Photosynthesis Research (2006) 87: 331–335
DOI: 10.1007/s11120-006-9035-2

Announcement

Photosystem II: The Light-Driven Water: Plastoquinone Oxidoreductase, edited by Thomas J. Wydrzynski and Kimiyuki Satoh, Volume 22, Advances in Photosynthesis and Respiration, Springer, Dordrecht, The Netherlands

I am delighted to announce the publication, in *Advances in Photosynthesis and Respiration* (AIPH) Series, of *Photosystem II: The Light-Driven Water: Plastoquinone Oxidoreductase,* a book covering the central role of the oxygen-evolving system for life on earth; it deals with both the structure and the function of this unique process. Two distinguished authorities have edited this volume: Thomas J. Wydrzynski of Australia and Kimiyuki Satoh of Japan. Some of the earlier volumes have included descriptions of Photosystem II: Volume 4 (*Oxygenic Photosynthesis: The Light Reactions*, edited by Donald R. Ort and Charles F. Yocum); Volume 10 (*Photosynthesis: Photobiochemistry and Photobiophysics*, authored by Bacon Ke); and Volume 19 (*Chlorophyll a Fluorescence: A Signature of Photosynthesis*, edited by George C. Papageorgiou and Govindjee). The current volume follows the 21 volumes listed below.

Published Volumes (1994–2005)

Volume 1: Molecular Biology of Cyanobacteria (28 Chapters; 881 pages; 1994; edited by Donald A. Bryant, from USA; ISBN: 0-7923-3222-9);

Volume 2: Anoxygenic Photosynthetic Bacteria (62 Chapters; 1331 pages; 1995; edited by Robert E. Blankenship, Michael T. Madigan and Carl E. Bauer, from USA; ISBN: 0-7923-3682-8);

Volume 3: Biophysical Techniques in Photosynthesis (24 Chapters; 411 pages; 1996; edited by the late Jan Amesz and the late Arnold J. Hoff, from The Netherlands; ISBN: 0-7923-3642-9);

Volume 4: Oxygenic Photosynthesis: The Light Reactions (34 Chapters; 682 pages; 1996; edited by Donald R. Ort and Charles F. Yocum, from USA; ISBN: 0-7923-3683-6);

Volume 5: Photosynthesis and the Environment (20 Chapters; 491 pages; 1996; edited by Neil R. Baker, from UK; ISBN: 0-7923-4316-6);

Volume 6: Lipids in Photosynthesis: Structure, Function and Genetics (15 Chapters; 321 pages; 1998; edited by Paul-André Siegenthaler and Norio Murata, from Switzerland and Japan; ISBN: 0-7923-5173-8);

Volume 7: The Molecular Biology of Chloroplasts and Mitochondria in Chlamydomonas (36 Chapters; 733 pages; 1998; edited by Jean David Rochaix, Michel Goldschmidt-Clermont and Sabeeha Merchant, from Switzerland and USA; ISBN: 0-7923-5174-6);

Volume 8: The Photochemistry of Carotenoids (20 Chapters; 399 pages; 1999; edited by Harry A. Frank, Andrew J. Young, George Britton and Richard J. Cogdell, from USA and UK; ISBN: 0-7923-5942-9);

Volume 9: Photosynthesis: Physiology and Metabolism (24 Chapters; 624 pages; 2000; edited by Richard C. Leegood, Thomas D. Sharkey and Susanne von Caemmerer, from UK, USA and Australia; ISBN: 0-7923-6143-1);

Volume 10: Photosynthesis: Photobiochemistry and Photobiophysics (36 Chapters; 763 pages; 2001; authored by Bacon Ke, from USA; ISBN: 0-7923-6334-5);

Volume 11: Regulation of Photosynthesis (32 Chapters; 613 pages; 2001; edited by Eva-Mari Aro and Bertil Andersson, from Finland and Sweden; ISBN: 0-7923-6332-9);

Volume 12: Photosynthetic Nitrogen Assimilation and Associated Carbon and Respiratory Metabolism (16 Chapters; 284 pages; 2002; edited by Christine Foyer and Graham Noctor, from UK and France; ISBN: 0-7923-6336-1);

Volume 13: Light Harvesting Antennas (17 Chapters; 513 pages; 2003; edited by Beverley Green and William Parson, from Canada and USA; ISBN: 0-7923-6335-3);

Volume 14: Photosynthesis in Algae (19 Chapters; 479 pages; 2003; edited by Anthony Larkum, Susan Douglas and John Raven, from Australia, Canada and UK; ISBN: 0-7923-6333-7);

Volume 15: Respiration in Archaea and Bacteria: Diversity of Prokaryotic Electron Transport Carriers (13 Chapters; 326 pages; 2004; edited by Davide Zannoni, from Italy; ISBN: 1-4020-2001-5);

Volume 16: Respiration in Archaea and Bacteria 2: Diversity of Prokaryotic Respiratory Systems (13 chapters; 310 pages; 2004; edited by Davide Zannoni, from Italy; ISBN: 1-4020-2002-3);

Volume 17: Plant Mitochondria: From Genome to Function (14 Chapters; 325 pages; 2004; edited by David A. Day, A. Harvey Millar and James Whelan, from Australia; ISBN: 1-4020-2339-5);

Volume 18: Plant Respiration: From Cell to Ecosystem (13 Chapters; 250 pages; 2005; edited by Hans Lambers, and Miquel Ribas-Carbo from Australia and Spain; ISBN: 1-4020-3588-8);

Volume 19: Chlorophyll a Fluorescence: A Signature of Photosynthesis (31 Chapters; 817 pages; 2004; edited by George C. Papageorgiou and Govindjee, from Greece and USA; ISBN: 1-4020-3217-X);

Volume 20: Discoveries in Photosynthesis (111 Chapters; 1262 + xxx pages; 2005; edited by Govindjee, J. Thomas Beatty, Howard Gest and John F. Allen, from USA, Canada and Sweden (& UK); ISBN: 1-4020-3323-0); and

Volume 21: Photoprotection, Photoinhibition, Gene Regulation and Environment (21 Chapters; ~500 pages; 2005; edited by Barbara Demmig-Adams, William W. Adams III and Autar K, Mattoo, all from USA; ISBN: 1-4020-3564-0).

For a description of the scope of the AIPH Series, see the back cover of this book. Further information on these books and ordering instructions can be found at <http://www.springeronline.com> under the Book Series 'Advances in Photosynthesis and Respiration.' Special discounts are available for members of the International Society of Photosynthesis Research, ISPR (<http://www.photosynthesisresearch.org>).

Photosystem II: The Light-Driven Water: Plastoquinone Oxidoreductase

Photosystem II is truly an unprecedented discovery of evolution; one couldn't have modeled it 30–40 years ago despite all the advances in chemistry, physics and biology. It consists of a light-harvesting unit (antenna) and a reaction center unit that operates at an unusually high redox potential; it is this latter unique characteristic that allows it to oxidize water to oxygen at its 'oxygen-evolving complex.' A book on this unique system has been edited by two outstanding authorities in the area of the structure and the function of the oxygen-evolving Photosystem II: Thomas J. Wydrzynski (of the Research School of Biological Sciences, The Australian National University, Canberra, Australia) and Kimiyuki Satoh (of the Department of Biology, Okayama University, Okayama, Japan).

Respiring organisms, including humans, on this planet depend on the oxygen that green plants, algae, and cyanobacteria generate through Photosystem II. Thus, this book is a very important addition to the already published books in the AIPH Series. It essentially addresses water first as a source of the electrons that are necessary for the reductive syntheses of organic matter, and then as a source of molecular oxygen that is necessary for the energy producing catabolic oxidations, including respiration.

During the last decade or so, dramatic advances have been made in elucidating the structure of Photosystem II to near atomic scale through X-ray crystallography, and in relating it to its biophysical, biochemical and molecular biological properties. Thirty-four chapters, authored by 75 internationally acknowledged experts, summarize this extraordinary scientific progress, covering areas that range from the capture of fleeting photons, their conversion into chemical energy (oxidation–reduction), to the dynamic regulatory processes that sustain and optimize the photosynthetic oxidation of water. A discussion is also provided on the beginnings of Photosystem II and photosynthesis more than 3 billion years ago (in the Archaean Era) and on its eventful evolution to the present day diversity of microbial and higher plants. Lastly, the design of artificial (biomimetic) Photosystems II is also discussed. Who knows, one day these systems may serve the needs of humanity either on Earth, or on some distant outpost in Space.

The book is designed to be used by graduate students, beginning researchers and advanced undergraduate students in the areas of plant sciences, microbiology, cell and molecular biology, biochemistry, biophysics, bioenergetics and chemistry, as well as those in agriculture and biotechnology.

This book is appropriately dedicated to a pioneer in the field Gerald T. Babcock (the dedication is authored by Charles F. Yocum, Robert Blankenship and Shelagh Ferguson-Miller, all of USA). Kimiyuki Satoh (Japan), Thomas J. Wydrzynski (Australia) and Govindjee (USA) provide an *Introduction* to Photosystem II and the chapters in this volume (*Chapter 1*). It is followed by five chapters that deal with the *Protein Constituents of Photosystem II*: Beverley Green (Canada) and Elisabeth Gantt (USA) discuss the distal and extrinsic antenna (*Chapter 2*); Julian Eaton-Rye (New Zealand) and Cindy Putnam-Evans (USA) summarize our understanding of the CP 47 and CP 43 core antenna components (*Chapter 3*); Peter Nixon (UK), Mary Sarcina (UK) and Bruce Diner (USA) provide an account of the D1 and D2 core proteins (*Chapter 4*). This is followed by *Chapter 5*, by Terry Bricker (USA) and Robert Burnap (USA) on the oxygen enhancing extrinsic proteins, and *Chapter 6*, by Leeann Thornton (USA), Johnna Roose (USA), Himadri Pakrasi (USA) and Masahiko Ikeuchi (Japan) on the low molecular weight components.

The next nine chapters focus on the *Organization of the Functional Sites in Photosystem II*: Gernot Renger and Alfred Holzwarth (both of Germany) discuss the primary electron transfer (*Chapter 7*); Vasili Petrouleas (Greece) and Anthony Crofts (USA) summarize information on the quinone-iron acceptor complex (*Chapter* 8); Bruce Diner and David Britt (both of USA) discuss the redox active tyrosines Y_Z and Y_D (*Chapter* 9); Vittal Yachandra (USA) summarizes the current understanding about the organization of the manganese ions of the manganese cluster of the O_2-evolving complex (*Chapter* 10); Richard Debus (USA) summarizes what is known about protein ligands of the manganese cluster (*Chapter 11*); Karin Åhrling (Australia), Ronald Pace (Australia) and Michael Evans (UK) provide information on spectroscopic observations and their implications on structural and functional details of catalytic manganese cluster (*Chapter 12*); Hans van Gorkom (The Netherlands) and Charles Yocum (USA) discuss the roles of Calcium and Chloride ions (*Chapter 13*); Jack van Rensen (The Netherlands) and Vyacheslav Klimov (Russia) address the unique role of bicarbonate on the acceptor side and the donor side of Photosystem II reaction center (*Chapter 14*); and Peter Faller, Christian Fufezan and William Rutherford (all of France) examine the secondary electron transfer pathways around the Photosystem II reaction center (*Chapter 15*).

Subsequently, in the next six chapters, the focus shifts to the *Structural Basis for Photosystem II*: Takumi Noguchi (Japan) and Catherine Berthomieu (France) analyze the molecular structure of the intermediates of the system, using information obtained from vibrational spectroscopy (*Chapter 16*); Robert Bittl (Germany) and Asako Kawamori (Japan) summarize the configuration of the electron transport intermediates of Photosystem II, as obtained by electron paramagnetic resonance spectroscopy (*Chapter 17*); Ben Hankamer (Australia), James Barber (UK) and Jon Nield (UK) describe the structure of the core/antenna holocomplex as visualized by electron microscopy (*Chapter 18*); Horst Witt (Germany) discusses the first three-dimensional structure of Photosystem II obtained by X-ray crystallography and other biophysical methods (*Chapter 19*); Jian-Ren Shen and Nobuo Kamiya (both of Japan) discuss this structure, using also X-ray crystallography (*Chapter 20*); and James Barber and So Iwata (both of UK) discuss a somewhat refined structure, and its implications to the function of Photosystem II (*Chapter 21*).

These chapters on the structure are followed by four chapters on *Molecular Dynamics of PhotosystemII*: Laura Barter (UK), David Klug (UK) and Rienk van Grondelle (The Netherlands) summarize our understanding about excitation energy trapping and its equilibration (*Chapter 22*); Barry Pogson (Australia), Heather Rissler (Australia) and Harry Frank (USA) elaborate the role of carotenoids in energy quenching (*Chapter 23*); Vladimir Shinkarev (USA) discusses the pattern and the analyses of the O_2 evolution in a train of light flashes (*Chapter 24*); and Warwick Hillier (Australia) and Johannes Messinger (Germany) present an overview on the mechanism of water oxidation (*Chapter 25*).

This is followed by a discussion of *Assembly and Biodynamics of Photosystem II* in four chapters: Charles Dismukes, Gennady Ananyev and Richard Watt (all of USA) discuss the photoassembly of the catalytic manganese cluster (*Chapter 26*); Wah Soon Chow (Australia) and Eva-Mari Aro (Finland) summarize our understanding of photoinactivation and mechanisms of recovery

(*Chapter 27*); Kenichi Yamaguchi (USA), Stephen Mayfield (USA) and Mamoru Sugita (Japan) present a current picture of transcriptional and translational regulation of gene expression (*Chapter 28*); and Steven Theg and Lan-Xin Shi (both of USA) discuss transport and post-translational processing in biosynthesis and homeostatis (*Chapter 29*).

This is followed by a discussion of the *Comparison of Photosystem II with Other Natural/Artificial Systems* in four chapters: Charles Dismukes and Robert Blankenship (both of USA) describe the origins and the evolution of oxygenic photosynthesis (*Chapter 30*); Gary Brudvig (USA) and Mårten Wikström present mechanistic comparisons between Photosystem II and Cytochrome *c* oxidase (*Chapter 31*); Lázló Kálmán (Hungary), JoAnn Williams (USA) and James Allen (USA) summarize research on mimicking the properties of Photosystem II in purple bacterial reaction centers (*Chapter 32*); Brian Gibney (USA) and Cecilia Tommos (Sweden) discuss *de novo* protein design in respiration and photosynthesis (*Chapter 33*); and Ann Magnuson, Stenbjörn Styring and Leif Hammarström (all of Sweden) end this book with an understanding of Photosystem II through artificial photosynthesis.

The ISBN number of this volume is 1-4020-4249-3; it has 16 color plates; and xxvii + 786 pages (including a 10-page index).

A Brief of History: First Clear Evidence of the Series Scheme, and the Naming of System 2 (Now Photosystem II) by Louis N.M. Duysens, Jan Amesz and B.M. Kamp in 1961

A recently published time-line on oxygenic photosynthesis covers many aspects of the history of 'Photosystem II' (see Govindjee and D. Krogmann (2004) Discoveries in oxygenic photosynthesis (1727–2003): A perspective. Photosynth Res 80: 15–57). Chapter 1 of this book by K. Satoh, T.J. Wydrzynski and Govindjee includes a historical account of Photosystem II (for references, see this chapter). In a paper, published on May 6, 1961, Louis N.M. Duysens, Jan Amesz and B.M. Kamp (Two photochemical systems in photosynthesis. Nature 190: 510–511) used for the first time the name 'System 2' for the photosystem responsible for the action spectrum of chlorophyll *a* fluorescence; it was the system that was suggested to oxidize water to oxygen, and reduce cytochrome. 'System 1', on the other hand, oxidized cytochrome, and reduced pyridine nucleotide. Duysens and colleagues added first red light (680 nm light; absorbed mainly by chlorophyll) and observed oxidation of a cytochrome in a red alga *Porphyridium cruentum*, and then they added green light (562 nm; absorbed mainly in phycoerythrin) and observed reduction of this oxidized cytochrome. Addition of the herbicide DCMU eliminated the reduction of cytochrome by green light, but not its oxidation by red light. This antagonistic effect of light 1 and 2 on cytochrome provided not only the evidence for the series scheme of photosynthesis, but was the first paper to call the system that oxidized water and reduced cytochrome as 'System 2' (currently, Photosystem II), whereas the other system that oxidized cytochrome as 'System 1' (currently, Photosystem I). In this seminal paper, Duysens and colleagues had recognized not only their own work, but that of Robert Emerson (with Marcia Brody), Eugene Rabinowitch (with Emerson, and with Rajni Govindjee and Jan B. Thomas), C. Stacy French (with V.K. Young, and with Jack Myers), Norman Bishop, and Leo Vernon (with L.P. Zaugg). Since in sunlight both systems are excited simultaneously and begin to function almost simultaneously, it is not a question of which starts first. The naming of the system is thus arbitrary.

Future AIPH books

The readers of the current series are encouraged to watch for the publication of the forthcoming books (not necessarily arranged in the order of future appearance):

The Structure and Function of Plastids (Editors: Robert Wise and J. Kenneth Hoober; expected to contain 27 Chapters and ~775 pages; ISBN: 1-4020-4060-1);

Photosystem I: The Light-Driven Plastocyanin: Ferredoxin Oxidoreductase (Editor: John Golbeck);

Chlorophylls and Bacteriochlorophylls: *Biochemistry, Biophysics, Functions and Applications* (Editors: Bernhard Grimm, Robert J. Porra, Wolfhart Rüdiger and Hugo Scheer);

Biophysical Techniques II (Editors: Thijs J. Aartsma and Jörg Matysik);

Photosynthesis: A Comprehensive Treatise: Physiology, Biochemistry, Biophysics and Molecular Biology, Part 1 (Editors: Julian Eaton-Rye and Baishnab Tripathy); and

Photosynthesis: A Comprehensive Treatise: Physiology, Biochemistry, Biophysics and Molecular Biology, Part 2 (Editors: Baishnab Tripathy and Julian Eaton-Rye).

In addition to these contracted books, we are already in touch with prospective Editors for the following books:

Molecular Biology of Cyanobacteria II
Protonation and ATP Synthases
Genomics and Proteomics
Sulfur Metabolism in Photosynthetic Systems
Molecular Biology of Stress in Plants
Global Aspects of Photosynthesis and Respiration
Chloroplast Bioengineering
Artificial Photosynthesis.

In view of the interdisciplinary character of research in photosynthesis and respiration, it is my earnest hope that this series of books will be used in educating students and researchers not only in Plant Sciences, Molecular and Cell Biology, Integrative Biology, Biotechnology, Agricultural Sciences, Microbiology, Biochemistry, and Biophysics, but also in Bioengineering, Chemistry, and Physics.

Readers are encouraged to send their suggestions for future volumes (topics, names of future editors, and of future authors) to me by E-mail (gov@uiuc.edu) or fax (1-217-244-7246).

I take this opportunity to thank Thomas J. Wydrzynski and Kimiyuki Satoh for their outstanding and painstaking editorial work. We are grateful to them for (personally) subsidizing 8 of the 16 color plates in this volume. I thank all the 75 authors of volume 22: without their authoritative chapters, there would be no such volume. I thank Jacco Flipsen and Noeline Gibson (both of Springer) for their friendly working relationship with us that led to the production of this book.

Special thanks go to Larry Orr for his wonderful work in typesetting this book. His constant advise to the editors and his outstanding interactions with all those involved in this book are a source of inspiration to all of us.

Govindjee
Series Editor, Advances in Photosynthesis and Respiration
Department of Plant Biology
University of Illinois at Urbana-Champaign
Urbana, IL, 61801-3707
USA
E-mail: gov@uiuc.edu