Alessandro Minelli’s latest contribution to the ongoing effort to forge the discipline of evolutionary developmental biology is clearly a mature work by a scholar who has spent a career absorbing and thinking about the intricacies of morphology and development in a wide variety of animal groups. While it lacks the theoretical coherence of the recent works by Arthur (1997) or Wilkins (2002) or the breadth of synthesis of Hall (1999), this book contains some very interesting ideas and is well worth the read.

A large portion of the book is devoted to attacking a series of biases or preconceptions in the study of evolution and development. For instance, Chapter 1 is devoted to the idea that developmental biology, unlike evolutionary biology, is biased by finalism. This produces an emphasis on the adult form and a view of developmental processes and stages as merely means to achieve the adult end. He points out how our adultocentric view of development produces skewed perspectives in many cases, particularly of complex life cycles. The second bias that he attacks is the central explanatory role that genes play in developmental biology. He points out many examples of important evolutionary changes which are appropriately explained at the cellular level. For instance, he explains the evolution of the most primitive multicellular forms as the consequence of changes in cell adhesion patterns. He notes that the evolution of forms such as hollow spheres or tubes with lumina can be explained by changes in differential cell adhesion patterns. Accordingly, the level of explanation that allows us to understand these forms is the cell and not the gene. The genetic and molecular basis for differential cell adhesion is a separate question at a different level, just as the physics of the molecular bonds that underlie these adhesions is a different question at a yet different level. While this argument is not original, Minelli presents it very convincingly and shows how our fixation with genes leads us to choose a level of explanation that
is arbitrary and not necessarily tied to the level of the questions that we ask.

In Minelli’s view, the genocentric bias in developmental and evolutionary biology also leads us to an overly functionalist conception of genes. Genes, he argues, are more accurately viewed as stabilizers of developmental processes than as players in linearly arranged developmental pathways. It is interesting how this Waddingtonian view of development, with its emphasis on epigenetics and canalization is central for both Wilkins (2002) and Minelli, even though they take diametrically opposed views on the importance of the developmental pathway or genetic network metaphors.

In subsequent chapters, Minelli tackles the evolution of complexity in body form, the central role of cellular level processes in developmental mechanisms, and the role of cell size and number for both body size and morphological complexity. This discussion draws on examples from an impressive range of phylogenetic and developmental contexts. For those of us working with mammals, the vertebrate examples are few and far between, which may reflect Minelli’s desire to subvert yet another common bias.

In two chapters, Minelli discusses the topics of body axes, and segmentation. The discussion of the latter is quite original and a must-read for anyone interested in the evolution of segment, e.g., vertebral number or morphological variation along segments. In this section, the bias attacked by Minelli is the tendency, whenever confronted with nebulous concepts such as segments or germ layers, to revert to typological thinking. Discussing the possibility of multiple segmentation patterns in different tissues or germ layers as well as the developmental basis for the determination of segment boundaries, Minelli subverts the simplistic “variation along a segmental theme” concept of most bilaterian body plans. He also presents his concept of paramorphism as a mechanism of the evolution of novel morphologies. This concept differs subtly from the more common concept of gene or pathway co-option (True and Carroll, 2002) in that paramorphism involves wholesale duplication of a developmental pattern. In Minelli’s view, for instance, limbs represent duplications of the main body axis. Interestingly, he argues that tails are equivalent to limbs in this regard, rather than extensions of the trunk.

Minelli’s book is a mixture of critiques of common biases such as finalism and reductionism and the author’s novel ideas on segments, body plans and appendages. Don’t look to this book for a grand synthesis of evolutionary developmental biology, but instead look to it for a series of very interesting arguments on important topics in evolutionary developmental biology. Some of these may change your perspective while others may not.