



Phylogeography: The History and Formation of Species by John C. Avise

Review by: James H. Brown

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GENETICS & EVOLUTION

SYMBIOTIC PLANET: A NEW LOOK AT EVOLUTION.
The Science Masters Series.

By Lynn Margulis. New York: Basic Books. \$21.00. vi + 147 p; ill.; index. ISBN: 0-465-07271-2. 1998.

This is a personal account of the scientific odyssey of one of the leading scientists of our time. Margulis states: "My best work, I believe, is the development of the details of the serial endosymbiosis theory" (p 37). SET explains the architecture of modern eukaryotic cells as the product of successive microbial symbioses. An original archaebacterium, itself now represented by nucleus and cytoplasm, fused with other bacterial forms and so gained cilia and other appendages first, mitochondria, and then chloroplasts. Margulis admits that, although there is much evidence for the last two stages, the evidence for the first is slim. But she will "explain why I hold my unpopular opinion . . . Some colleagues label me combative; others, unfair. Some say I only collect relevant work and unfairly ignore contradictory data. These accusations may be correct" (p 39).

This book is, in large part, an account of SET intended for nonspecialists. I felt, however, that considerable biological knowledge would be needed to understand SET properly or to appreciate why, for example, Margulis records her disagreements with Crick on Directed Panspermia, or with Woese on bacterial classification, or why she agrees with Lovelock on Gaia. She touches briefly and tantalizingly on her early scientific career, her meeting and marriage to Carl Sagan, her children, her beliefs and values, triumphs and disappointments, manuscripts rejected, and theories confirmed.

Margulis scintillates in her own field, the taxonomy and morphology of microbes. When she strays into chemistry or global ecology, she sometimes skates on thin ice. To describe methane as "CH₃" and ammonia as "HN₃" (p 83) is almost unforgivable, although the correct formulas are given on page 121. Her attitude to humankind's terrible degradation of the natural world seems like a blend of optimism, indifference, and *laissez-faire*: "the microbes, the whales, the insects, the seed plants, and the birds, are still singing. The tropical forest trees are humming to themselves, waiting for us to finish our arrogant logging so they can get back to their business of growth as usual. And they will continue . . . long after we are gone" (p 128). Generally, Margulis writes well and conjures beautiful images throughout. This book is easy to read, inexpensive, and worth buying.

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PHYLOGEOGRAPHY: THE HISTORY AND FORMATION OF SPECIES.

By John C. Avise. Cambridge (Massachusetts): Harvard University Press. \$49.95. ix + 447 p; ill.; index. ISBN: 0-674-66638-0. 2000.

The last two decades have seen enormous progress in historical biogeography. The advances have come in two areas: paleobiologists using fossils to study how earth history has influenced the diversification of organisms, and geneticists and systematists using molecular data to reconstruct the geography of ancestor-descendant relationships. The latter is the subject of the current book. It begins with a thorough treatment of the conceptual and empirical bases for using gene sequence data to reconstruct the genetic and phylogenetic histories of lineages. Then these methods and ideas are applied to two kinds of biogeographic studies: using intraspecific variation to infer effects of demographic and genetic processes on microevolutionary differentiation of populations; and using interspecific patterns to understand influences of environmental conditions and events of earth history on the macroevolutionary processes of speciation, extinction, and adaptive radiation.

Phylogeography is largely an effort to summarize the author's own research and place it in the context of recent advances in phylogenetic biogeography. A disadvantage of this personal approach is that the book does not reflect the diversity of alternative concepts, methodologies, and interpretations in the discipline. For example, relative advantages of mitochondrial and nuclear DNA are discussed without indicating the extent of theoretical controversies and conflicting empirical results. Times and modes of divergence are estimated from simplistic models that assume that permanent absolute barriers either split existing populations (vicariance) or were crossed just once by colonizing individuals (dispersal). In reality, the effectiveness of barriers to dispersal and gene flow has varied across space, over time, and among taxa. Other authors have made much more complicated interpretations of the biogeographic history of Hawaii than Avise's: "the sequential order of clades in a gene tree generally parallels the linear physical (and, hence, temporal) arrangement of the islands" (p 258).

These criticisms are far outweighed, however, by positive features. *Phylogeography* presents a compelling case for an emerging discipline by one of its most prominent practitioners. It provides a concise, well-organized treatment for nonspecialists, and a clearly articulated synthesis of Avise's many contributions for specialists. I recommend it to all population geneticists, evolutionary biologists, and biogeographers. *Phylogeography* would make a stimulating

centerpiece for a graduate seminar, especially if accompanied by readings that present alternative viewpoints.

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A PRIMER OF POPULATION GENETICS. Third Edition.

By Daniel L Hartl. Sunderland (Massachusetts): Sinauer Associates. \$29.95 (paper). xvii + 221 p; ill.; index. ISBN: 0-87893-304-2. 2000.

With the advent of molecular techniques and DNA sequence based studies, the field of population genetics has grown greatly since the second edition of this book was published in 1988. In this third edition, the author has outlined the major principles of population genetics and incorporated the recent impacts from the last twelve years, while actually reducing the outcome by almost 100 pages. Moving the distracting problem sets to the end of chapters and making the answers available via the author's website is just one improvement in the reorganization of the content and focus of this edition.

A new section in Chapter 1 on molecular techniques, from classical (yet valued) allozyme electrophoresis to SNP (single nucleotide polymorphism) and microsatellite analyses at the DNA level, demonstrates their applications for disciplines from evolutionary biology to conservation to forensics. An improved Chapter 2 begins with a clear discussion of mutation, migration, and natural selection, and ends with random drift; whereas, the previous edition awkwardly opened with random drift, a topic that was quite abstract to novices since mutational input had not yet been discussed. Chapter 3 is the definitive strength of this edition with discussions of coalescent theory, codon usage bias, neutrality tests for DNA sequence data, and molecular phylogenetics—all recent contributions to the field that have revamped molecular population genetics. This chapter clearly demonstrates the recent evolution of this field due to new molecular tools and statistical tests that are applied to a well-founded theoretical basis. Although the fourth chapter tackles the genetic architecture of complex traits at an introductory level, Hartl does an excellent job of providing a useful foundation for those interested in getting up to speed. An important addition is the discussion of QTLs and mapping candidate loci using maximum likelihood estimates from linkage disequilibrium studies in humans. With the recent completion of the Human Genome Project, the inclusion of this topic is very relevant to human population geneticists.

The author succeeds in providing a simple introductory guide to those interested in the fundamentals of population genetics. This book demonstrates

how valuable population genetics has become to a diverse number of disciplines now that molecular tools are available and can be combined with the classical models of genetic inheritance and Darwinian selection. With a very timely and up-to-date revision, Hartl continues to contribute to this field.

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TECHNIQUES IN QUANTIFICATION AND LOCALIZATION OF GENE EXPRESSION.

Edited by Bruce K Patterson. Boston (Massachusetts): Birkhäuser. \$100.00. xvii + 150 p + 2 pl; ill.; index. ISBN: 0-8176-4034-7. 2000.

This book contains 11 chapters by various investigators that discuss the central theme of identification, localization, and quantification of gene expression using in situ hybridization and related techniques. The volume begins with a very good discussion of the theory, instrumentation, and application of flow cytometry to the techniques that will be presented later in the book. This chapter is followed by subsequent ones on tissue preparation, fixation, and preservation, and on several methods of in situ hybridization using reverse transcriptase-coupled polymerase chain reaction (RT-PCR), branched DNA, and reverse transcriptase and 5' nuclease assays (RT-FISNA). All chapters provide easy-to-follow protocols for the methods discussed. Also included are several chapters dealing with specific examples such as using immunofluorescence and in situ hybridization to detect cytokine-expressing cells and cells containing low copy numbers of pathogenic orbiviruses. Unfortunately, although there are some very good sections, the somewhat confusing and haphazard organization of the book detracts from its usefulness.

This book contains several very good and detailed protocols, but many other protocols and approaches to in situ hybridization are omitted. Thus, the volume is far from comprehensive. Also lacking are extensive discussions regarding potential pitfalls and areas of concern or special attention in the methods. For a volume devoted to in situ nucleic acid hybridization, it is disheartening that there is no chapter or discussion that deals with choice or design of nucleic acid probes for detection or their preparation and use. Even with these shortcomings, this book should be a good resource for those just beginning in the area of in situ hybridization, but a more comprehensive volume marrying molecular biology with the histological methods would be welcome.

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