PHYSIOLOGY OF THE EYE

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To my fellow Academician
Professor Ljubiša Rakić

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PREFACE TO THE FIFTH EDITION

In writing this preface to the fifth edition of my *Physiology of the Eye* I am asserting the privilege of age by the indulgence in a little reminiscing. The first edition appeared some forty years ago, and was written at a time when I was teaching ocular physiology to budding ophthalmologists and orthoptists at Moorfields Hospital, and acting as examiner for the British College of Ophthalmic Opticians. The book was thus designed to be read by students in these three professional categories; in addition, of course, I hoped that students and teachers in physiology and experimental psychology would find it useful.

The first edition was, in my view, a fair presentation of the existing state of knowledge of the physiology of the eye, a field that involves several distinct disciplines, as revealed by the segregation of the book into four sections*. In making this presentation I endeavoured to be simple in my accounts so that any student with A-levels in the biological sciences would be able to follow it, but I trust that I never avoided treating the subjects in depth where there was depth; and, in looking over this first account and comparing it with the present edition, I cannot but admire the extraordinary increase in the depth of our knowledge that has resulted from the accretions of the successive decades.

Thus, the sensory electrophysiology of the visual system at the time of the first edition consisted of little more than the pioneering studies of Granit on the electroretinogram and the first single-unit studies on optic nerve fibres described by Hartline; the recording of electrical events in the actual vertebrate photoreceptor, and their interpretation, would have seemed visionary at the time. Cortical events consisted of little more than the plotting of visual fields through the analysis of the effects of lesions; and it was not until the third edition, which appeared in 1972, that I was able to begin the presentation of the studies on single units pioneered by Hubel and Wiesel. This presentation has expanded from a mere 20

pages in the third edition to some 80 pages in the fourth edition and 157 pages in the present volume.

In a similar way, the section covering the intraocular fluids, the cornea and crystalline lens, has expanded in keeping with the transformation of our knowledge from little more than vague speculations to sound theory, a transformation that has led to a real understanding of the physical bases for such clinical conditions as glaucoma, corneal opacification and vascularization, and cataract. In these last fields, covered by the general term 'Vegetative Physiology', my own researches on the eye were concentrated, so that their expansion, after I transferred my loyalties to the brain fluids in about 1953, has been a matter of peculiar satisfaction to me, and I like to think of myself and my younger colleagues at University College London, who continued these studies along lines that we had explored together, as pioneers in work that has led to such successful clinical applications.

In one field only, namely that of psychophysics, I find that I have not expanded my treatment in proportion to the large amount of experimental work that may largely be found described in the volumes of *Vision Research*. This limitation, imposed by the requirement to keep the book within the compass of a single volume, requires some apology in case I should appear to be undervaluing the contributions that this kind of experiment makes towards the understanding of higher visual functions. My excuse, then, is that Helmholtz's treatment of such visual functions as stereopsis, torsional eye movements, and the general interpretation of the visual image, remains as fundamental and as valid as it was when he published his *Physiologischen Optik*. It was this treatment that formed the basis of my first account in 1949; and, although I have added to it in the light of more modern psychophysical studies, such as those of Julesz on random-dot presentations, I have found little in the literature that has made me want to alter this first account in any fundamental way. A further reason, if not an excuse, is my own prejudice as a physiologist in favour of the direct approach; thus the validity of the Young-Helmholtz trichromatic theory, supported as it was by the psychophysical studies of Wright and Stiles, was only finally clinched by the absorptiometric and electrophysiological studies of single

* In the first three editions there was a fifth section on the Physiological Optics of the Eye. This was subsequently abandoned to make room for the rapidly expanding physiology.

photoreceptors described by Tomita, Hodgkin, Wald and Dartnall.

Finally, in the field of the control of the eye movements, once again the psychophysical approach that led to the development of models of motor control has been heavily supplemented by electrophysiological studies of the cen-

tral and peripheral neurones concerned in this control; and in this case it is of especial interest that the pioneers in both aspects are the same people, notably Robinson and his colleagues.

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H.D.

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