

obvious boundaries. The whole world is criss-crossed with causal arrows joining genes to phenotypic effects, far and near.... But the individual body, so familiar to us on our planet, did not have to exist. The only kind of entity that has to exist in order for life to arise, anywhere in the universe, is the immortal replicator.

After reading this somewhat mystical passage, you may feel, as I do, that you *don't* want to read the enormous extension of this chapter which you can expect to find in the 300 pages of 'The Extended Phenotype'.

To sum up my view of 'The Selfish Gene' (revised), while the book contains many interesting behaviour case histories, some of which are good enough to help push the Dawkins' thesis along but not to prove it or provide critical data, the author is so fond of emotive terms and phrases such as the 'ruthless selfishness' of successful genes, genes 'ganging up in the primeval soup', 'survival vehicles', 'lumbering robots' and so on, and is so quick to fit any example into his particular selfish-gene straightjacket, that I keep on thinking I am reading an advertisement by Saatchi & Saatchi, who are also very persuasive.

My selfish genes evidently differ from those of Dawkins, or I would find myself forced to recommend his book. It certainly contains much attractive material for reaching out to numerous phenotypes via television: nevertheless, I have to remind the reader that (to use the author's own term) it was written by a "lumbering robot".

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*Evolution and Animal Breeding: Reviews on Molecular and Quantitative Approaches in Honour of Alan Robertson.* Edited by WILLIAM G. HILL and TRUDY F. C. MACKAY. Wallingford, Oxon, UK: C.A.B. International. 1989. 313 pages. Cloth £45.00. ISBN 0 85198 639 0.

For many years the Institute of Animal Genetics at Edinburgh has been a mecca for visitors with an interest in quantitative genetics. Of particular influence was the institution of the coffee hour in Alan Robertson's room where problems arising from the interaction of animal breeding, quantitative genetics and evolution were discussed, and which is remembered in this volume as 'paradise lost' by Joe Felsenstein and as 'having an aura similar to that of the Columbia University Fly Room' by Dick Frankham. Of course, Alan Robertson was also highly influential in more orthodox ways, through his characteristically lucid papers, through those of his students now scattered through the world, and through his advice to animal breeders. The volume under review is a series of essays by his students and collaborators intended as a festschrift in his honour; sadly, Alan died just before its publication after a prolonged period of deteriorating health.

The book is divided into four sections, reflecting the breadth of Alan Robertson's scientific interests in population genetics, quantitative genetics, and the application of quantitative genetic and molecular techniques to animal breeding. Each section begins with a chapter reviewing Alan's own contributions in the field, followed by a series of minireviews covering recent developments in subjects in which he was interested. The format works very well, making a valuable and fascinating survey, though I suspect that many readers with narrower interests will wish to concentrate either on the evolutionary topics in the first half or on the animal breeding topics in the second half of the book.

The first section opens with a chapter by Felsenstein reviewing Alan Robertson's work on population genetics. He argues that it derives its strength from its origin from practical concerns in animal breeding, eschewing unnecessary regard for mathematical rigour; there is a lesson here. Many of the following reviews concern aspects of molecular evolution: neutral theory and possible alternatives (Kimura, Langley), evolution at 'silent' sites (Sharp), DNA sequence polymorphisms (Lewontin), restriction map analysis (Leigh-Brown), transposable elements (Charlesworth), multigene families (Ohta). Other reviews are on disequilibrium coefficients (Weir and Cockerham), phenotypic models of evolution (Maynard Smith) and population structure (Barker).

In the second section Frankham reviews Alan's contributions to quantitative genetics, the field on which he has probably had most impact. This is a valuable and balanced account of both his theoretical and experimental work, and of the relation between the two, and of his influence on colleagues and students. The reviews discuss the measurement of fitness (Crow, Sved), mutation and its significance for quantitative genetic variation (Hill, Mackay), selection experiments (Falconer, López-Fanjul), selection for growth (McCarthy & Roberts) and the identification of individual genes for metric traits (Mayo, Piper & Shrimpton).

In introducing the third section on quantitative approaches to animal breeding, King stresses that theory and application were closely linked in Alan Robertson's work, as they are in many areas of applied scientific work. The reviews cover the statistical estimation of genetic parameters (Meyer, Thompson, McGuirk, Dempfle) and the design of animal breeding programmes (James, Webb), including the impact of artificial insemination and embryo transfer (Nicholas). This leads on naturally to the fourth section on the application of genetic manipulation to livestock improvement. In the introductory chapter, Roger Land (who sadly died soon after completing it) discusses Alan Robertson's maxim that catching the right genes to transfer would be more difficult than the technical problems of transfer and would require detailed understanding of the

physiology and biochemistry of gene action. Four reviews pursue this theme (Kacser, Bulfield, McKay, Smith & McMillan), while the last two reviews discuss the genetic basis and technology of transgenics (Church, Bishop & Al-Shawi).

The distinction of the caste of authors is obvious. The standard of their contributions is high, and it is clear that they have taken trouble to write well-constructed reviews because of their high regard for Alan Robertson. Anyone interested in evolution and/or animal breeding will find this book both a pleasure and a stimulus to read.

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*Process and Pattern in Evolution.* By CHARLOTTE J. AVERS. Oxford University Press. 1989. 590 pages £28.00. ISBN 0 19 404174 7.

This is one of a new kind of evolution text, aiming to integrate traditional evolutionary material with a full treatment of the mass of modern experimental results relating to processes of molecular evolution. One must admire Charlotte Avers' courage in tackling single-handed almost all topics relevant to modern evolutionary biology, from cosmology and creationism through cladistics, continental drift and finally to cultural evolution. Her command of the relevant literature is impressive and the writing generally clear. However, such an ambitious book deserves critical assessment: it proves to be somewhat flawed.

In the area of molecular and cellular biology (which is not the field of the reviewer) Avers is successful in presenting a clear account of exciting and complex developments which – during the last couple of decades – have transformed our understanding of the way in which evolution has operated at this level. There is excellent coverage, for instance, of the origin and evolution of primeval life, of the endosymbiotic and other theories of the origin of eukaryotes, and of the five-kingdom system of classification. Similarly, the chapter on phylogenetic analysis, which discusses methods based on morphological, protein and DNA studies, is very welcome and generally a model of clarity (although one may be forgiven a double-take at the statement on p. 384 that 'Even if it is constant, the rate of {molecular} change may vary at different times in a group's history'). Here and throughout the book there is a welcome willingness to expose students to controversy and to alternative hypotheses.

A decision faced by all writers of evolution texts is to decide how extensively (if at all) to treat 'the march of life': Should students be presented with information as to which group succeeded which, and when, and (possibly) why? Avers gives only the briefest of sketches, covering the history of life in the Phanerozoic in about 20 pages. In contrast to the thumbnail coverage in this general section, there are over 80 pages on the evolution of the primates and the

hominines. Emphasis on humans in general textbooks is sometimes criticized on the grounds that the biological principles are better explained using other examples. I sympathize with Avers' implicit view that biology students should have the opportunity to gain an understanding of what is – and what is not – known about human evolution, especially since both molecular and paleontological data can now be brought to bear. Avers' thorough treatment will undoubtedly be useful, but it is perhaps unduly long, and the writing is in places noticeably less polished than in other parts of the book. The author also occasionally gets bogged down in the complexities of primate taxonomy, for instance in the discussion of sister clades on p. 487.

Unfortunately, the chapter on natural selection and adaptation, which should perhaps still rank as the core material for a general evolution text, is the weakest in this one. It gets off to a bad start with a diagram (on p. 213) which will strike a chord with experimental microbiologists but which, in its implication of all-or-none success and failure, is liable to mislead students as to the way in which selection normally works in natural populations.

I may not be alone in finding unfortunate the extensive use of the word 'strategy' in such contexts as (p. 227): 'Balancing selection, or heterozygote advantage, is a strategy by which stable polymorphism is maintained in populations.' Those who try to ensure that students view with caution arguments appealing to group selection will also be uneasy at the reference (p. 231) to 'adaptive diversity in populations' and at what is apparently the only discussion of the evolution of reproductive rates (pp. 463–4): 'The relatively few young born to mammals, compared with the number of eggs produced by reptiles, are an economical reproductive measure made possible by a greatly reduced mortality rate due to predators.' It is perhaps significant that the name of G. C. Williams seems to be absent from the book.

A surprising feature is the deliberate avoidance of the concept of quantitative inheritance. The section (pp. 221–226) that discusses stabilizing, directional and disruptive selection entirely in terms of a single locus, but with accompanying figures with normal curves showing frequency distributions of phenotypes, makes very strange reading. In the same chapter, the explanation of Batesian mimicry (p. 224) primarily as an example of diversifying selection is inadequate and confusing. A similar failure to give enough information occurs elsewhere. For instance, treatment of the Darwin finches (pp. 295–7) without bringing out the crucial fact that many species coexist on the same island, must be frustrating to the curious student.

This omission is actually only one aspect of a striking lack of ecological perspective in the book: Avers seems to draw the line at ecology. Neither Robert MacArthur nor the author of 'Evolutionary Ecology' rates a mention, none of the Grants' recent