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BOOK REVIEW

Gernot Renger (ed): Primary processes of photosynthesis: principles and apparatus, parts 1 and 2

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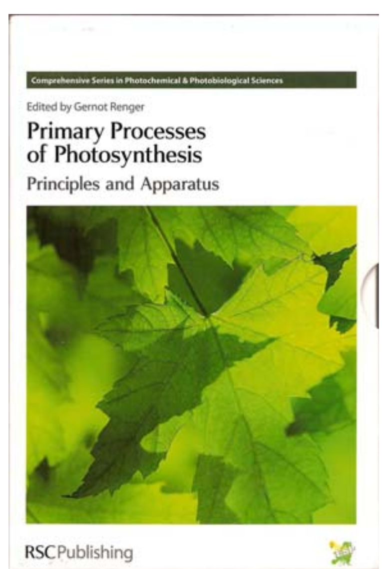
The book *Primary Processes of Photosynthesis: Principles and Apparatus*, edited by Gernot Renger, one of the leading biophysicists of the World in the field of photosynthesis research, was published in 2008 in the *Comprehensive Series in Photochemistry and Photobiology*, as its Volume 9 (ISBN of the set: 978-0-85404-364-4); European Society of Photobiology holds its copyright. The book is in two parts, in two separate physical volumes. Together, they cover the earliest events of the life-giving process of photosynthesis in 1,044 pages (Part 1: 474 pp; Part 2: 570 pp), which include a highly useful ~50-page subject index. This book contains 22 chapters written by 42 leading authorities in the field from 11 countries (Australia (1), Austria (1), Finland (1), France (3), Germany (7), Hungary(1), Italy(2), Japan (8), (The) Netherlands (2), UK (2), and USA (14)). Gernot Renger wished in the Preface of the book that reading it would be "a pleasant and stimulating journey through the fascinating world of the primary process of photosynthesis". For me, it is the most comprehensive treatment of the field since the early extensive discussion by Eugene I. Rabinowitch in his 2,088-page classic book (Photosynthesis, Vol I (1945), Vol II (Part 1, 1951)), and Vol II (Part 2, 1956), Interscience Publishers, Inc, NY). In my opinion, Renger's book will continue to be used by graduate students and researchers in photosynthesis for years to come, especially when we are faced with dwindling energy for the expanding number of inhabitants on our Earth. My only regret is that I missed having this wonderful book in the Series '*Advances in Photosynthesis and Respiration'* (abbreviated as 'AIPH'; Springer, Dordrecht). In this book review, I will refer to some of the AIPH books that are relevant complementary reading for this book. For a background for this new comprehensive book, see Volume 10 (*Photosynthesis: Photobiochemistry and Photobiophysics*, by Bacon Ke), published in 2001, in the AIPH Series (<http://www.springer.com/series/5599>).

A very nice feature of this book is that all the color figures are placed right in the text instead of being bunched together at one place elsewhere. Also, Renger has provided a common list of *Abbreviations* and *Symbols* at the beginning of the book.

Part 1 of *Primary Processes of Photosynthesis* covers photophysical principles, pigments, light harvesting, adaptation, and light stress, In *Chapter 1*, Gernot Renger



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presents a general overview of the primary processes, a description of the photosynthetic apparatus, and a short description of the current attempts to construct biometric devices that mimic the biological processes of solar energy exploitation. I particularly liked the quotation of L. Boltzmann (1886) where he emphasizes the '*fight for entropy*'. *Chapter 2* by Thomas Renger deals with light absorption, excitation energy transfer (EET), and subsequent electron transfer reactions. It provides an excellent summary of the theoretical framework of biophysical and mathematical description of the EET process in the antenna system. In *Chapter 3*, Hugo Scheer offers an excellent overview of the properties of chlorophylls and bacteriochlorophylls (chemistry, spectra, and synthetic pathways). [I refer the readers to the excellent 2006 book on *Chlorophylls and Bacteriochlorophylls*, edited by Bernhard Grimm, Robert J. Porra, Wolfhart Rüdiger, and Hugo Scheer, Volume 25 in the AIPH series.] *Chapter 4*, by Yasushi Koyama, Yoshinori Kakitani, and Yasutaka Watanabe, describes photophysical properties of carotenoids involved in both light harvesting and photoprotection of anoxygenic photosynthetic bacteria. [Volume 8, published in 1999, in the AIPH Series, entitled *Photochemistry of Carotenoids*, edited by Harry Frank, Andrew A. Young, George Britton, and Richard J. Cogdell deals with relevant history, and the details on the structure and function of carotenoids.] It is interesting to read the '*reasons for the selection of the carotenoid structures*' in *Chapter 4* of Renger's book.

The subsequent five chapters summarize our current knowledge of the structure and function of light harvesting complexes, and the regulation of excitation energy fluxes. *Chapter 5*, by Christopher J. Law and Richard J. Cogdell, provides us with a very illustrative overview of the light harvesting system of purple anoxygenic photosynthetic bacteria, and, in particular, on the enormous progress achieved in unraveling the 3D structure of their pigment–protein complexes. The antenna systems of oxygen evolving cyanobacteria (the phycobilisomes, as well as the two photosystems I and II) are described in *Chapter 6* by Mamoru Mimuro, Masami Kobayashi, Akio Murakami, Tohru Tsuchiya, and Hideaki Miyashita. The discussion of EET is excellent. *Chapter 7*, by Tomas Morosinotto and Boberto Bassi, discusses the antenna system of Photosystem I of higher plants, whereas *Chapter 8*, by Roberta Croce and Herbert van Amerongen, discusses the antenna system of Photosystem II of higher plants. Adam Gitmore (who had worked with me in Urbana, Ilinois during 1995–2000) and Xiao-Ping Li describe in *Chapter 9* the regulatory control of antenna functions in plants, in particular, the protection mechanisms against high light. [I refer the readers to the excellent 2005 book on *Photoprotection, Photoinhibition, Gene Regulation and Environment*, edited by Barbara Demmig-Adams,William W. III Adams, and Autar K. Mattoo, Volume 21 in the AIPH Series.] Related to this topic are the consequences of light stress which give rise to photoinhibition, as outlined in the final *Chapter 10* of Part 1 by Eva-Mari Aro and Imre Vass.

All the above chapters (1–10) are authoritative, and of high quality; they offer the readers a comprehensive overview of light harvesting and its regulation in both oxygenic and anoxygenic photosynthesis. [For earlier information on the antenna systems, I refer the readers to Volume 13 (*Light-Harvesting Antennas in Photosynthesis*, edited by Beverley R. Green and William W. Parson), published in 2003 in the AIPH Series.]

Part 2 of *Primary Processes of Photosynthesis* deals with several topics: reaction centers, photosystems, electron transport chains, photophosphorylation, and evolution. Thus, this part 2 focuses on the structure and function of the operational units that have developed for light-induced charge separation, electron transport, and phosphorylation.

The first seven chapters deal with our state of knowledge on the structure and function of the reactions centers of anoxygenic photosynthetic bacteria and the Photosystems I and II of oxygen-evolving organisms. I am sure that most readers are aware that the 1988 Nobel Prize in Chemistry was awarded to Hartmut Michel, Johann Deisenhofer, and Robert Huber for the determination of the 3D structure of the reaction center of an anoxygenic photosynthetic bacterium *Rhodopsuedomonas* (renamed *Blastochloris*) *viridis*, a topic that is included in *Chapter 11* by C. Roy D. Lancaster; and *Chapter 12*, by William W. Parson, provides an excellent review on the functional pattern of the reaction centers of anoxygenic photosynthetic bacteria. For further details, I refer the readers to Volume 28 (*The Purple Phototrophic Bacteria*, edited by C. Neil Hunter, Fevzi Daldal, Marion C. Thurnauer, and J. Thomas Beatty) of the AIPH Series (2009). In *Chapter 13*, Raimund Fromme, Ingo Grotjohann, and Petra Fromme discuss elegantly the current understanding of the structure and function of Photosystem I, whereas Pierre Setif and Winfried Leibl discuss in depth the functional patterns of Photosystem I. For further details on Photosystem I, see John Golbeck (Ed.) (*Photosystem I: The Light-Driven Plastocyanin: Ferredoxin Oxidoreductase*), Volume 24 of the AIPH Series. Photosystem II is the topic of three chapters because of it being the unique photosystem that can oxidize all abundant water to molecular oxygen and hydrogen equivalents. Enormous progress in the analysis of the crystal structure of Photosystem II is reviewed by Athina Zouni in *Chapter 15*. Gernot Renger provides an outstanding overview of the state of knowledge on the functional pattern of Photosystem II in *Chapter 16*. In *Chapter 17*, Johannes Messinger and Gernot Renger elegantly summarize the results and achievements in unraveling the nature of the mechanism of photosynthetic water oxidation. For further details on Photosystem II, see Thomas J. Wydrzynski and Kimiyuki Satoh (Eds.) (2005): *Photosystem II: The Light-Driven Water:Plasoquinone Oxidoreductase*, Volume 22, of the AIPH Series.

The subsequent three chapters are devoted to electron transport: in anoxgenic bacteria (*Chapter 18* by André Vermeglio); in oxygenic cyanobacteria (*Chapter 19* by Günter Peschek); and in the cytochrome *b6f* complex with a very illustrative description of its structural and functional peculiarities (*Chapter 20* by William A. Cramer and 7 of his coworkers). In *Chapter 21*, Wolfgang Junge presents a thorough overview of the machinery of photophosphorylation.

This two-part book on the *Primary Processes of Photosynthesis: Principles and Apparatus*, ends with a fascinating *Chapter 22* by Anthony W.D. Larkum; it describes rather elegantly the development of life and the invention of photosynthesis during evolution.

I conclude that the book does provide *a pleasant and stimulating journey through the fascinating world of the primary process of photosynthesis*, as Gernot Renger had wished in the Preface of his book.

I recommend this book to all those who are interested in Molecular Physics, Physical Chemistry, Biochemistry, Photochemistry, and Energy Storage aspects of Photosynthesis. It is a book that deals thoroughly with all aspects of science of photosynthesis; however, its content has also potential applications in exploring methods to produce Bioenergy and Biohydrogen as well as Biomass. (I must add that we will have to learn to use both Photosystems I and II together for making sustainable hydrogen, not just one or the other.) Further, I recommend that not only Biology, but all Chemistry, Physics as well as Engineering libraries acquire this two-part book for their graduate students, postdocs as well as their research faculty.

I end this book review by congratulating the Royal Society of Cambridge, the European Society of Photobiology, the Series Editors, Donat P. Häder and Giulio Jori, of Comprehensive Series in Photochemistry and Photobiology, and most certainly, the Editor (Gernot Renger) for this special book, a gift for the future knowledge of mankind.