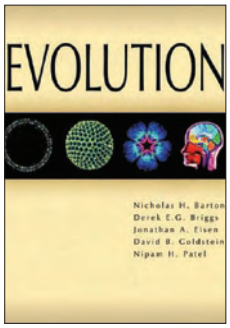
A textbook for all seasons



Evolution

By Nicholas H. Barton, Derek E.G. Briggs, Jonathan A. Eisen, David B. Goldstein & Nipam H. Patel

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Reviewed by Francisco J Ayala

There is now a consensus that the twenty-first century will be the century of biology, just as the twentieth century was the century of physics. Biology now has larger budgets and a larger workforce than physics, and it faces problems of great scientific significance and relevance to human life, such as the brain-to-mind transformation and the ape-to-human transformation. By the brain-to-mind transformation, I refer to the puzzle of how the chemical and electric signals by which neurons communicate are transformed into perceptions, feelings, ideas, critical arguments, aesthetic emotions, ethical values and religious beliefs; and how, out of this diversity of experiences, a unitary reality emerges—the mind, or self. By the ape-to-human transformation, I refer to the conundrum of how a seemingly insignificant one percent difference—out of three billion nucleotides—between the human and chimpanzee genomes accounts for the important biological and behavioral differences between the two species, whereby humans have bipedal gait and a much larger brain, as well as language, technology, art, ethics and religion.

In 1973, the eminent evolutionist Theodosius Dobzhansky famously noted: "Nothing makes sense in biology except in the light of evolution." Indeed, evolution is increasingly moving to the center of biological studies. When I came to the United States in 1961 as a student at Columbia University, neither Columbia nor other universities offered courses in evolution. Now many have entire departments of evolution and offer numerous undergraduate and graduate courses. Textbooks in evolution are available as well, such as the excellent *Evolution* by Douglas J. Futuyma. *Evolution* by N.H. Barton, D.E.G. Briggs, J.A. Eisen, D.B. Goldstein and N.H. Patel, a remarkable set of distinguished evolutionists, is of similarly high quality.

At 833 pages, *Evolution* by Barton *et al.* is a large book, and it is copiously and helpfully illustrated with photos, figures and line drawings, mostly in color. The lion's share consists of Part II, "The Origin and Diversification of Life," and Part III, "Evolutionary Processes." The three chapters of Part I introduce the history of evolutionary biology, including molecular biology, and the evidence for evolution. The final two chapters, in Part IV, provide an excellent, up-to-date summary of human evolution. The discussion of the Out-of-Africa and multiregional hypotheses of the origin of modern humans is nuanced rather than dogmatic. A section on "Genomics and Humanness" is brief but incisive. The final chapter on "Current Issues in Human Evolution" is exemplary and can be profitably read by medical geneticists seeking to establish associations between genes and diseases.

The enormous strides made in the field of evo-devo during the last two decades are integrated in two clearly written and superbly illustrated chapters of Part II: "Multicellularity and Development" and "Evolution of Developmental Programs." Surprisingly, however, five of the nine chapters of Part II are dedicated to the history of microbial evolution, and only one chapter deals with the diversification of plants and animals.

Only three pages of Part II are primarily dedicated to the concepts and methods of phylogenetic reconstruction. I would have expected a more extensive treatment of cladistics and other methods of phylogenetic inference. The molecular clock and its virtues and pitfalls are also very much shortchanged, in my view, receiving only a few pages of discussion in a chapter dedicated to "Variation in DNA and Proteins."

The expertise of Barton *et al.* in population and evolutionary genetics is eminently displayed in Part III, which makes up somewhat more than half of *Evolution*. All the bases are covered, and well covered at that: mutation and variation, population structure, random drift and gene flow, selection, social evolution, speciation, and much more. Algebraic symbolism and equations are not excessive but may be off-putting for students with scant mathematical training. The authors could have further explained the biological significance of the equations and segregated the mathematics away from the narrative text, in 'boxes' and other pedagogic devices, more often than they do. The last two chapters of Part III, "Evolution of Genetic Systems" and "Evolution of Novelty," are priceless. In length, depth and excitement, these two chapters go far beyond what is typically covered in evolution textbooks. The increasingly relevant topic of the evolution of evolvability is helpfully included, and evo-devo considerations are again brought to bear in these chapters.

There is little that is inappropriate or unseemly in *Evolution*. However, in the introductory section on historical background, dates are given for some scientists and books but not for others, even important ones. Do we need to be told three times on a single page that Charles Lyell's *Principles of Geology* was published in 1830? And do we need three photos of R.A. Fisher, two of them the same photograph reversed, and one not listed in the index? I found the index less complete and helpful than I would prefer. These minor deficiencies are mostly editorial matters, and if I bring them up it is so that they may be attended to in future editions of this superb textbook.

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