surprising. Although there are a number of good up-to-date review articles on particular aspects of telomeres, this book represents the first attempt that I have come across to cover such a breadth of telomere topics in a comprehensive manner. The result is excellent. It is written in a clear and easily readable style, and although it discusses many topics in depth, it never gets too bogged down in detail. Many books of this type are multi-authored affairs, with good and bad chapters. This book benefits from the single author approach, with a consistency of style and the absence of overlaps. There are ten chapters which range from a basic discussion of what telomeres are and why chromosomes need them, through details relating to telomeric sequences, telomere binding proteins and telomerases, to telomere position effects and the weird telomeres in *Drosophila*. The chapters are sufficiently self-contained and detailed to be worth reading as stand-alone reviews. I found the detailed descriptions of telomeric sequences and telomere structure in chapter 3 particularly useful, other readers may get far more from different chapters. I did find that the final chapter (10) was a little down-beat with respect to some of the other chapters, and it may have been better to have slipped this in elsewhere in order to end the book on a high. It is also easy to criticise any book in a fast-moving field for being out of date. It is particularly unfortunate that in this case a number of major breakthroughs occurred in 1995, too late to be included in the book. This is not a major problem, because the strength of this book is that it contains a comprehensive review of the vast amount of literature available at the time of publication. After reading this book it would be easy to get up to date with the relatively small number of more recent key references. The aim of the book is to introduce some of the basic concepts and key questions in telomere research to both advanced undergraduates and more experienced research workers. To my mind the book is too specialized for most undergraduate purposes, but it is a superb source of material for anybody already in the telomere field or thinking of moving into it. In summary, I think that this is an excellent piece of academic writing and I would certainly spend £45.00 to own it.

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Population Genetics of Bacteria, Society for General Microbiology Symposium 52. S. Baumberg, J. P. W. Young, E. M. H. Wellington and J. R. Saunders (eds). Cambridge University Press. 1995. Pp. 348. Price £55.00, hardback. ISBN 0 521 48052 3.

Bacteria present a major challenge to population genetics; with often limited recombination between phenotypically similar individuals and the occasional transfer of genes between phenotypically very different individuals, much of our knowledge of population genetics, based as it is on sexually reproducing organisms, is of little use. For instance the concept of a species is very poorly defined. Population genetics has however allowed us to start to address questions about the rate of recombination between bacteria, and has provided us with an experimental system in which to examine some of the fundamental questions about adaptation. Furthermore population genetics has given us insights into the origins of pathogenic strains and the spread of antibiotic resistance.

This book, which is the proceedings of a conference held by the Society for General Microbiology in January 1995, covers many of these topics. Overall the volume lacks any coherent structure in terms of the order of the topics, or the topics covered; furthermore many of the chapters are only obliquely related to population genetics. So, for instance, the chapter on conjugation (Wilkins) is a thorough and good review of the molecular mechanisms of conjugation but deals little with the population genetics consequences of the process and is not supplemented by chapters on transduction and transformation, the other mechanisms of gene transfer in bacteria. However, there are many excellent chapters.

One of the central questions in bacterial population genetics is the degree to which bacteria recombine. From electrophoretic data the picture is one in which some species, such as *E. coli*, are essentially clonal, whereas others appear to be freely recombining panmictic populations like *N. gonorrhoeae* (Maynard Smith). However, on closer examination even species such as *E. coli* show evidence of localized recombination in which a clonal background is pockmarked with short segments of DNA from other sources (Milkman and McKane). As John Maynard Smith points out, this limited recombination may be extremely difficult for population geneticists to model. Recombination between different strains or even different species of bacteria has had terrible implications for medicine, as illustrated by the rapid spread of antibiotic resistance across bacterial species (Bennett) and the acquisition of virulence factors by commensal *E. coli* (Whittam). Although far from understood, there is also a correlation in *N. meningitis* between epidemiology and clonality; it is the clonal strains which cause the most widespread pandemic disease (Spratt *et al.*, Maiden and Feavers).

Bacteria, with their large population sizes and short generation times, have proved to be extremely useful tools for studying evolution. It has been relatively easy to address questions of whether populations will always adapt to an environment in the same way, whether an adaptation to an environment is specific, are there tradeoffs, and can tradeoffs be compensated for? Richard Lenski reviews a number of excellent experiments which address these fundamental problems. However, a question remains as to how general the results will prove to be. In particular, are the results dependent upon the complexity

of the genome and the ability of the organism to recombine? A different approach has been to analyse the fitness effects of naturally occurring variants in the laboratory (Dykhuizen). This has generally suggested that the variants are neutral with respect to one another, although the resolution of the system is limited. However, variants which are similar in one environment can be quite different in another (Lenski, Dykhuizen). Experimental populations have also demonstrated how incredibly easy it is to evolve plasmids carrying multiple antibiotic resistance genes (Levin).

The volume is rounded out with good chapters on the population genetics of restriction systems (Barcus and Murray), insertion sequences (Werner *et al.*), adaptive mutation (Foster) and phase variation (Saunders). In one of the last chapters, Roger Pickup describes what is one of the most exciting areas of bacterial population genetics; the use of PCR to study the community structure of unculturable microbes. This approach has greatly increased our understanding of community ecology at the microbial level. Despite our relative ignorance of bacterial population genetics the future looks bright for the study of both natural and experimental populations. We can learn a lot about both the basic evolutionary mechanisms which affect a huge proportion of the earth's biota, and also many of the organisms which are medically and economically important. This book offers good reviews on many of these aspects.

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Non-Neutral Evolution: Theories and Molecular Data. Brian Golding (ed.). Chapman and Hall, London. 1994. Pp. 249. Price £29.95, paperback. ISBN 0 412 05391 8.

A lot of time and soul searching must have gone into the title of a volume which defines evolution in terms of what it is not, rather than what it is. The phrase 'Non-Neutral Evolution' tacitly acknowledges that the Neutral Theory of Molecular Evolution has frustrated virtually all attempts to pin the observed patterns of molecular variation to adaptive models of evolution. The title, more than anything, illustrates just how much things have changed in the last ten years.

This volume is the result of a recent workshop, sponsored by the Canadian Institute for Advanced Research, which brought together some of the World's most respected evolutionary biologists to assess the state of play. As such it provides an accurate cross-section of current research, ranging from largely descriptive empirical work to purely theoretical contributions. My most basic criticism is that the interaction of theory and experimentation is rarely shown to bear fresh fruit. However, this is perhaps understandable in a field which openly laments the fact that it provides 'fodder for the theoretician, but little solace for the experimentalist' (Chapter 1).

Despite this reservation there is evidence that the deluge of DNA sequence data is providing new ways of looking at old problems. One of the clearest predictions of the Neutral Theory, the existence of a quantitative relationship between levels of DNA sequence variation within and between species (they are both products of the same combination of mutation and drift), is challenged repeatedly here using data from *Drosophila* species. The conclusions are firm; the null hypothesis of the Neutral Theory can be rejected, some sequence variation clearly isn't strictly neutral. Unfortunately, as several authors go to some length to point out, this does not necessarily mean it is adaptive either.

An instructive example comes from an excellent series of chapters on the relationship between recombination, variation and selection. Regions of reduced meiotic recombination exhibit low levels of intraspecific variation, but interspecific levels of variation are normal. This has been cited as clear evidence for the presence of linked loci under positive directional selection. However, the observed levels of within- and between-species variation can be explained equally well by selection against linked deleterious loci being maintained by mutation. While the theoreticians are busying themselves trying to find conditions under which the competing explanations can be discriminated we can conclude one thing for certain; empirical proof of natural selection and confirmation of Darwinian evolution remains as elusive as ever at the molecular level.

There is some clear, informative writing here, particularly where a relatively well-defined problem or small body of work can be covered comprehensively. There is also a healthy mix of novel and established work which broadens its appeal. Ultimately, however, the volume is disappointing simply because of the intractability of the subject matter. So many chapters detail the pattern of sequence variation at so many loci in so many species and in so many different ways, yet come up with so few firm conclusions. I suppose that's just the way it is always going to be when you take snap-shots of molecular variation and try to extrapolate the pictures across the millenia.

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Stress-Induced Gene Expression in Plants. A. S. Basra (ed.). Harwood Academic Publishers GmbH, Chur. 1994. Pp. 287. Price £84.00, hardback. ISBN 3 7186 5466 0.

Stress-Induced Gene Expression in Plants, according to the description on the back cover, 'is a book aimed at