

*Handbook
of
Sensory Physiology*

Volume VII/2

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Physiology of Photoreceptor Organs

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Preface

This volume is a collection of essays which attempts to summarize the recent progress in the field of photoreceptor and retinal physiology.

Reflecting the way in which research is organized, each author reports on the studies performed with the techniques with which he is most familiar: morphological, chemical or physiological. The first chapters describe the structure of visual cells and the histological architecture of the retina. Next comes a summary of the laws governing photochemical reactions and a report on the biochemistry of photopigments. Four articles cover the optical properties of invertebrate eyes and the electrophysiology and the interactions of their photoreceptors. These are followed by a discussion of the properties of vertebrate eyes, including chapters on optics, on the electrical responses of rods and cones and on the functional organization of the retina. The final chapter provides an extensive review of retinal biochemistry and metabolism.

Even though the experimental approach differs, all studies are directed toward the solution of two basic problems: transduction in the photoreceptors and organization (often called "information processing") in the retina.

The central problem of photoreceptor cells is to determine how light produces a response. We know that illumination evokes electrical changes and we have recently learned a great deal about the features of these changes. The evidence indicates however that elaborate processes must be interposed between the absorption of photons by the pigment and the production of electric currents through the membrane. These intermediary events remain to be unraveled.

The final aim of the studies on the retina is to find how the different cells interact in order to bring about the messages which are transmitted along the optic nerve. In the *Limulus*, inhibitory interactions between ommatidia have been discovered and carefully analyzed. They seem to be appropriate for sharpening the resolution of spatial contrast. In the vertebrate retina, systematic investigations have been started only recently, but they have already disclosed important, (and often unfamiliar) properties of responses, of synaptic mechanisms and of interactions.

Reading the reviews collected in this volume, it will be evident that remarkable progress has been made, both in the studies on photoreceptors and in those on the retina. And yet it will be realized that the same advances which have clarified a number of important details have also opened up new problems, often unsuspected and puzzling. No unifying generalization has yet been reached to permit a simple description of the principles governing the functions of visual organs.

The electron-microscope can now resolve the structure of cells with great detail but we do not yet understand what order is hidden under the convoluted outlines of the histological sections. Similarly, the responses recorded with micro-electrodes give evidence of astonishing subtleties of function, which we do not know how to analyze, and comparative studies show a multiplicity of action which is probably related to a disappointing diversity of mechanisms.

It seems that much painstaking work will still have to be performed. But perhaps the profitable path to follow has been traced and we can now rely for further progress on the tenacity and talent of the young investigators who have recently joined the field of vision.

M. G. F. FUORTES

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