

BOOK REVIEW

Gerd B. Müller and Stuart A. Newman (Eds) (2003). *Origination of Organismal Form. Beyond the Gene in Developmental and Evolutionary Biology*. The MIT Press, Cambridge, Mass. ISBN 0-262-13419-5.

The origin of organismal form and structure is an important topic in evolutionary biology. Yet, relatively few studies are devoted to it. The study of evolutionary novelties is usually limited to the documentation of their phylogenetic distribution and the analysis of their value as synapomorphies in the construction of phylogenetic trees or, in evolutionary morphology, to the comparative analysis of the relationship between form and function. Most studies on evolutionary processes concentrate on the modification or maintenance of existing forms and structures.

Fortunately, a book has now come out that focuses on the questions of why and how new forms and structures appear in organismal evolution, entitled “*Origination of Organismal Form. Beyond the Gene in Developmental and Evolutionary Biology*”, edited by Gerd Müller and Stuart Newman. The book is important for several reasons. Firstly, it reminds us of the necessity to analyse the underlying mechanisms of qualitative evolutionary changes. Secondly, it outlines in a lucid way the conceptual issues that are involved in the study of evolutionary novelties, i.e. when is an evolutionary change considered to be a novelty and how does the concept novelty relate to the concept of homology. The chapters by Müller, and Wagner and Chia are particularly clear and useful in this respect.

Another important aspect is that this book reviews the current status of experimental data on the origination of evolutionary novelties. Unfortunately, the neglect of the subject in current evolutionary biological research is necessarily reflected in the paucity of experimental data that can be presented. Nonetheless, several promising studies are presented. In particular I was struck by Steinberg’s on the role of adhesivity in self-organization. Steinberg first shows how important self-organization is in morphogenesis, in particular in early organogenesis. He then proceeds to explain the important role of differential adhesivity of cells in the production of self-organization during morphogenesis. Building on the interesting experiments by Holtfreter, he proceeds to describe the equally interesting experimental and theoretical studies that he and his collaborators have carried out. He then integrates their findings on the role of adhesivity in morphogenesis with current molecular biological insights. The chapter is not primarily devoted to the origination of evolutionary novelties, but Steinberg points out how changes in adhesivity or changes in topology of tissues can result in novelties as a result of the self-organizing character of morphogenesis. To make plausible transformation scenarios for the origination of evolutionary novelties one needs to have a good understanding of the morphogenesis of structures, including the physical determinants of morphogenesis. This chapter fills part of that gap. The chapter by Pourquié on time-measuring devices during development provides another example on how progress is being made in unravelling the underlying mechanisms of morphogenesis.



Currently many evolutionary studies are carried out at the molecular and genetic level and also at the population and community level. For making real progress in understanding evolutionary change it is a requisite to integrate these different levels. The current challenge is to link the genetic and functional/selective scenarios. This requires studies that link morphogenetic changes with, on the one hand, genetic changes and on the other hand changes of the form-function relationship of forms and structures. The scarcity of knowledge on the integration between levels forms one of the important constraints on making progress in the study of evolutionary novelties. Another equally important constraint is the low level of integration between theoreticians and experimentalists in evolutionary developmental biology, quite unlike the situation in evolutionary ecology where there is a mutually beneficiary interaction. Nijhout has written a useful chapter on this subject. He explains how theoreticians try to understand the underlying principles of pattern formation and not the specific genetic mechanisms, whereas experimentalists in general are investigating genetic mechanisms and not the underlying principles of these. The chapter is particularly useful because it does not only analyse the problem, but provides concrete solutions on how integration can be furthered as well. Nijhout lists for example seven questions for experimentalists of which the answers would be directly useful for theoreticians in investigating the underlying principles of genetic mechanisms. Questions such as, What is the rate of gene product synthesis and the rate of its decay? This is an important question because the gene product, the protein, is the active principle in genetic developmental regulation.

The difficulty of coming to an integrative view seems, thus, to be the major barrier for studying the generation of evolutionary novelties. Several authors in these chapters blame the gene-centered view of most current evolutionary studies and the neglect for epigenetic aspects for the slow progress. Although this is certainly part of the truth, it is too simplistic. I think that the major problem is not so much an absence of interest for morphogenesis in geneticists, but the above-mentioned difficulty of coming to an integrated view. Some of the same authors in this book could perhaps also have been more fruitful in their studies if they would have tried to integrate their findings more with current genetic knowledge, instead of only warning against a gene-centered view. Fortunately most chapters provide an integrated perspective, as for instance the carefully reasoned chapter by Conway Morris and the historical perspective by Gilbert. Ultimately an integrated view will lead to the fullest understanding of the origination of organismal form and hopefully this stimulating book will help further such a view in evolutionary biology.

Frietson Galis
Institute of Biology
Leiden University
Kaiserstraat 63
2311 GP Leiden
The Netherlands
galis@rulsfb.leidenuniv.nl