Finally, we turn to *Principles of Optics;* it is always a pleasure to praise this book, now in its fifth edition. Most of the earlier 'editions' were scarcely more than reprints, as was made clear in the prefaces. But in the fifth edition, much of the material on the optical properties of metals has been rewritten, where the original text was misleading. Although sympathising entirely with Professor Wolf's reluctance to tamper with the text piecemeal in an attempt to bring it all up to date, it would be particularly pleasing if he consented to incorporate into the sixth edition the new material recently published by his own group in the field of partial coherence and the radiometric quantities. Even so, it remains a near-definitive account of classical optics at a very reasonable price. It is included in this group of books on image processing since a thorough grasp of the chapters on image formation at least is indispensable for anyone seriously embarking on digital or optical processing.

How far has image processing got in practice? In some respects, the mathematics has outstripped the practical applications with the result that the same test images tend to recur repeatedly after undergoing a wide variety of treatments. Nevertheless, the volumes on digital methods may leave the misleading impression that theory and practice are at present far apart, for there is little mention of specific applications: X-ray tomography, for example, or three-dimensional reconstruction of electron micrographs. Despite this, the possibilities are very exciting: solution of the phase problem; extrapolation beyond the classical limit of resolution; the acceleration of picture processing using fast transforms other than the FFT; and many others. The second decade will undoubtedly witness as many innovations as the first, no less unpredictable. □

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Proprioception

J. W. S. Pringle

Structure and Function of Proprioceptors in the Invertebrates. Edited by P. J. Mill. Pp.xviii+686. (Chapman and Hall : London; Distributed in USA by Halsted Press; August 1976.) £19.50.

A BIOLOGIST considering whether to read (or purchase) a volume with multiple authorship does well to consider not only the field covered but also the standing of the contributors. The editor's tasks is like that of a building contractor: he cannot construct well without good materials. Of this book it can be said at the start that the authors are well chosen. They come from Australia, France, Germany and the USA as well as from the UK, and have all developed their insight into the subject by original contributions to it.

In 1938, I published what may have been the first paper on Proprioception in Arthropods. Now, 38 years later, 419 out of the volume's 686 pages deal exclusively with this Phylum, and as much is known about them as about vertebrate animals. The diversity of form and function is much greater. A definitive textbook on vertebrate proprioceptors has been written by one man; for invertebrates the task requires a contributory volume and an editor like this one, prepared to identify the most qualified contributors and to perform such integration as is possible.

The chosen definition of 'proprioceptors' is not Sherrington's—his task was easier because he was considering only the vertebrates; this volume covers all "sense organs capable of registering continously deformation and stresses in the body due to the animal's own movement or to its weight or to other external mechanical forces". So defined, the vertebrate semicircular canals, otoliths and lateral line would be proprioceptors, which may seem absurd. But such a wide definition is indeed necessary for invertebrates, and if this volume is nearly a textbook of invertebrate mechanoreception it is no less valuable as that.

Laverack's Chapter 1 is largely a structural review and well illustrates the diversity. In Chapter 2, Fields, in a review of all aspects of the physiology of the crustacean muscle receptor organ, includes a clear statement of the evidence for a causal relationship between the electrogenic sodium pump and adaptation of impulse frequency, the latest demonstration of the value of this preparation for basic sensory physiology. Our knowledge of the mode of action and behavioural utilisation of this organ is at least as complete as for the vertebrate muscle spindle. Bush follows this with an account of another preparation important to general physiology—the only sense organ known to operate without impulses.

In Chapter 4, Finlayson gives us a comprehensive review of the multiterminal neurone system of arthropods, the importance of which has only recently been fully appreciated. It seems to be responsible for the overall coordination of movement necessary in a primitively soft-bodied multisegmental animal and to provide the main feedbacks by which the intrinsic motor patterns are adjusted to a variable environment. But neither in locomotion nor in the specialised mouthpart and gut receptors (chapter 5 by Wales) is it posible yet to decide whether these multiterminal type II receptors and the chordotonal type I receptors (chapter 6 by Mill) serve a distinct or a complementary function in proprioception.

At the base of the decapod leg are two peculiar groups of internal chordotonal organs which neither cross a limb joint nor are attached to a muscle or apodeme. In chapter 7, Clarac considers the probable role of these organs in the autotomy reflex. The arthropod section of the volume ends with a long chapter by Wright on limb and wing receptors in insects, chelicerates and myriapods, a detailed description by Moulins of the ultrastructure of chordotonal organs and a valuable chapter by Macmillan on apodeme tension receptors. The diagram which this last author gives comparing vertebrate and arthropod proprioceptive systems will no doubt be much used by lecturers, but ought to be viewed with caution in the present state of our knowledge.

As Dorsett points out at the beginning of chapter 11, proprioception in many soft-bodied invertebrates is not the well-differentiated system found in vertebrates and arthropods possessing a rigid skeleton. Most of the locomotor activity of these animals is stereotyped and is pre-programmed in the central nervous system. Orientation to gravity by means of statocysts is, however, widespread and is included under the definition used for the volume; but proprioceptors *sensu stricto* have only been established in a few cases. Spatial equilibrium in arthropods (chapter 12 by Sandeman) needs separate treatment since the necessary information may be obtained, without a special sense organ, by monitoring the relative position of the parts of the body under linear and angular accelerations. Molluscs (chapter 13 by Budelmann) usually have statocysts.

The final chapters of the volume deal with the processing of proprioceptive information. Wells considers its role in learning; Mill and Price give the necessary theory of feedbacks; and Wiersman writes generally on various relevant topics. The editor's final brief contribution picks up some loose ends and highlights residual problems.

Altogether a most useful book, well produced and not unduly expensive. □

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