Book Reviews

Molecular Evolution and Phylogenetics. By M. Nei and S. Kumar. Oxford University Press. 2000. ISBN: 0-19-513584-9 (hbk); 0-19-513585-7 (pbk). xiv + 333 pages. Price: £65 (hbk); £32.50 (pbk).

More than a decade ago, the first author of this book, Mashatoshi Nei, published the very influential *Molecular Evolutionary Genetics* (Nei, 1987), attempting the unification of population genetics and molecular phylogenetics. The field of molecular evolution is ever more productive and, perhaps more importantly, the boundaries between population genetics, molecular phylogenetics and molecular evolution have, to a large extent, disappeared, so the appearance of the new *Molecular Evolution and Phylogenetics* by Nei and Kumar is timely. The authors' aim was not to rewrite *Molecular Evolutionary Genetics*, but rather to '… present statistical methods that are useful in the study of molecular evolution and to illustrate how to use them in actual data analysis' (pages v–vi).

The book consists of 14 chapters, the first part starting with an introduction to molecular evolution, followed by two chapters on the evolution of nucleotide and amino acid sequences, respectively. Another chapter reviews synonymous and non-synonymous substitutions. The rest of the book deals chiefly with molecular phylogenetics. After an introduction to phylogenetic jargon, three chapters deal with methods of phylogenetic inference and additional chapters discuss phylogeny-related issues such as methods for assessing the robustness of phylogenies, molecular clocks and ancestral sequence reconstruction. Two chapters are also devoted to intra-specific (population-level) questions and the book ends with a short perspective on what the future holds for the study of molecular evolution. Surprisingly, genomics and the interplay between genomics and molecular evolution (e.g. Brown, 1996; Eisen, 1998) are mentioned only very briefly.

One may distinguish phylogenetic methods into those of the past, the present, and the future. Methods used in the past (e.g. UPGMA) are briefly and adequately covered, and currently widely used methods such as neighbour-joining, parsimony and maximum likelihood get fair coverage, albeit unbalanced in treatment. What is missing is discussion of methods holding promise for the future. Methods such as Bayesian analysis are very briefly (and unsatisfactorily) discussed, while others are not mentioned (e.g. genetic algorithms, Lewis, 1998) or quickly dismissed, without much explanation: 'In practice, network trees are produced only occasionally so they will not be considered in this book' (page 75). Is frequency of use a serious reason for not including them?

Our main criticism of *Molecular Evolution and Phylogenetics* is the advocacy of a particular perspective in molecular phylogenetics. The presentation of methods and examples is rather biased towards methods developed by Nei's group and collaborators (these are admittedly impressively many) and their underlying philosophy (i.e. the use of distance methods). For example (page 180), various authors (e.g. Hillis *et al*., 1994; Huelsenbeck, 1995) are criticised for using extreme sequence divergences for simulation analyses of the performance of phylogenetic inference methods, since such divergence is stated to be 'biologically irrelevant'. This criticism is unfair, given that important phylogenetic reconstruction issues may involve extreme sequence divergence (e.g. the case of the Strepsiptera, see Huelsenbeck, 1998). 'Simple' phylogenies will probably prove easy to reconstruct using any method of inference. It is for certain 'biologically relevant', and difficult to resolve, scenarios (e.g. adaptive radiations) that we are most in need of knowledge about which method performs best. The authors are also unduly critical with regard to the amount of time spent in calculation of phylogenies. Likelihood and parsimony methods certainly require more computational time than neighbour-joining or other distance methods, but current advances in computers allow parsimony or likelihood analyses where this was formerly impossible, and further speeding up can be anticipated. Although the time required is a valid criticism of a method of phylogenetic inference, it is a less serious a problem than the quality.

In a few cases, arguments are presented without supporting data. For example, the authors argue on page 155 for the a use of simpler models (with a worse

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fit to the data) rather than more complex ones (with a better fit). Their reason is that the former more often give the correct topology (based on the limited number of studies of this issue). Although this is an important point, they make no attempt to provide an explanation.

The focus of the book is less on biological issues than on algorithms (although alignment of nucleotide and amino acid sequences are only superficially covered). Almost all the examples deal with nucleotide and sequence data, with only a brief mention of the phylogenetic value of extremely rare types of mutations. Examples of phylogenies supported by the use of retroposons, intron insertions and genomic rearrangements are described, but other character types, such as changes in mitochondrial DNA gene order, or in genetic codes are not mentioned (e.g. Boore & Brown, 1998; Rokas & Holland, 2000). Many of these rare genomic changes pose interesting and challenging theoretical issues (e.g. modelling changes in mtDNA gene order, Sankoff *et al*., 1992) but, unfortunately, only retroposons are discussed from a theoretical viewpoint. Perhaps more importantly, taxon sampling and its effects on tree reconstruction is not discussed at all, although it is one of the most important aspects of phylogenetics (e.g. pages 161, 182–5).

The book is well written, with only a few inaccurate statements. On page 41 the authors claim that 'the cytochrome b gene in animal mitochondrial DNA is highly conserved…'; this is not true, especially at the nucleotide level (which is under discussion in this particular example). In page 136 we read that 'Recent molecular data, however, suggest that the order Cetacea is most closely related to Ruminantia…'. However, Cetacea (whales and dolphins) are most closely related to hippopotamuses (which were previously assigned to the Suiformes, a group including pigs and peccaries, which turns out to be paraphyletic) and the whole-hippo clade is a sister group to Ruminantia (deer, cows, etc.). In another example (page 141), SINEs (a category of retroposons) are, mistakenly, presented as capable of self-amplification (see Shedlock & Okada, 2000).

The general appearance of the book is good with few typographical mistakes (e.g. on page 89 'uprooted' instead of unrooted, and on page 177 'Kishino and Hasegawa 1980' instead of 1989). The boldface script in certain figures is unclear (e.g. see figures in pages 60 and 92) and too many figures appear many pages apart from the relevant text. The writing style is sometimes difficult to understand, as on page 222 where we read about '…hemoglobin in vertebrates and hemocyanin in *lower sea animals*…' (emphasis added). A useful addition might have been a glossary, and a better index would be desirable, especially for a book which will be used as a reference. Another useful addition might have been an index of available phylogenetic software (the issue is not covered and references are made only to a few programs).

Overall, despite our criticisms, this is a valuable addition to the increasing literature of molecular phylogenetics, complementing other books (e.g., for parsimony, see Kitching *et al*., 1998). However, it offers a particular perspective of molecular phylogenetic theory, which is by no means generally accepted. Despite the disclaimer at the beginning of the book that is not heavy in mathematics and statistics concepts, it will be difficult to read without a firm grasp of statistics. It is thus unsuitable for most beginners in the field. Page and Holmes's excellent introduction to the subject (Page & Holmes, 1998) or alternatively Nei's old book (still a classic) will offer a more enjoyable read. For an all-in-one text of phylogenetics though, we would still suggest Swofford *et al*.'s masterly summary (Swofford *et al*., 1996).

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Systematics, edited by D. M. Hillis, Moritz, C. & Mable, B. Sinauer Associates, Sunderland, MA.

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A Passion for DNA. Genes, Genomes and Society. J. D. Watson

This is a collection of personal essays, enjoyable and easy to read, and not offensively egotistical. The author comes over as neither a totally focussed scientist of the class of Fred Sanger, nor of a polymath biologist like Joseph Needham or J. B. S. Haldane, people who were interested in ***everything*** – but a wonderful scientific bee, with marvellous recognition of the nectar of ideas and their metabolism into honey.

Somewhat conflicting signals come through in two essays, '*The Dissemination of Unpublished Information*' (1973) and '*Succeeding in Science*' (1993). In the later essay, he emphasizes the need for a young maverick scientist to have people around who ***care*** about him, and the young JW **was** nurtured, tolerated and protected. But the mature lab-leader JW of 1973 (age 45) seems to have become a dynamic organization man, fighting ruthlessly but ethically to make sure his group keeps ahead and gains as much kudos and research funds as possible, but with not much sign of caring for any particular individuals. Earlier in his 'small group' Harvard days, his PhD students were individuals, encouraged to get on with specific and exciting things and probably with his name not on their papers, but by the CSH Tumour Virus days all seems to have become much more competitive. The Cambridge ethos of 1952, and the ebullient style of Francis Crick has changed.

Would passion for DNA have been maintainable on ***Planet X***, where there exists a DNA/RNA/Protein Life System, and where Higher Forms had evolved and discovered the Double Helix, although the simple forms had not chosen the restriction-modification road to limiting lateral gene transfer? Are there any *a priori* reasons why endonucleases of the specificity of EcoR1 or HpaII must be present in a Life System – and without them how far would the Biotechnology Revolution have progressed? In our sequencing days in the early sixties, DNA seemed an impossible target, and small RNA's only explorable, in preference to proteins, because of their phosphate structure and the cheapness of ^{32}P. Did anyone postulate the existence of such endonucleases – and, is so, when? It has been interesting to look through successive editions of *The Molecular Biology of the Gene*, and see the arrival of restriction endonucleases in the 3rd (1975) – and a brief but emphatic (and *italicized*) notice of their importance.

I was surprised at the number of subjects involved with DNA and of much concern today that do not surface in these essays, which date from 1966 until 1999. Such topics include AIDS/HIV, BSE/CJD and Prions – perhaps to be regarded as blasphemous – xenotransplants, and Ancient DNA. In 1965, JW at Harvard was sensibly teaching that Embryology was not then the approachable problem that it has now become. It is fascinating to compare the plates from Joseph Needham's (1950) ***Chemical Embryology*** with late-nineties Developmental Biology seminar slides, where immunology and recombinant DNA probes at last show where and when different genes are acting. The struggle with the Creationism lobby to enable the proper teaching of biology in schools, trying to ensure national acceptance of evolution (which is DNA change) does not seem to have involved JW, though his gifts would have greatly helped the arguments. Fraud in Science has aroused much media interest in these years, but is not discussed, even though one of the most stylish frauds in molecular biology with a tumour virus system, was first presented at a Cold Spring Harbour meeting.

The 'autobiographical flights' make fascinating reading. What a place Chicago must have been in the Forties! Fermi and the first controlled and sustained chain-reaction happening at the sports field, unknown to JW then and not worrying him much thereafter. The University of Chicago had an inspired policy, recruiting people like him and Carl Sagan when still in their early teens. The Cambridge chapter makes nostalgic reading, and it is good to see Roy Markham and Kenneth Bailey remembered. He comments that the biochemistry descendants of Hopkins were 'often more lost than inspired (excepting the Protein Hut)', which has some point, but Robin Hill, Keilin and Needham were certainly inspiring, though the lack of appreciation of biology by Todd was a tragedy, as was Marjorie Stephenson's death.

These essays ***are*** fun, and make one realize how the character of JW throughout his career incited everyone who conversed with him to argue and exchange ideas. Reading the book forces one to make marginal comments and to want to send him e-mails. But it also does make this reader feel glad that he had his scientific time in the fifties and onwards, and is not starting in the new millennium to strive to succeed in science. Could a career like JW's happen nowadays?

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Abraham Lincoln's DNA and other adventures in Genetics. PHILIP R. REILLY. Cold Spring Harbour Laboratory Press. Hardback 358 pp $25. ISBN 0-87969-580-3.

This enjoyable and readable book consists of 24 essays, four under each of 6 subjects that cover an impressive range of genetic topics, all currently of headline-making importance. The book is written to be accessible to the layperson but it contains much to illuminate undergraduate lectures and most students will learn a great deal from it. It will appeal to a varied readership and it is strongly recommended.

The author is qualified in law, genetics and medicine and, as you might expect, writes with authority on tropics chosen to encompass all three disciplines. The basic genetic background is introduced where relevant within each essay topic without, however, going into any unnecessary detail. There is a strong emphasis on legal issues contained within many of the essays.

The first essay, about investigating the possibility that Abraham Lincoln had Marfan syndrome, sets the tone for the whole book. It places before the reader the argument for and against the desirability and feasibility of testing for the presence of a mutation conferring Marfan syndrome. Following a request to the National Museum of Health and Medicine in Washington to investigate Abraham Lincoln's DNA, a DNA advisory panel was set up to advise the museum. The conclusion was reached that testing should not be carried out. This decision was made for technical reasons, but the ethical arguments for and against are clearly put. This format is repeated in many of the essays; a considered debate surrounding alternative points of view is a hallmark of most of the chapters. The Abraham Lincoln essay is the first of four delving into historical aspects of genetics.

The remaining subject areas covered are: DNA profiling and the law; DNA and behavior; transgenic plants and animals; human genetic disease and testing and finally, genetic dilemmas arising from increasing genetic characterisation. In each part I came across novel argument or example. In this short review, a few examples will have to suffice to give a flavour of the book. In the DNA profiling chapters, the use of DNA from semen of an unidentified rapist was used to file an arrest warrant against 'Joe Dole, unknown male with a matching deoxyribonucleic acid profile'. This was done in order to overcome a six-year statute of limitations. The use of DNA in forensic investigation is well known both to establish guilt and innocence, but the chapters in this section contain more than anecdotal examples of this application. For example, the growth of felon databanks, both in the USA and Europe, and the potential for their use and abuse is also considered at some length. In the behavioural section, the location of a dominant gene predisposing children to bed-wetting has given rise to a change in advice to parents. No longer is there a suggestion of conflict within the family as an anxiety-related cause of the problem. Within this section, and indeed throughout the book, there is a clear and repeated distinction made between genetic predisposition and genetic determinism. In the section on transgenic technology, there is an attempt to look to the future in the area of nutritional genomics, in which molecular biology is used to redefine food so that it confers health benefits to those that eat it. As in the rest of the book, speculation of this sort is conducted in an imaginative, but disciplined, manner. The speculation is clearly identified as such and the reader is left in no doubt of the distinction to be made between the achieved and the achievable.

The author's first hand experience of ethical and public policy issues means that the book is full of fascinating examples gleaned from his exposure to genetic controversy. The book contains a lot of information on current [American] practice with respect to counselling, testing and genetic discrimination. Although both sides of the argument are advanced for the topics discussed, the reader is left in no doubt of the author's opinions on most of these. There is a keen awareness that the public needed to be kept informed of the rate of progress if they are to be persuaded that this progress is in the general interest of humankind even if it raises difficult problems. The testing for mutation in BRCA1 and BRCA2, predisposing to breast cancer, has, in the authors phrase, 'created new hope and profound uncertainty'. The issue – to test or not to test – is not shirked but confronted head-on.

There are some errors in the book – for example 'electrosporulation' [p. 61] and the idea that restriction enzymes defend bacteria against other bacteria [p. 177]. A question posed about Dolly – 'Is she fertile?' answer 'Yes' – is placed [p. xix] amongst a series of other questions to which the answers are not known. These are very minor blemishes however and do not detract from a thoroughly entertaining and informative read.

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