

PHOTO

BIOLOGY

Elli Kohen • René Santus • Joseph G. Hirschberg



Academic Press

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*This book is dedicated
to the memory of
Ginette Tétard Hirschberg*

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PREFACE

The Sun is such a familiar companion that many people forget that sunlight is a prerequisite for life on Earth. Do we fully realize that conversion of the almost inexhaustible solar photon energy into free oxygen and fuel by the plant kingdom is the basic pathway by which we survive on our planet? Also, do we fully understand that conversion of light signals into electrochemical energy enables us to see? Paradoxically, whereas light is life, the endless creativity of man's brain in many areas of science has led us in the past decade to the recognition that certain rays of sunlight can become the fatal Trojan horse to living species.

The understanding of the mechanisms of life and death constitutes the science of photobiology. We have tried in this book to show the multiple impacts of photobiology, not only on a great number of biological and environmental processes, but also in biomedical research and medicine. The importance of the effect of light on living things is so great that photobiology has become a truly multidisciplinary field. People with many different kinds of scientific training find themselves pursuing research in photobiology or applying principles and using instruments relevant to photobiology. Among biologists this includes molecular biologists, geneticists, developmental biologists, immunologists, physiologists, toxicologists, nutritionists, radiation biologists, and environmental

biologists. Among the chemists, biochemists, photochemists, physical chemists, and pharmacologists are likely to deal with photobiological processes. The same holds true for physicists studying atmospheric physics and biophysics, laser and optical physics, and radiation physics. Biomedical engineers play a significant role in updating and modernizing the instrumentation relevant to photobiology. Among physicians, dermatologists, ophthalmologists, oncologists, immunologists, pediatricians, psychiatrists, and endocrinologists are those most likely to have close interaction with photobiology. Mention should also be made of veterinary medicine and veterinary photopathology.

Since photobiology involves the interaction of light and molecules, in the first five chapters we present the physical and chemical bases of molecular photochemistry. These include concepts that are crucial in photobiology, such as quantum yield, quenching and chemical reactivity of the excited states resulting from absorption of light, emission and action spectra, and basic instrumentation. Thus we have principles that are sometimes difficult for the biologist, who often has no more than a distant awareness of molecular photobiology. Therefore, wherever possible, we have incorporated tables and figures to allow a smooth development and a clear understanding of the topic.

Chapters 6–11 include light–chemical energy transductions (bioluminescence and photosynthesis), light-controlled processes (photomorphogenesis, chronobiology, and photomovement), and vision. In Chapters 12–16 we present the biological effects of ultraviolet irradiation, photocarcinogenesis, and photoimmunology; the final three chapters address the diseases associated with light, and, paradoxically, the use of light as a tool in modern human health (e.g., phototherapy and photochemotherapy). We hope that our readers will be convinced that photobiology is a major scientific discipline, holding important potential for further progress in biology, biotechnology, and medicine.

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