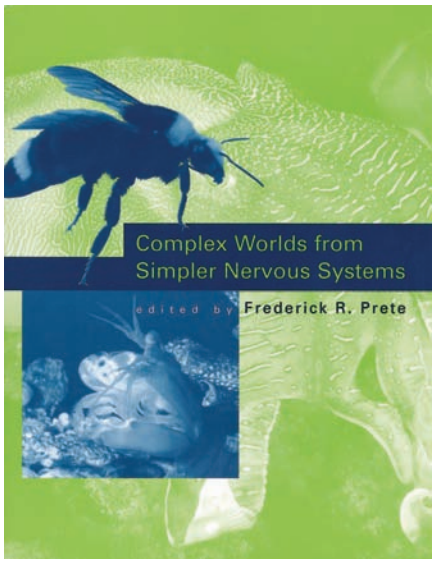
Book Review

DON'T UNDERESTIMATE THE LITTLE ONES!



Complex Worlds from Simpler Nervous Systems

Edited by Frederick R. Prete

A Bradford Book, The MIT Press (2004)
464pp. ISBN 0-262-66174-8
$40.00/£25.95 (pbk)

At a time when neuroscience – again – searches for the seat of the soul, now fashionably called consciousness, it needs reminding that we are still unable to explain, in terms of signal and information processing, how a bee works, or an octopus. *Complex Worlds from Simpler Nervous Systems* sets out to do just that: to document, with a series of well-told stories, how versatile, robust, flexible and complex 'lowly' animals (i.e. insects, spiders, crustaceans, cephalopods and amphibians) are, when considered as information processing entities. The stories are told from different perspectives, either trying to gain insight into the perceptual world of animals by analysing their seemingly 'cognitive' behaviour and the natural conditions in which they have to operate, or by studying the stunning arrays of sophisticated sensors they have evolved to cope with their diverse 'information habitats', which we are just beginning to be able to describe.

Once upon a time, when neurophysiology was young and optimistic, it was thought by many that 'simpler', smaller nervous systems would be easier to understand than larger ones. What we have come to learn is that neurons in small brains are adaptive, finely tuned processing and feature-extracting modules. Furthermore, networks with apparently simple tasks, like those operating the gastric mill, grinding surfaces in lobsters' stomachs that rhythmically masticate their food, can reconfigure themselves under the influence of neuromodulators, thus adapting to subtle changes in the task. We now know a lot about sensory systems, neural function and the behaviour of animals, but we are still largely ignorant about the sensory worlds they have evolved to process and the structure of the information processing tasks they face.

In trying to understand the design of sensory systems and the tricks of information processing in nervous systems, we have to understand the 'Umwelt' of animals, that is, the world in which they live, from their perspective. This is the point *Complex Worlds from Simpler Nervous Systems* aims to make from a neuroethological and comparative perspective. By reviewing the finely tuned sensory systems and some of the nifty neural processing involved in the rich, clever and adaptive behaviour of insects, spiders, crustaceans, cephalopods and amphibians, the contributions in this book show that the ecology of information processing for even 'lowly' animals is much more complex than some may have previously thought. Most of the book's chapters are excellent, readable and informative reviews in their own right, which contribute to this central message in different ways. Some emphasise the astonishing behavioural flexibility of animals, others their intricate sensory and neural specializations and how these may be related to environments and tasks.

The book opens with an elegant foreword by M. F. Land (from whom I borrowed the title of this review) and is organized in three parts: *Creating Visual Worlds: Abstract Representations and Algorithms*, introduced by F. R. Prete, with four chapters on jumping spiders, honeybees, praying mantids and amphibians; *Enhancing the Visual Basics: Using Color and Polarization*, introduced by T. W. Cronin, with five chapters on bees, butterflies, crayfish, mantis shrimps and cephalopods, and *Out of Sight: Creating Extravisual Worlds*, introduced by M. H. van Staaden, with two chapters on mechanosensory integration and sound communication in insects. The book is thus quite dominated by work on vision and is unfortunately silent on the topic of yet another highly complex perceptual world, namely that of olfactory information processing. This said, I can imagine a wide

readership for the book, with some parts providing inspiration for prospective PhD students and other parts offering comprehensive reviews of the sensory worlds of particular animals for the expert reader. Many of the book's chapters are lavishly illustrated by 18 central colour plates.

Like most compiled volumes of multi-author writings, the book has an uneven texture. It contains wonderfully charming, honest and informative descriptions of the 'Umwelt' of animals and the information processing demands they face. Particularly gripping reads are D. P. Harland and R. R. Jackson on the 'Umwelt' of hunting jumping spiders, I. G. Gleadall and N. Shashar on the visual world of octopus and squid and C. Comer and V. Leung on predator avoidance in cockroaches and crickets. Furthermore, there are splendid, authoritative reviews of colour and polarization vision by L. Chittka and H. Wells for bees, K. Arikawa, M. Kinoshita and D. G. Stavenga for butterflies and T. W. Cronin and J. Marshall for mantis shrimps. These are complemented by a review of the 'cognitive' capacities of honeybees by S. Zhang and M. Srinivasan, a reminder by T. Hariyama that the information processing needs (and the sensory systems!) of animals change with the seasons and a lucid discussion of the sensory ecology and neuroethology of sound communication in bladder grasshoppers by M. H. van Staaden, H. Römer and V. C. K. Couldridge. This part of the book is as good as it gets.

But there are also several chapters in the book that would not have passed a critical referee. K. Kral and F. R. Prete on prey catching in the praying mantid and J.-P. Ewert on predator/prey discrimination in amphibians tend to get lost without a compass in the complex world of 'simpler' nervous systems. Their chapters contain much hand-waving and too many just-so stories, both with regards to 'visual worlds' and to neural processing design. In addition, it is unclear to me how one can review vision in the praying mantid without reference to S. Rossel's beautiful work on eye movements and binocular stereopsis in this insect and, even more distastefully, how one can attempt to discredit his work without citing it.

Yet I do recommend this book to lovers of neuroethological biodiversity, to those who study model systems and would like a glimpse of the world beyond *Drosophila*, zebra fish or rats, and to those who are intrigued – as I am – by the meaning of its title.

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