Book Reviews

Genetics and Evolution

Evolution of Genes and Proteins. MASATOSHI NEI and RICHARD K. KOEHN, Eds. Sinauer, Sunderland, Mass., 1983. xvi, 332 pp., illus. Cloth, $36; paper, $20.

Some years ago Francis Crick admonished that "a molecular biologist who wishes to discuss the evolution of the eukaryotic genome will need not only to know a lot about the way DNA and its transcripts behave but also something about modern ideas on population genetics." Conversely, a population geneticist who wishes to be serious about evolutionary mechanisms had better know a lot about modern molecular biology. The field of population genetics has, as they say, "gone molecular." (This is usually said in the rueful tone of voice used in referring to persons gone to pot or buses gone off cliffs.) The going molecular makes for exciting times in population genetics, and the vitality of the field is well represented in this timely collection of papers that originated at a symposium held in 1982 at a joint meeting of the Society for the Study of Evolution and the American Society of Naturalists.

This is unlike most symposium volumes in that Nei and Koehn have carefully edited the contributions for uniformity of level and terminology, have cross-referenced chapters where appropriate, have bundled all the references into a single bibliography at the back of the book, and have provided an index. Although this is by no means a textbook covering the field systematically or comprehensively, the book should prove useful as supplementary reading in a modern course or seminar in population genetics and evolution.

The volume has a higher than average number of excellent papers. N. Arnheim provides a fine discussion of the various processes by which similar DNA segments in a genome can come to have identical or nearly identical sequences. His discussion of concerted evolution in mammalian rDNA is an elegant blend of molecular biology and cytogenetics. The chapter on the use of electrophoretic variants to study the genetic structure of populations by R. K. Selander and T. S. Whittam is arguably the best available discussion of the subject, focusing largely on Selander's own beautiful work with Pyrenean *Cepea*, Californian *Helix*, and, more recently, *Escherichia coli*. A principal point is that the neutral theory provides a convenient and simple null hypothesis with which to examine an observed spatial distribution of enzyme polymorphisms. In *Cepea* and *Helix*, no assumptions beyond population subdivision and random genetic drift, including founder effects, are necessary to account for the observed pattern of allozyme frequencies, although natural selection has evidently affected shell banding and coloration in *Cepea*. R. K. Koehn, A. J. Zera, and J. G. Hall's discussion of enzyme polymorphisms and natural selection is thorough, careful, and critical, emphasizing gaps in the data and not marred by preconceived notions or special pleading. The authors make the point that Kacser and Burns's influential theory of metabolism suggests that allozyme differences should have negligible effects on metabolic flux, which seems to be at variance with observations of, for example, *Drosophila* G6PD and 6PGD allozymes—although additional relevant data are badly needed. Avise and Lansman's discussion of the use of mitochondrial DNA polymorphisms as genetic markers in population genetics is in the same vein—realistic, tough-minded, and critical.

Readers interested in M. Kimura's latest views on the neutrality hypothesis, which he developed and has done much to promote, will particularly want to examine his chapter. This hypothesis has had an enormous impact in population genetics. Once it raised the hackles of conventional evolutionary biologists, now it raises nary an eyebrow. Kimura seems to be saying that nearly neutral allozyme markers do indeed have developmental and physiological effects. They may in fact be the sort of loci envisaged in the classical theory of quantitative genetics—loci that in the aggregate have a significant impact on quantitative characters, including those related to fitness, but that individually have effects so nearly imperceptible that their changes in allele frequency are strongly influenced by random genetic drift. Kimura also subscribes to the view that selection is a matter of genotype and environment, and the same alleles that are neutral in one set of environments may be nonneutral in an altered environment and thus can become the raw material of evolutionary change. (Incidentally, in a book otherwise nearly free of typographical errors, one does appear in a formula. Kimura's equation 2 on p. 211 should read $P_{\text{mono}} = q^{4N_e v}$, which is derived in *Theor. Pop. Biol.* **2**, 174 [1971] rather than in the reference cited in the book.)

One particularly pleasing aspect of *Evolution of Genes and Proteins* is that, like *Perspectives on Evolution*, edited by R. Milkman (Sinauer, 1982), it includes microbial systems, particularly prokaryotes, without apology. In spite of the very considerable influence that microbes have had on thinking in what may be called organismic genetics, they have had little influence on population genetics or evolutionary biology. It is a pity, because the technical advantages of microbes in testing evolutionary hypotheses are unparalleled. B. G. Hall reviews the subject of "directed evolution"—the deliberate selection of organisms that have acquired novel metabolic functions—with emphasis on newly evolved β-galactosidase. Once merely a collection of interesting anecdotes and special cases, this field has reached the stage where new principles of evolution are beginning to emerge. As might be expected, A. Campbell's discussion of the evolutionary significance of transposons is another example of his talent for rigorous evolutionary thinking presented in clear, simple prose. Here his theme is that the long-term evolutionary significance of transposable elements may be in their capacity to generate new genomic arrangements, a view that has yet to be incorporated into the fabric of evolutionary biology, partly because, Campbell comments wryly, "evolutionists do not care much about mechanisms."

All in all, *Evolution of Genes and Proteins* is a book that the editors, the publisher, and the contributors can all be proud of. In representing the diversity of interests in modern population genetics and the high quality of much current research, it satisfies a distinct need and will be well received by professionals and students alike.

DANIEL L. HARTL
Department of Genetics, Washington University School of Medicine, Saint Louis, Missouri 53110