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Phenotypic Evolution — A Reaction Norm Perspective. Carl D. Schlichting and Massimo Pigiucci. Sinauer Associates Inc, Sunderland, Massachusetts. 1998. Pp. 387. Price £29.95, paperback. ISBN 0 87893 799 4.

Every biologist interested in evolutionary biology should read this book. In a highly readable manner Schlichting and Pigliucci outline the present status of thinking on the importance of reaction norms in phenotypic evolution. The book has one central purpose, to propose and defend the proposition that to understand phenotypic evolution we must take into account phenotypic plasticity, not simply as an interesting peripheral phenomenon but as an integral part of the evolutionary process. Although I am already strongly biassed in this direction, I think that the authors produce an extremely strong case which should encourage more research in this fast-developing area. One of the great strengths of this book is that it presents an historical perspective, an assessment of the present state of thinking, and, the authors' own opinions on where future research should be directed.

The first two chapters present an overview of approaches and an historical review of the development of ideas. These two chapters are a particular delight to read and show how some evolutionary biologists, such as Waddington, tended to be marginalized during the neo-Darwinian synthesis, but have lately become rehabilitated. Thus these chapters not only present the historical view but give insight into the sociology of science. Chapter 3 outlines the basic concepts of reaction norms and phenotypic plasticity. Schlichting and Pigliucci divide the study of reaction norms into two avenues, the statistical description via quantitative genetics and the mechanistic analysis through manipulative experiments. Chapters 3 to 9 present the analysis of phenotypic evolution using the reaction norm perspective as judged from these two methods of study. Chapter 10 presents an overall summary and 14 potential research projects, which should be of particular value for graduate students in this field.

In their attempt to encompass the entire field of phenotypic evolution Schlichting and Pigliucci have on occasion included areas that I did not find fitted well into their perspective. A particular example is their chapter on allometry: as a discussion of allometry the chapter is interesting and informative but in their last section entitled 'Plasticity of character correlations' they assert that correlation coefficients are themselves allometric coefficients, which to me seems to be stretching the definition of allometry. This said, the section is interesting but should be viewed simply as the evolution of suites of correlations.

This book is provocative and will likely promote debate, which is a sign of success. To give an example of where the book provoked me: Schlichting and Pigliucci seem to view quantitative genetic analysis as a temporary necessary evil that will be eliminated once we have a better set of mechanistic models. To illustrate the inadequacy of the quantitative genetic approach they present a model that purportedly demonstrates that different phenotypic outcomes are possible even with identical correlations and phenotypic optima (p. 81). The model is a single locus, two-allele one, which is hardly representative of quantitative genetics. To give an analogy; it is like using an ostrich as a model for the analysis of flight in birds. Certainly ostriches are birds, and have wings, but they are not truly representative of the majority of birds. Pigliucci's model does demonstrate that it is possible to construct models that have aberrant behaviour, but it does not demonstrate that this behaviour is typical of quantitative genetic models. Because of the limited character states available in a single-locus model it is not surprising to find that it is limited in its evolutionary trajectories.

There are a number of other assertions with which I disagree but this does not detract from the enormous value of this book. It has brought together very disparate sets of data under a common umbrella and thus provides a unifying theme in evolutionary biology, surely one of our major goals.

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Sperm Competition and Sexual Selection. T. R. Birkhead and A. P. Møller (eds). Academic Press, London. 1998. Pp. 826. Price £39.95, paperback. ISBN 0 12 100543 7.

Significant advances in evolutionary biology are often associated with simple but elegant ideas. Parker's (1970) suggestion that competition for fertilizations between the sperm of different males could be a powerful evolutionary selection pressure is a clear illustration of this point. Nearly 30 years on, the study of sperm competition and its evolutionary consequences is an extraordinarily diverse and still rapidly expanding field. A major success of Birkhead & Møller's book *Sperm Competition and*

Sexual Selection is to have captured something of the excitement being generated by advances in understanding the evolutionary significance of sperm competition.

A general overview of progress in this field has been long awaited. The most recent previous summary was Smith's (1984) excellent *Sperm Competition and the Evolution of Animal Mating Systems*, which emerged from a largely transitional phase in sperm competition research, when ideas generated from insect studies were being applied to more diverse taxa. If a successor to Smith has been a long time coming, it is perhaps testament to the enormous undertaking required to produce a comparable overview of the field today. Several chapters in Birkhead & Møller's book could be expanded to fill volumes in their own right, including those on sperm competition theory (Parker), sperm competition and sexual selection (Møller), and sperm competition in insects (Simmons & Siva-Jothy); indeed some already have (female roles in sperm competition by Eberhard; sperm competition in birds by Birkhead). To have condensed this information into a single cohesive text is undoubtedly a major achievement.

The book is divided into two sections; the first covering general themes and the second devoted to taxonomic treatments. This division is both a strength and to some extent a weakness of the book. Although there is much to be said for adopting both perspectives, the volume of advances covered by taxonomic group has inevitably reduced available space for more general treatments which the field is now mature enough to support. Birkhead & Møller's closing chapter is particularly valuable in this respect, providing a general overview of key problems and directions for future research. But if the diversity of taxa covered by chapters in the second half of the book limits space for more general treatments, it also leaves little room for doubt of the widespread evolutionary significance of sperm competition. Taxa covered include groups as diverse as flowering plants (Delph & Havens), external fertilisers (Levitan), simultaneous hermaphrodites (Michiels), molluscs (Baur), fishes (Petersen & Warner), amphibians (Halliday), birds (Birkhead) and eutherian mammals (Gomendio, Harcourt & Roldan). Most chapters are also readily accessible to those previously unfamiliar with these various taxonomic groups. My own favourites in this regard are contributions on spiders and other arachnids (Elgar), reptiles (Olsson & Madsen), and the first account of sperm competition in marsupials and monotremes (Taggart, Breed, Temple-Smith, Purvis & Shimmin).

I would recommend Birkhead & Møller's book as an essential reference text for anyone with more than a passing interest in sexual selection or reproduction. Early growth in this field has established sperm competition as a ubiquitous and highly influential evolutionary selective force. The challenge now underway, signified by the arrival of Birkhead & Møller's book, is to assimilate and integrate data and ideas from widely diverse disciplines and taxa. Although much still remains to be discovered, I suspect it will be a long time before anyone attempts a similarly comprehensive and detailed overview of sperm competition research.

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