
Alessandro Minelli is a unifier. In this, his most recent book, he provides wide-ranging evidence to support the bringing together of two separate research traditions, developmental biology and evolutionary biology, to form one tightly intertwined discipline known as evolutionary biology of development, or “evo-devo” for short. A multitude of fine books have already been written about evo-devo, but they mostly assume that the reader already knows a great deal about developmental and evolutionary biology. Forms of Becoming is intended for the nonspecialist who wants an introduction to the field, but be forewarned: it leans toward an academic piece of writing and Minelli assumes that you already know a bit about Hox genes and molecular homologies. The author presents a lot of organisms, a lot of people, and a lot of arguments, but in the end this is overshadowed by a lot of good questions that he invokes you to consider.

Minelli is a professor of zoology at the University of Padua in Italy and draws on his extensive work with centipedes and millipedes to show how evo-devo helps us answer questions about why living organisms look the way they do. The book is divided into three parts, and each part is subdivided into several chapters. Part 1 serves as an introduction to the comparative method in the context of the history of biology, part 2 discusses the limitations of the gene’s role in determining the form of organisms, and part 3 looks at the biological concept of species.

The author discusses organisms that we are familiar with, like the giraffe, and some that are less familiar, like giant centipedes. With both the familiar and unfamiliar, he points out a number of unusual phenomena dealing with repetitive structures and numerical constraints. For example, all 500 known species of leeches have 32 segments. This is true for the short and stumpy medicinal leech as well as for leeches that are long and cylindrical. Minelli argues that if segment number were entirely determined by natural selection, then chances are we would find at least one leech species in the world with segments not adding up to 32. Evolutionary biology leads us to think that different leeches in different habitats might well result in leeches with different segment numbers, but here is a case where this does not hold true. Because of this, it is conceivable to attribute such things as segment number and the number of cervical vertebrae in most mammals to developmental constraints on phenotype production. This apparent lack of evolvability occurs because the environment cannot pressure organisms into developing something that cannot be produced (forbidden phenotypes), and, likewise, a new phenotype cannot always exist in a new environment.

Minelli would like researchers to view the entire life cycle of an organism, and not just embryogenesis, as one of development. He believes that in focusing only on the final adult forms (adultocentrism) it becomes “exceedingly easy to adopt a deterministic view of development that is dangerously close to finalism” (p. 81). In ignoring life cycles, developmental biologists have forgotten that selection acts upon all stages of development. One intriguing example is the role of ciliated cells in marine embryos. Minelli asks why a rather nonmotile larval form would have cilia. This requires us to go beyond looking at the adult function of cilia—that of locomotion. Our adultocentric view of organismal development needs to recognize that ciliated cells do not undergo mitosis. Ciliated cells located in the epidermis of the marine embryo help control growth and body size by slowing the division rate of the more interior and nonciliated cells. The dual role of cilia “belongs to different moments of the life of the cell” (p. 89).

Minelli also visits subjects such as competition and cooperation between cells during development, miniaturization of tick species, and the evolution of novelties. He covers a lot of ground in a short book, but this is exactly what makes Forms of Becoming so appealing. Minelli’s narratives draw you into evo-devo with details about butterflies, corals, and anemones, but he then tells you something about those organisms that you probably have never paid a great deal of attention to, like leeches’ double segmentation.

It is also refreshing that the author is a biologist who understands that his discipline does not exist in an ahistorical world. Minelli is able to show how the common structural design work of Geoffroy and the “embranchements” of Cuvier continue to be relevant to evo-devo today. It is only because Minelli sometimes builds his arguments and then stops short, telling the reader that “we shall not concern ourselves with it further in these pages” (p. 62), that I give Forms of Becoming four frogs instead of live.

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We Homo sapiens may think we rule the world. However, ants outnumber us a million to one. And little can stand in their way! For hundreds of years, these tiny creatures have spurred our curiosities and fascinated us. Ancient Greeks have written about their wisdom, Brazilians have admired their strength, and children and adults alike have flocked to see science fiction movies about ants such as the 1950s classic Them and the more recent 1990s animated film, A Bug’s Life. Like us, ants live in complex societies, they have a caste system, they defend their territories, and they landscape their gardens. The Lives of Ants provides educators, scientists, and entomological neophytes with an engaging account “of their lives, loves, wars, and family feuds, and the biology and social behavior that drives them.” Laurent Keller, a leading biologist who works on ants, teams up with science writer