so it even swayed the reluctant Delbrück. This was no small achievement, to be put alongside the simplicity and substantial benefit to molecular biology of caesium chloride gradients for ultracentrifugation.

Holmes suggests that the growing knowledge of the immense complexity of the mechanism required for DNA duplication may be starting to crowd out mention of the Meselson–Stahl experiment. When Watson and Crick suggested in 1953 that DNA replication might occur without the aid of a special enzyme, little did they foresee the complexity of the process, involving as it does not only DNA polymerase, but also the DNA helicases and primases, the proofreading exonuclease, the sliding DNA clamp and the Okasaki fragments — a multienzyme system that performs its task with remarkable fidelity. Nor, perhaps, did they expect the unwinding problem to resurface again to challenge the double helix as late as the 1970s.

This book joins a growing library of outstanding historical studies of modern experimental biology that includes Hans-Jörg Rheinberger's study of protein synthesis in the cell-free system, *Toward a History of Epistemic Things* (Stanford University Press, 1997) and Nicolas Rasmussen's analysis of the adaptation of the electron microscope for the study of the cell, *Picture Control* (Stanford University Press, 1999). Their scholarship is impeccable and their analyses perceptive and revealing, not just of an age fast receding into the past, but of what Bruno Latour called "science in the making". ■

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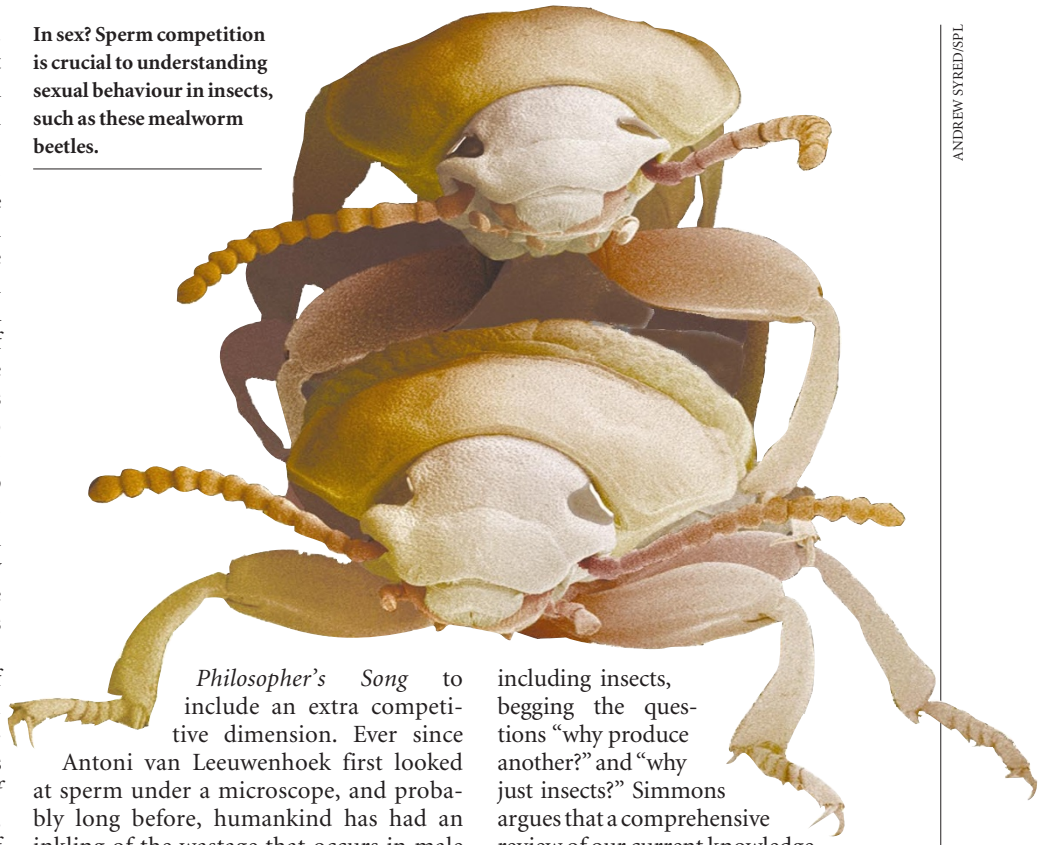
When ejaculates collide…

Sperm Competition and its Evolutionary Consequences in the Insects
by Leigh W. Simmons
Princeton University Press: 2001. 434 pp. £24.95 (pbk)

Michael T. Siva-Jothy

A million million spermatozoa
All of them alive
Out of their cataclysm but one poor Noah
Dare hope to survive.
And among that billion minus one
Might have chanced to be
Shakespeare, another Newton, a new Donne —
But that One was Me.

If Aldous Huxley had lived another seven years he might have amended his *Fifth Philosopher's Song* to include an extra competitive dimension. Ever since Antoni van Leeuwenhoek first looked at sperm under a microscope, and probably long before, humankind has had an inkling of the wastage that occurs in male gametes.



ANDREW SYRED/SPL

In sex? Sperm competition is crucial to understanding sexual behaviour in insects, such as these mealworm beetles.

But it was not until 1970 that a formal theoretical framework, and some elegant empirical support for it, emerged. Geoff Parker realized that when two or more males mated with the same female, selection would favour the evolution of male traits that gave one sperm-owner a paternity advantage. This elegant and, with the benefit of hindsight, obvious concept opened the floodgates to a sea of ideas and explanations. Suddenly post-copulatory guarding behaviour made sense, we began to understand the causal basis of variation in hitherto ignored aspects of reproductive behaviour, and we had an elegant explanation for a million million spermatozoa.

Parker's theory had a profound effect on the fledgling field of behavioural ecology — he laid a cornerstone that defined it and illustrated the value of combining modelling, empiricism and a productive disregard for disciplinary boundaries to address questions about the how and why of evolution. Parker used insects as his model system: they were particularly susceptible to this form of selection and were amenable to the combined physiological, anatomical and behavioural studies that revealed the nature of the adaptations that resulted.

Having served his intellectual apprenticeship in Parker's laboratory and played a significant part in directing the field, Leigh Simmons is better qualified than most to define the current state of sperm competition. However, there are already three books that examine sperm competition in a range of taxa, including insects, begging the questions "why produce another?" and "why just insects?" Simmons argues that a comprehensive review of our current knowledge of the phenomenon in insects provides the broadest platform on which to base any understanding of sperm competition. To make this point he picks the field apart, paper by paper, and skilfully reassembles it around the important conceptual issues, thereby bringing sperm competition, rather than insect behavioural ecology, into crisp focus.

Each chapter starts, when appropriate, with the theoretical basis for its sub-theme, followed by a well-structured review of the empirical work. For example, the chapter on behavioural adaptations to avoid sperm competition begins with a very readable distillate of the theory and modelling of mate-guarding. (Similar summaries of the critical modelling and theory preface other chapters and are a real bonus.) The chapter then reviews the substantial literature on mate-guarding and alternative hypotheses for this behaviour, before moving on to the more contentious subject of male mate choice. By leaving the open-ended subjects until the end of their chapters, Simmons contextualizes the new areas and so guides the reader to paths that have potential for future work.

This book is an excellent summary of a recent, important and relatively large addition to our understanding of evolution and its consequences. It is an essential read for anyone interested in the reproductive determinants of fitness. ■

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