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Evolution - The Extended Synthesis. A research proposal persuasive enough for the majority of evolutionary biologists?

Book Review

Handschuh, Stephan^{1,2}; Mitteroecker, Philipp¹

¹Department of Theoretical Biology, University of Vienna, Austria

²Konrad Lorenz Institute for Evolution and Cognition Research, Austria

Evolution - the extended synthesis, edited by Massimo Pigliucci and Gerd Müller. MIT Press, 2010, 504 pp. ISBN 978-0-262-51367-8 (Paperback)

The book *Evolution – The Extended Synthesis*, edited by Massimo Pigliucci and Gerd Müller, represents a collection of sixteen essays on diverse areas of contemporary evolutionary research, aimed at mirroring the “ongoing shift from a population-dynamic account to a causal-mechanistic theory of phenotypic evolution” (Pigliucci & Müller, 2010, page 12). During the last decade, claims became louder and more persuasive that our current theoretical framework of evolutionary theory is in need for a serious extension and revision (e.g. Carroll, 2008; Gould, 2002; Müller, 2007; Pigliucci, 2007). This feeling, shared by numerous scientists, should not at all be surprising, because the framework – known as the *Modern Synthesis* – dates back to a scientific movement that has its roots in the 1920ies and, basically, was formed during the following three decades. When Julian Huxley published his book *Evolution: The Modern Synthesis* in 1942 (Huxley, 1942), which coined the term for this ongoing process and the resulting theoretical framework, the first part of this synthesis already took place. Fisher (1930), Haldane (1932), and Wright (1932) published their contributions during the two preceding decades, and Dobzhansky’s book *Genetics and the Origin of Species* (Dobzhansky, 1937), which closed the first phase of the *Modern Synthesis* by integrating *Darwinism* and

Mendelism, was published five years before. Although major contributions were still ahead, this movement was already in progress at the time it received its name by Huxley, and since Dobzhansky’s book scientists agreed that a real synthesis was going on. The *Modern Synthesis* was a landmark in the history of evolutionary biology, and ever since represented the backbone of evolutionary theory. *Evolution – The Extended Synthesis* evaluates the validity of the major tenets of the *modern synthesis* at the dawn of the 21st century (more than 50 years after it was shaped) and summarizes major contributions to the field since then. It discusses the resulting theoretical implications for an expansion and a remodeling of evolutionary theory. As the editors put it, “Under the heading ‘Extended Synthesis’ this volume represents a broad survey of key ideas in this multifaceted research program, and a first look at an expanded theory of evolution as a work-in-progress” (Pigliucci & Müller, 2010, page 3).

Based on the sixteen essays provided in the book, readers get an excellent overview on how diverse the field of evolutionary biology is today. The book is a valuable read for both students of evolutionary biology and established researchers. It originated from a workshop held at the Konrad Lorenz Institute for Evolution and Cognition Research in

Altenberg, Austria, in 2008 under the same title, which aimed to bring together leading scientists from different areas of evolutionary biology to discuss the adequacy of our current theoretical framework of evolutionary theory. In five sections, new perspectives on different empirical branches, that had not been part of the original *Modern Synthesis* framework, are treated in detail. These sections are on *Variation and Selection*, *Evolving Genomes*, *Inheritance and Replication*, *Evolutionary Developmental Biology*, and *Macroevolution and Evolvability*. The final section *Philosophical Dimensions* discusses the structure of the field in terms of conceptual integration and theoretical unity/disunity.

After Stephen Jay Gould's *The Structure of Evolutionary Theory* (Gould, 2002), *Evolution – The Extended Synthesis* represents the second large-scale attempt of a 21st century update on what evolutionary biology right now is and which of the central *Darwinian* and *Modern Synthesis* assumptions have to be altered and expanded. Both books bring up similar topics such as contingency, non-gradual change, and the role of internal constraint (constraint in the enabling, not in the restrictive sense; developmental constraints became an important explanandum for understanding the nature of phenotypic variation). They both offer an extensive body of concepts and almost endless food for thought, but they are quite different in style. While Gould's book is the final comprehensive contribution of one of the most influential personalities in our profession, the present book constitutes a collection of essays by 16 leading researchers of diverse disciplines. Significantly, both Gould as well as Pigliucci and Müller agree that the basic foundations (in Gould's case the Darwinian tripod) of our field will remain intact, but at the same time major shifts and expansions must and will appear. As Pigliucci and Müller note in their introduction: a "common retort to our arguments is that the new ideas are 'not inconsistent' with the framework of the *Modern Synthesis*; this may very well be true...but being consistent with the *Modern Synthesis* is not at all the same as being part of the *Modern Synthesis*" (Pigliucci & Müller, 2010, page 4).

Besides consensus that evolutionary theory is getting more and more diverse and complex and that our framework must continuously be altered and expanded to handle this increasing complexity, it is tempting to speculate whether a "real" *Extended Synthesis* movement will take place during the coming decades, and also whether it will be perceived as such. To achieve a true synthesis it is crucial that the different conceptual camps acknowledge and incorporate both data and theory from other disciplines. The first phase of the *Modern Synthesis* mainly brought together the two disciplines of *Darwinian Evolutionary Biology* and *Mendelian Genetics* (some biological disciplines, such as paleontology or botany, were successfully incorporated during its second phase when the original synthesis was expanded, whereas others were famously neglected, such as developmental biology and ecology). Today, the field is immensely diverse and it is no trivial task to integrate the different disciplines. By analogy to the *Modern Synthesis*, an *Extended Synthesis* movement may happen in several stages. (1) Integration of new developments in the core topics of the old *Modern Synthesis* framework, such as the nature of *variation*, mechanisms of *inheritance*, the dominant role of *natural selection* and *gradual change*. Some of the old assumptions already have been relaxed, altered, or given up based on new findings, leading to a continuous re-modeling of the old *Modern Synthesis* core. (2) An expansion of the re-modeled *Modern Synthesis* framework by adding concepts from new research fields such as genomics. Here and only here, in fact, it would again become a new *synthesis* in the narrow sense by linking previously unconnected disciplines. (3) Acceptance, by consensus, of a new core (much more diverse and thus much looser in interdependency), integrating the spectrum of concepts to a web-like theoretical network. The *Modern Synthesis* in its later, hardened version (Gould, 2002) was quite restricted in content and focus, but it was this restriction and relatively small set of assumptions that made it graspable for practicing biologists and an ideal backbone for a complex research program. Despite rising

complexity, an *Extended Synthesis* should equally have a graspable core, to make it useful as a conceptual framework. And (4), maybe an exclusion or, at least, smaller weighting of some concepts in disfavor of others. In this case, history might repeat itself. A consensus on a conceptual core might be established along with exclusion, since several of the involved disciplines currently include ideas and concepts that are not completely compatible with others. We probably all agree that we are not yet ripe for *Evolution: The Final Synthesis*.

Evolution – The Extended Synthesis is a book of high value, mainly for two reasons: first, for the large diversity of “hot” evolutionary topics the 16 authors review in high quality, and second, for the challenge it poses to its readers (especially to those trained to think in the classical *Modern Synthesis* framework) to integrate the ongoing conceptual shifts into their own work. In any case, this book is an excellent opportunity to enlarge the readers scope and to soften reservations against less familiar concepts, making it more likely to incorporate these concepts on a broad base (including textbooks), which will be the critical factor in deciding whether an *Extended Synthesis* framework will be perceived as such and accepted by a majority of evolutionary biologists. Even though the book does not directly address the evolution of human behavior, the presented concepts can play a decisive role in extending the theoretical underpinnings of human ethology and may even inspire new empirical research programs. For example, the presented concepts of the generation of phenotypic variation and the multiple ways of inheritance and replication may be fruitfully applied to variation in human behavior. The role of developmental constraints in the evolution of behavior is not well understood but will be central to avoiding a purely adaptationist research program. Not all concepts presented in the book may be directly applicable to the study of human behavior, but it definitely represents a rich source of ideas for future theoretical and empirical research in human ethology.

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Stephan Handschuh is PhD student of Theoretical Evolutionary Biology at the University of Vienna, Austria, and currently research fellow at the Konrad Lorenz Institute for Evolution and Cognition Research in Altenberg, Austria. He works on crustacean mating systems, 3D imaging methods, and evolutionary developmental biology.

Philipp Mitteroecker is Assistant Professor at the Department of Theoretical Biology, University of Vienna. He is mainly working on the quantification of concepts in evolutionary developmental biology and on the morphometrics of phenotypic variation. He has

worked on various topics in biological anthropology and human ethology.