THE EVOLUTION OF EVOLUTIONARY GENETICS

Evolutionary Genetics: Concepts and Case Studies. Charles W. Fox and Jason B. Wolf, eds. Oxford University Press, New York, 2006. 608 pp., illus. $59.50 (ISBN 9780195168181 paper).

We evolutionary geneticists hold the history of our field nearly sacred. For example, one of my mentors referred to Ronald Fisher, Sewall Wright, and J. B. S. Haldane as the "holy trinity" of evolutionary genetic theory. Theory that emerged from the modern synthesis and later in the molecular revolution spearheaded by Motoo Kimura has served us well for nearly a century, and is arguably unsurpassed in biology in its elegance and explanatory power. The last two decades have ushered in rapid technological changes in the field concurrent with the development of the polymerase chain reaction and rapid genomic sequencing. These advances have given us unprecedented comparative data and insight into the workings of evolution at the nucleotide, gene, gene-network, and whole-genome levels.

Some new insights have suggested that this substantial body of evolutionary theory may still be useful but sometimes inadequate, or at worst, misleading to our understanding of how genes, genomes, and phenotypes are integrated and evolve. The question for the field is, How tightly should we cling to our past? Is modern synthesis–era theory still useful, and if so, when? What kinds of adjustments or modifications to evolutionary genetic theory have been or need to be made, and what are the empirical observations that motivate such changes? *Evolutionary Genetics: Concepts and Case Studies* endeavors to address these issues directly.

Editors Charles W. Fox (University of Kentucky) and Jason B. Wolf (University of Manchester) have assembled an impressive compendium of essays that can be loosely categorized into two main themes: (1) evaluation of principles, pitfalls, and developments in analytical methods of inquiry, and (2) new problems and conceptual directions in evolutionary genetics. Entries in the latter category are usually (but not always; see chapter 23, by Steven A. Frank) motivated by comparative genome-level analysis. This book is intended to be a companion volume to *Evolutionary Ecology: Concepts and Case Studies* (2001), also coedited by Fox. While there is some overlap in the topics treated by these two books (and a recurrence of some authors in this volume), the approaches to questions and empirical examples are strikingly different.

Fox and Wolf study invertebrates, so it is not surprising that this book relies heavily on results obtained from a classic model system in evolutionary biology: the fruit fly, *Drosophila.* I first thought that this relatively narrow focus was a weakness. It occurred to me, however, that many of the chapter authors who use *Drosophila* in their work also happen to be among the most prolific and thoughtful researchers in evolutionary genetics. It is thus natural for the book to focus predominately on this model system, as most of our understanding about how genomes integrate and translate into phenotypes has emerged from study of such systems. The challenge for researchers who examine nonmodel systems (as I do) will be to evaluate how and when we can apply knowledge obtained from models to our own research (e.g., chapter 15, by David L. Stern). This is an area of intensive investigation and will undoubtedly be the subject of books in the near future. I learned a lot from *Evolutionary Genetics: Concepts and Case Studies,* and I encourage evolutionary biologists of all stripes to read it.

The book is arranged in 32 chapters and six parts, beginning with the basics of evolutionary theory, empirical observations, and the rationale for fundamental tenets of the field. The first section, "Principles of Evolutionary Genetics," provides an introduction to the

kinds of forces (i.e., mutation, genetic drift, and natural selection) that operate to change genotypic and phenotypic frequencies in populations. Chapters 2, 3, and 4 effectively and concisely lay the groundwork for the chapters that follow in other sections.

It is in these chapters, however, that I found the information boxes (included in nearly all of the book's 32 chapters) to be distracting. Boxes are ostensibly included either to treat topics that are outside the area of expertise of the chapter authors or to provide concise descriptions of topics that could not otherwise be covered in the chapter because of length restrictions. However, the boxes sometimes spanned several pages and digressed to an extent that detracted from the flow of some chapters. This is not to say that the boxes were poorly written or uninformative, but that they were best integrated and most readable when they were short (one page or less) and tightly reined by the goals of the chapter. John H. Gillespie's chapter (chapter 5) is a good example of effective use of boxes. (As an aside, I also found Gillespie's chapter to be inspiring and provocative, especially to those of us who wish to use coalescent theory to estimate demographic parameters from genetic variation in natural populations.) Information boxes notwithstanding, the editors do a commendable job of providing uniformity and continuity of chapter organization, which makes this compendium highly readable in general.

A major emphasis of the book is examining the use of quantitative genetic approaches for the integration of genotype and phenotype, and this topic is evaluated to some degree in all six sections. At least 11 of 32 chapters develop analytical and empirical approaches to study two crucial but comparatively poorly understood features of gene interactions: pleiotropy and epistasis. It is difficult to overstate the importance of these gene-by-gene interactions. A full understanding will help us to detail the workings of gene networks more fully (e.g., chapter 13, by Simon C. Lovell) and to understand robustness to mutation and developmental canalization (e.g., chapter 16, by Mark L. Siegal and Aviv Bergman). Accordingly, rich analytical and empirical toolboxes to document the outcomes of epistatic and pleiotropic interactions are a linchpin for advancing the field of evolutionary genomics and proteomics.

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Two sections of the book, "Genetics of Speciation" and "Evolutionary Genetics in Action," captured my attention and imagination. Most attractive was the sheer variety of topics treated in these sections, ranging from the coevolution of hosts and parasites (chapter 29, by Paula X. Kover) to the role of hybridization as a creative force in evolution (chapter 26, by Michael L. Arnold and John M. Burke). The chapter by Daniel E. L. Promislow and Anne M. Bronikowski (chapter 30, "The Evolutionary Genetics of Senescence") was an intriguing combination of life history theory and genetics for examining hypotheses regarding the evolution of senescence. Finally, the chapter on experimental evolution (chapter 31), by Adam K. Chippindale, provided a concise vision of the power of model systems to examine genotypic and phenotypic change over evolutionary timescales (i.e., over many thousands of generations). In all, I was impressed with the holistic and synthetic nature of the chapters in these sections and felt they were a perfect way to draw together the preceding sections into a wonderful finish.

This book does what it sets out to do. It clearly lays out where the field of evolutionary genetics has been, develops theoretical and analytical modifications of modern synthesis–era theory that fully encapsulates new empirical knowledge, and provides an enticing glimpse of the future direction of the field.

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