Literature

Stavenga, D. G. & Hardie, R. C. (eds.) 1989: Facets of Vision. — Springer-Verlag, Berlin, Heidelberg, New York. 454 pp. ISBN 3-540-50306-4. DM 280.

This beautiful book on compound eye vision is a sort of present-day incarnation of the German academic *Festschrift*, having originated as a symposium in honour of the 80th birthday of Hansjochem Autrum in 1987. Be it said at once that it has none of the dry and dusty qualities of the genre while retaining some of its best features — above all the broad authority of an impressive collection of leading specialists. It is also a well-written and tightly edited whole, avoiding the danger of disintegrating into a literary *Naturalienkabinett*. Add to that a very attractive appearance with excellent illustrations and printing, and you have a volume which is almost irresistible for anyone with any interest in how arthropods see.

"Facets of Vision" is really a complete textbook, covering everything from optics, over the photochemistry of visual pigments, phototransduction and neural integration, to visual behaviour. Throughout, there is also a gratifying sense of the continuity of ideas and their bearing on general problems of vision, as exemplified by the two introductory chapters on "Compound eyes and the world of vision research" by Timothy Goldsmith, and "Autrum's impact on compound eye research in insects" by Dietrich Burkhardt. This is appropriate for a volume commemorating not only Autrum's birthday but also the centennial of the seminal monograph "Die Physiologie der facettirten Augen von Krebsen und Insekten" (1891) by Sigmund Exner, an achievement which remained essentially unsurpassed until the 1960s.

The book is of course indispensable for students and researchers in compound eye vision. But it really deserves a much wider audience. This sophisticated field holds many lessons not only for visual scientists in general, but even for ecological and evolutionary biologists.

What above all fascinates a reader primarily focused on vertebrate vision is the versatility of biological solutions to the common problem of extracting information from the light in the environment. If compound eyes (and those of cephalopods) did not exist, we would be inclined to regard the vertebrate visual system as the only feasible way of organizing highly developed vision. Now we are faced with a radically alternative plan, which has obviously also passed the test of natural selection. This offers a fruitful field for studies of evolutionary choices under the dialectical tensions between physical and (emergent) biological constraints on the one hand, and biological "goals" set by different modes of life on the other. Given that any neural system has a limited capacity for handling information, excellence in one aspect of performance is always bought at the expense of performance in other respects. A blowfly escaping our swatter in the kitchen obviously sees much "faster" than we (thanks to differences already in the photoreceptors), but has much lower visual acuity (a compound eye allowing our foveal acuity would become impossibly large, about 1 m in diameter).

Moreover, the impressive variety of particular solutions among compound eyes offers a rich treasury for similar considerations of evolutionary "optimizations" at a level of finer taxonomical resolution. The externally accessible modular design, appreciated already by the classical 17th century microscopists, has made the compound eye a rewarding object for strict quantitative analysis. Modern inquiry has uncovered an amazing range of ingenious optico-anatomical solutions, summarized in a thought-provoking chapter on optics and evolution by Dan-Eric Nilsson. The transparency of the design has also helped the clarification of patterns of neural integration. As is evident from the last four chapters, for example that by Nicholas Strausfeld on neuroanatomical analysis and physiological correlates, there is already hope for complete accounts of the neural computations underlying some forms of behaviour.

As opposed to a true comparative approach, however, one often encounters a different type of expectations about the benefits of studying insect vision. These are based on the idea that the insect system is a useful model from which something can be directly inferred about the mechanisms of, e.g., human vision. It is of course excusable if medically oriented physiologists construe comparative physiology as the study of insignificant but experimentally accessible creatures with the sole purpose of providing some knowledge about the Crown of Creation. Unfortunately, even insect physiologists occasionally seem to build their hope for social acceptance on this claim, although in less fortunate cases it is rather like studying the flight of flies as a model for that of eagles. No doubt, arthropod research has often been ahead of vertebrate research even in areas related to general principles of vision (e.g. lateral inhibition, some noise problems, neural computation and correlates of behaviour). The problem, however, is that in all important particulars, the situation in vertebrates may be either fairly similar, somewhat different, or entirely different. Phototransduction, presented in a lucid chapter on *Limulus* ventral receptors by Alan Fein and Richard Payne, is a case in point. The molecular vocabulary in the horseshoe crab is similar to that in humans (being of considerable evolutionary antiquity), but it is put to quite "perverse" uses — from the vertebrate point of view.

Thus, the general lessons from a study of compound eye vision are probably to be learnt by contrast rather than by analogy. This exciting field offers an abundance of important insights for natural history in the broadest sense. Although "Facets of Vision" will find its primary audience among researchers and students focused on compound eye vision as such, it can be recommended without any reservation to any enlightened entomologist or visual scientist as an inspiring textbook and a standard reference for many years to come.

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