of the isolation of the soma from the germline. This leads to the acceptance of a Neo-Lamarckian view of inheritance, i.e. the somatic selection hypothesis, which is experimentally testable by endogenous mammalian RNA viruses carrying somatic genes to the germline.

The biochemical details of this theory are necessarily technical and much attention is given to many specific facts from immunology, virology and molecular biology. But all these numerous facts will be omitted from the following discussion, because the review of this book will concentrate on the basic concepts and principles and the theory and consequences developed from these assumptions.

First, we will give some references to the classification and content of the book, which has been divided into six chapters and an appendix. Chapter 1, 'The problem and the purpose', contains an introduction and some general considerations on the author's thesis that in many multicellular sexually reproducing organisms Lamarckian modes of inheritance exist, which provide an element of 'directional' progress in the evolution of biological complexity.

Chapter 2, 'Lamarck in perspective', gives an historical account of Lamarckism, followed in chapter 3, entitled 'The central paradox of immunology', by a discussion of some topics from modern immunology, virology and molecular biology. Here the author puts aside the usual consideration of natural selection acting on populations of organisms and the discussion has been focussed on natural selection operating on cell populations within the body of an individual. Chapter 4, 'The somatic selection hypothesis', contains the most essential part of the book, namely a Neo-Lamarckian model of a possible mechanism for the transmission of acquired characters, in the sense that somatic gene mutations can be genetically inherited. In chapter 5, 'Implications and conclusions', it is shown how the somatic selection hypothesis provides solutions and predictions to the theory and practice in many areas of modern biology. The final chapter 6, 'Speculations on man, mind and matter', deals with the philosophical implications of this theory; for example, contributions to the perennial nature-nurture debate, and an approach to the mind-body problem. It concludes with a speculation on how man may shape his own evolution. An appendix 'On the relevance of the RNA tumor viruses to the somatic selection hypothesis' describes some further biochemical and virological details. Additionally, all chapters are followed by extensive Notes, which include supplementary comments, literature and explanations.

The author's main ideas can be summarized as follows. One difficulty with Darwinism arises from the fact that it provides no satisfactory explanation for the intuitive belief of 'directional' progress in the evolution of biological complexity. The reasons lie not in Darwin's concept of selective survival but in the two assumptions that 1) the locus of all meaningful phylogenetic changes (in multicellular organisms) occurs only in the germline genes of the gonads and 2) that the genes in the gonads are resistant to most direct influences of the contemporary environment. One problem of the hereditary phylogenetic adaption process is that one important change can be expressed usefully in the organism only if additional harmonious adjustments are also made in other parts of the organism. Conventional Darwinian theory requires no concept of simultaneity by assuming that a sufficient time interval exists for all these evolutionary changes. The author's rejection of this concept is based upon a discussion of spontaneous mutation rates.

All these difficulties can be simply solved by altering our views on where the Darwinian process of chance mutation and natural selection first takes place. The author's hypothesis stresses that this locus is not so much the genes in the germ cells but rather those genes carried in that large, constantly changing differentiated cell population of the soma. If these new somatic gene mutations can be incorporated into the hereditary DNA of the gonads this mechanism makes it possible that adaptive solutions to contemporary environmental pressures achieved by the parental generation can be passed on to their offspring via the hereditary genes of the gonads.

The author's argument makes use of the properties of the immune system, which responds to the unexpected, because a given organism can produce antibodies specific for almost any chosen antigen, naturally occuring or artificially made by man. In the author's view it would be most improbable and most unbiological to expect all these possible organism adaptions to their antigenic environment to be codified by the hereditary DNA of the gonads, because it would be difficult to see how such an enormous gene array can be maintained in the face of random genetic drift.

All these difficulties of evolutionary adaptation can be surmounted by the author's somatic selection hypothesis, which proceeds in the following three steps: 1) chance generation of somatic mutations and their clonal selection under favourable environmental stimuli, 2) transfer of this clonally packaged information to an endogenous RNA viral vector which allows integration of the somatically selected mutant gene into the germline DNA and 3) classical Darwinian selection operating on members of the progeny generation. By this process the rate of evolutionary change is expected to be much faster than thought possible under the current Neo-Darwinian theory of evolution.

Furthermore, this hypothesis provides alternative explanations for a range of biological phenomena, for example the unexpectedly high rates of spontaneous mutation, which have been empirically observed in special situations of multicellular organisms, such as a) the sickle-cell trait and resistance to Malaria, b) the mouse H-2 complex and c) the male recombination in Drosophila. Here environmentally related, physiologically based stimuli are discussed, which may be responsible for these phenomena.

After reviewing the main ideas of the book I feel obliged to give at least some critical comments. Essential criteria for the development of scientific hypotheses are: 1) coherence, 2) simplicity and number of assumptions, 3) explanatory and predictive power and 4) refutation-possibility in the sense of Popper. These features are indeed realised by the author's somatic selection hypothesis. But besides some incontestable advantages compared to the conventional Neo-Darwinian theory it also possesses some clear difficulties and disadvantages. For example, in criterion 2 'simplicity and number of assumptions' the classical Neo-Darwinian theory seems to be unequivocally superior to the new hypothesis.

Because somatic mutants shall be clonally selected and integrated in the germline DNA this soma-germline-transmission and integration is of extraordinary significance for the evidence of the theory. But, unfortunately, just here we observe a lack of empirically proven facts, and a major part of the author's arguments and derivations are rather conjectures and hypotheses than uncontested experimental results.

Discussing the immune system's response to the unexpected, the author criticizes the conventional theory by explaining the impossibility of maintaining such an enormous gene array in the face of random genetic drift. Here an appropriate consideration of linkage effects has been almost completely ignored, which would provide a satisfactory explanation of this problem in the framework of the classical theory. Two criticisms are self-evident: 1) in a rapidly changing environment this proposed evolutionary process could potentially underestimate the problems of the immediate future leading to rapid extinction and 2) why should a somatic system with the ability to handle the unexpected ever need to transmit its solutions to the next generation? Indeed, both criticisms are mentioned by the author, but he doesn't agree to these objections substantially.

The following additional question appears closely connected with the two previous aspects. Based upon our current knowledge of the evolutionary process, in some situations, it probably becomes possible that under the author's somatic selection hypothesis the evolutionary process may proceed too quickly to realize the known phylogenetic changes and their corresponding temporal periods. Because of the great importance of these basic aspects for any approach to an evolutionary theory every book on this subject absolutely should include a detailed discussion of these problems.

Without any doubt or restriction I want to characterize this book as stimulating and fascinating. I enjoyed reading it and I am sure any biologist with an interest in evolution and population genetics will confirm this opinion.

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