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Book Reviews

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Evolution. 3rd Edition. MARK RIDLEY. Blackwell Publishing. 2003. 751 pages. ISBN 1 4051 0345 0. Price £27.50.

The field of evolution is diverse, spanning all levels of biological organisation. Whilst such diversity makes for a fascinating area of research, it makes the challenge of writing a general evolution textbook a daunting one. In the ten years since it first appeared, *Evolution* has attempted to rise to this challenge. Ten years on, we have a third edition, so how has Evolution evolved?

Users of the previous editions will find no great surprises. In fact, on the surface little has changed. The book is based around the same tried and trusted sections: Introduction; Evolutionary Genetics; Adaptation and Natural selection; Evolution and Diversity; and Macroevolution. The content of the book is also much as you would expect, with large sections devoted to population genetics, species and speciation. Indeed, this is very much an evolution textbook in the traditional mould with no real attempt to present the subject in a novel or unexpected way. That said, the traditional mould is filled rather well. The writing style is clear and straightforward and the text is liberally illustrated with figures. An improvement on previous editions is the inclusion of margin annotations, highlighting the main point being made in each section. Some may feel this goes too far towards the spoon-feeding of undergraduates, or smacks of 'soundbite science'. I think they will be invaluable in helping students navigate the text and digest the, occasionally, complex material.

Any book attempting to encompass the breadth of evolution will face the significant challenge of balancing generality and detail. Too much detail, and there is a danger of overwhelming the student, but too little and the text becomes superficial and will soon be outgrown. *Evolution* treads this line reasonably well, helped in part by the use of supplementary boxes to elaborate on the main text. Boxes on subjects such as the coalescent, and, genetic loads and Kimura's original case for the neutral theory provide detail for advanced readers without the main text becoming too bulky. This idea is extended to a new series of boxes dealing with applications and issues in evolutionary biology such as the ethics of human cloning and the effect of vaccines and the virulence of human diseases. These 'current topics' boxes will encourage students to think about Evolution as an important and relevant science, rather than a dry academic exercise involving finches and fossils.

The CD ROM from the 2nd edition is replaced by a web site containing resources to complement the book. Here we find virtual experiments to examine, among other things, the advantages of sex, video clips of famous biologists explaining aspects of evolution and also reprints of classic evolution texts. The site also holds downloadable versions of the figures from the book, which will be a welcome aid to busy lecturers.

Of course, it would be a sad indictment of our field if it has not moved on in the seven years since the last edition was published. Fortunately this is not the case, and Ridley has worked hard to update the book in the light of new research. In some cases this simply involves updating examples, but in others whole sections and chapters have been rewritten and rearranged. For example, the chapter discussing sexual selection now includes a new section outlining the possibility of sexual conflict, a field that has risen in prominence in this time. Similarly, the increasing use of sequence data to test evolutionary theories is also covered in several places.

Two new chapters, Evolutionary Genomics (which despite its similarity in name to the Genome Evolution chapter in the second edition, bares little resemblance) and Evolutionary Developmental Biology, reflect the unprecedented advances that have been made in these areas. Unfortunately, even amongst professional biologists these fields can appear somewhat amorphous and difficult to pin down, and these chapters reflect this, reading more as a series of linked examples rather than clear overviews. In fairness, Ridley admits as much at the end of the Evo Devo chapter, where he states his aim, 'to illustrate the promise – and the interest – of the two fields'. From a marketing point of view, the inclusion of these

chapters makes complete sense, but I wonder if this material would have been better integrated into existing chapters, rather than as stand alone units.

I was also disappointed to find that despite being told on the cover that '… scores of new applied plant and animal examples make this edition even more accessible and engaging', the updating did not extend to microbes. My own, admittedly biased, view is that microbial systems play an increasingly important role in the study of evolution. Indeed, such systems provide some of the most compelling examples of adaptation, co-evolution and diversification, but only find a single brief mention in this book. Many of my students have an inherent view that interesting science can only really be done with organisms possessing feathers or fur, and it is unfortunate to find this view apparently reinforced by this book.

So has *Evolution* evolved? In essence, this is fundamentally the same beast. The 3rd edition is largely a modification of the previous editions rather than a complete overhaul. This has many advantages, not least of which is the fact that lecturers who have based courses around previous editions will have little problem moving to the new edition. Whilst the structure and content of the book may not break new ground, this book certainly provides a good solid and up to date foundation to the subject of Evolution, and one that I think students will find easy to use.

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George Beadle, An Uncommon Farmer: The Emergence of Genetics in the 20th Century. P. BERG and M. SINGER. Cold Spring Harbor Laboratory Press. 2003. 383 pages. ISBN 0 87969 688 5. Price £25.00 (hardback).

George Beadle was a central figure in twentieth-century biology, whose work with Edward Tatum on the 'one gene-one enzyme' hypothesis was crucial for the transition from classical to molecular genetics. This book, by the eminent American geneticists Paul Berg and Maxine Singer, uses Beadle's remarkable career to portray the history of twentieth-century genetics up to the rise of modern molecular genetics. In their preface, they sadly, but probably accurately, point out that most contemporary researchers and students of genetics will be unable to name many of the figures responsible for even the most important discoveries of this period.

Their account is, as far as I can tell, scrupulously accurate, with careful accounts of basic principles for the benefit of readers not trained in genetics. As well as a wealth of information about genetics, they provide a very detailed account of Beadle's life, starting with his family background as the son of a farmer in the small town of Wahoo, Nebraska at the beginning of the last century. Beadle was encouraged by a high school science teacher, Bess McDonald, to attend the College of Agriculture at the University of Nebraska, in opposition to his father's wishes. This provided him with the springboard for his future career, as his exceptional abilities were quickly recognised by his professor, Franklin Keim, a former student of the maize geneticist Rollins Emerson, who was by then at Cornell. Ironically, Keim sent Beadle to Cornell to study ecology, but Beadle quickly realised that his interests lay in genetics, as a result of attending meetings of Emerson's discussion group, the Synapsis Club. This was a period of intensive activity in maize genetics under Emerson's leadership, and the group contained Harriet Creighton, Barbara McClintock and Marcus Rhoades, as well as Beadle.

Beadle made some important contributions to maize genetics as a graduate student, including the first account of what is now called a meiotic mutant, and then moved to Caltech as a postdoc, ultimately working on *Drosophila* with Sturtevant. Here, he discovered the 'centromere effect' on crossing over, and carried out the remarkable series of experiments on the effect of inversions on crossing over that resulted in his 1936 paper with Sturtevant, one of the most beautiful studies in late classical genetics, all too briefly described here. The transition to non-classical genetics came with his collaboration with Boris Ephrussi on the nature of the pathway of eye-pigment synthesis in *Drosophila*, in which they famously used transplanted imaginal discs to show that the products of the wild-type alleles of the genes *v* and *cn* act in sequence to control the production of the brown pigment of the fly's eye. But the biochemistry of *Drosophila* turned out to be frustratingly difficult, and the product of the reaction controlled by *v* gene was in the end identified as kynurenine by Adolf Butenandt, the German chemist, in 1939.

Little new of any real value could be obtained by this approach, as Beadle came to realise. His fundamental insight, that led to the breakthrough which won him and Tatum their Nobel Prize, was to see that 'Instead of looking for reactions controlled by known genes, why not look for genes that control already known chemical reactions, and thus make the chemistry easier' (p. 135). The rest is history: he and Tatum got to work with *Neurospora*, and quickly developed methods for isolating mutations with defects in specific metabolic pathways. This is, of course, the foundation for all work in which mutants are used to analyse biochemical, cellular and developmental mechanisms, and so can be viewed as the underpinning of the whole of modern molecular and developmental

genetics. Initially, though, it was chiefly important for providing the experimental evidence for the one gene-one enzyme concept, which ultimately resulted in the concept of the genetic code. Berg and Singer give a detailed account of how difficult it was for this idea to become widely accepted, with particularly strong criticisms coming from Max Delbrück and Joshua Lederberg (Lederberg later graciously admitted that he had been quite wrong).

In 1945, after the main experimental work on *Neurospora* supporting the one gene-one enzyme hypothesis had been completed, Beadle moved from Stanford to Caltech, as chairman of the biology division. The rest of his career, until his formal retirement, was as an extremely successful academic administrator, not a researcher, first at Caltech and then as President of the University of Chicago (from 1961 to 1968). While Beadle was an unassuming and private person, whose main interest in life outside science seems to have been gardening, he was clearly an exceptionally shrewd judge of people's abilities and personalities. Having spent a good part of my career at Chicago, I can testify that his influence on the development of the university was still deeply appreciated many years after he retired as President. His term at Caltech led to its key role in the development of molecular biology, with four Nobel prizes going to scientists whom he recruited.

Unusually for a senior administrator, he returned to research on retirement, and went back to his first organism, maize. A photograph of Beadle in his maize plot on campus used to adorn the student coffee shop next to the Zoology building in Chicago. His intensive genetic studies of crosses between teosinte and maize provided compelling evidence that teosinte, a wild maize relative that lives in Central America and Mexico, is the ancestor of maize. This is now more or less taken for granted, but for many years Paul Mangelsdorf had convinced most interested parties that the true ancestor was a cross between some unknown ancestor of maize and *Tripsacum*. By choosing a teosinte-like maize variety and a maize-like teosinte variety, Beadle was able to show that a relatively small number of major genes control the basic morphological differences between the two 'species'. The molecular genetics of these differences is now a thriving field of research. Sadly, Beadle developed symptoms of Alzheimer's disease in his late 70s, and was forced to move to a retirement community in Southern California in 1982, where he died in 1988.

Much of the information about the development of science administration in the US in the 40's and 50's is of considerable general interest. I was fascinated to learn that, at one point in the McCarthy period of anti-Communist hysteria, the NIH attempted to withdraw grants from politically suspect scientists. While George Beadle was no left-winger, he and other faculty members courageously persuaded Caltech to threaten to return its NIH grants, causing the NIH to back down. He also spoke out against loyalty oaths and other attempts at political intimidation. In the present era of anxiety, with repressive 'Patriot Acts' being enacted by right-wing US political leaders, not to mention the activities of members of our own government, this is a important lesson on how to behave under pressure from the authorities.

This is very much a book for geneticists, despite the authors' efforts to explain the science to the non-specialist. I hope that it will be read and enjoyed by the new generation of geneticists, since there are now few people left who had close contacts with the eminent figures of early twentieth century genetics to whom we owe so much.

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Vertebrate Sex Chromosomes. Edited by N. TAKAGI. S. Karger AG. 2003. 352 pages. ISBN 3 8055 7637 4. Price $138.25 (hardback).

This volume is a special issue of the journal Cytogenetics and Genome Research which has been made into a book. It is likely to provide a valuable source of information for those working on vertebrate sex chromosomes. It is unusual to find a scholarly work covering such a range of information on sex chromosomes of the various vertebrate classes. Commonly, reviews are confined to mammalian sex chromosomes, which are the best understood among vertebrates. The book is divided into five sections dealing with: X-chromosome inactivation, evolution of sex chromosomes, development and sex determination, X-linked diseases, and sex chromosome organisation. Within each section the papers constitute a mixture of reviews and of reports of new work.

The section on X-chromosome inactivation is the longest and includes several valuable reviews. These range from those giving history of the early work in the field (by Migeon), including details of studies of the 1970s and 1980s on CpG methylation by Riggs and by Monk, to one on the latest work on antisense RNAs by Ogata and Lee. Other reviews deal with the personal specialities of the authors, including those on escape from inactivation, and on comparison of human and mouse. In other papers a range of new work is discussed, covering various aspects of the initiation of X-inactivation, including histone modifications and the role of antisense RNA, among other things. There is also a paper on X-chromosome inactivation and elimination in bandicoot marsupials.

The section on evolution of sex chromosomes includes papers on fish and amphibia as well as birds and mammals. It begins with a review of evolution of sex chromosomes in vertebrates which provides a valuable introduction to the section. This and another paper on birds provide strong evidence that heteromorphic sex chromosomes of mammals and birds have evolved independently and are not homologous. This and the paper of Nanda *et al.* provide evidence that the *Dmrt1* gene may be involved in sex determination in birds. Graves *et al.*, discussing the human X, report that it has an atypical gene content, being rich in genes for sex and reproduction, cognition and general control mechanisms.

The section on development and sex determination includes a review by Hemberger on the role of the X chromosome in mammalian extraembryonic development which provide a very useful compilation of recent work. Other papers in this section discuss the role of the X chromosome in ovarian function in mammals, and the function of the Z and W chromosomes in birds. Burgoyne *et al.* show that growth retardation in $X^{P}O$ mice is due to a non-pseudoautosomal gene on the X.

There are a few papers in the volume that appear somewhat out of place, as can happen with special issues. One of these is a paper on X-linked *Zic3* gene in mammals, and others discuss some human X-linked disease genes. These may not get the audience they deserve.

Other papers in the section on X-linked diseases fit well in the volume, particularly those dealing with X-linked mental retardation, and fragile X mental retardation, as well as ring X Turner females.

The last section deals with sex chromosome organisation and includes papers on birds, marsupials and amphibia, as well as rodents. It provides a useful picture of the wide-range of sex chromosomes in vertebrates.

This is a book mainly for those working in the field of vertebrate sex chromosomes, who will find it a mine of information. However, in view of the number and range of review papers it will also be valuable for those who wish to extend their range of knowledge. It should have a wide readership.

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