

MANFRED D. LAUBICHLER and JANE MAIENSCHEIN (eds.), *From Embryology to Evo-Devo: A History of Developmental Evolution*, Cambridge, MA: MIT Press, 2007, viii + 569 pp., \$55.00 / £33.95 (cloth).

The biological process of development has always served as a focal point for empirical research and conceptual reflection on organisms and life in general. Many have drawn connections between development (ontogeny) and the history of life (phylogeny). The most recent manifestation of this is evolutionary developmental biology (evo-devo), currently one of the most thriving disciplines within biology. The contributions in *From Embryology to Evo-Devo: A History of Developmental Evolution* manifest how the topic of development continues giving rise to changing biological views and novel perspectives on the history of biology. The title is not meant to imply that evo-devo has simply grown out of developmental biology; in fact, the essays make clear that evo-devo has many historical roots—e.g. reaching back to 19th century evolutionary morphology—and that evo-devo is more than a synthesis of the two fields of evolutionary and developmental biology. Among other recurring historical themes, the contributions highlight how throughout the 20th century multiple traditions of developmental biology coexisted, how technological innovations played a significant role in the history of developmental biology, and how development provided the foundation for an organismal perspective in biology, particularly with respect to evolutionary issues.

Laudably, the volume gathers contributions by historians, biologists, and philosophers. It stems from an October 2002 workshop “From Embryology to Evo-Devo”, convened by the Dibner Institute for the History of Science and Technology (which has unfortunately closed in the meantime). In his opening essay (following the editors’ introduction), Manfred Laubichler addresses the questions of how a history of evo-devo can be written if the shape of evo-devo (and its very future existence) is not settled yet. His answer is that scientific questions about the relationship of ontogeny and phylogeny provide some historical continuity and can serve as an

object of historical analysis, like specific model organisms or the gene concept have provided the basis for previous historical analyses.

The volume is organized into three parts. Though the essays in Part I on “Ontogeny and Phylogeny in Early Twentieth-Century Biology” revisit topics that have been the subject of extensive historical discussion, they succeed in providing fresh perspectives on the history of embryology and developmental genetics. In his detailed review of the history of the biogenetic law, Fred Churchill illustrates how—apart from sociological factors largely doing away with evolutionary morphology and its developmental study of evolution—internal critique by comparative morphologists and embryologists led to different versions of the biogenetic law and more sophisticated understandings of relation between ontogeny and phylogeny. Stuart Newman discusses William Bateson’s vibratory theory of pattern formation in development, construing it in contrast to previous historical interpretations as a materialist and thus explanatorily legitimate approach, which foreshadowed themes in contemporary systems biology and epigenetics such as the origination of novel form. In her discussion of different historical views about the relevance of cells and other material factors for morphogenesis, Jane Maienschein points out that some of these cytological and embryological studies addressed questions about development in the light of evolution. Gar Allen uses the interplay and opposition of ‘synthetic’ (organismal) and ‘analytic’ (reductionist) approaches as an organizing theme to study the history of biology, detailing how this dialectic between approaches led to Haeckel’s unified program of evolution and development splitting into the separate fields of genetics, embryology, and evolution. Marsha Richmond discusses how Richard Goldschmidt’s physiological genetics significantly influenced British developmental biologists—despite the well-known rejection of his ideas by the Morgan school and proponents of the Modern Synthesis—showing how Goldschmidt worked towards a connected theory of development, genetics, and evolution at a time when most kept these domains separate.

Part II on “Roots and Problems of Evolutionary Developmental Biology” covers events

from 1920–1970, and thus a period that has been less prominent in past historical studies. The reader encounters a diverse range of intriguing essays addressing historical, biological, and philosophical issues relevant to evo-devo. John Wourms's thorough study of comparative embryology in the American context documents that despite being outside mainstream (developmental) biology, work in comparative and evolutionary embryology continued. This becomes clear if one takes a look at special institutional settings such as marine laboratories and fisheries. While historical accounts of evo-devo typically proceed from the historical split of developmental and evolutionary biology, Alan Love's detailed discussion of the morphologist D. Dwight Davis and the paleontologist W. K. Gregory emphasizes the fact that not only developmental biology, but also morphology and paleontology have been left out of neo-Darwinian evolutionary theory, thereby offering a broader perspective on the history of evo-devo and the fields that are relevant for this integrative approach. Bill Wimsatt scrutinizes the work of Rupert Riedl, comparing his notion of burden with similar ideas of Wimsatt and Arthur Wallace. Wimsatt discusses why Riedl's work was largely neglected, whereas nowadays his ideas are important for the evo-devo notions of modularity and evolvability. Scott Gilbert argues that there is a continuity between the method of establishing traditional cell fate maps and modern gene expression maps, pointing out that these representation techniques provide a way of linking old evidence and modern data. In his thorough discussion of representations and research styles in studies 'tracking' organic processes, Jim Griesemer contends that embryologists and classical geneticists often viewed themselves as tracking the same biological process—Mendel took himself to study inheritance / development. At the same time, representations and research styles foreground some aspects of a process and background others, making it easy for later generations to construe genetics as being concerned with transmission across generations and embryology as dealing with the separate issue of development from zygote to adult. Elihu Gerson analyzes several institutional, economical, and intellectual factors that promoted the historical split between evolutionary and developmental biology.

The third part “Reflections” concludes the volume with three stimulating essays by leading evo-devo practitioners. Brian Hall views contemporary evo-devo as having its roots in 19th century evolutionary embryology and morphology. Correspondingly, he surveys several aspects of late 19th century biology, including institutional settings and the development of scientific instruments. Hall emphasizes that both these historical approaches and modern evo-devo go beyond evolutionary and developmental biology by integrating further fields such as morphology, paleontology, and ecology. Gerd Müller offers a succinct overview of six areas that characterize the identity of evo-devo: the historical roots of its core ideas (tracing back to comparative morphology and embryology), its many novel concepts, evo-devo’s specific research agendas, its basic methods (especially the comparative approach), its modes and capacities of explanation, and its nature as an integrative approach. Müller emphasizes that evo-devo can succeed only if it is able to solve problems that cannot be tackled by traditional disciplines in isolation, pointing to some areas where evo-devo’s integrative potential exhibits preliminary progress: longstanding macroevolutionary problems, issues at the intersection of ecology, physiology and life history theory, topics involving behaviour and cognition, and close ties to philosophy. Günter Wagner closes the volume with a historically based look into the future. Pointing out that unsolved methodological disputes (problems with reconciling morphological and embryological evidence) significantly contributed to the decline of 19th century evolutionary morphology—a formerly thriving approach integrating evolution and development—Wagner reminds evo-devo biologists that there is still disagreement as to which data and inference methods should be used to determine which particular developmental mechanisms and changes were responsible for character transformations and the origin of evolutionary novelties.

It is striking that a core set of topics are recurrent throughout the volume and its fine contributions: the need for an organismal perspective in biology, the difficulties of pursuing any organismal approach, how the advent of evo-devo has opened novel interpretations of the history

of biology, how evo-devo biologists can learn from history, and the way in which issues at the intersection of development and evolution trigger reflection and intellectual interaction across historians, philosophers, and biologists.

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