

From the Series Editor

Advances in Photosynthesis and Respiration, Volume 21

I am delighted to announce the publication, in *Advances in Photosynthesis and Respiration* (AIPH) Series, of ***Photoprotection, Photoinhibition, Gene Regulation, and Environment***, a book covering the central role of excess light in how plants monitor, and respond to environmental changes. This volume was edited by three distinguished authorities, all based in the USA, Barbara Demmig-Adams, William W. Adams III, and Autar K. Mattoo. Two earlier AIPH volumes dealt with the topics of Environment and Regulation: *Photosynthesis and the Environment* (1996; edited by Neil R. Baker, from UK); and *Regulation of Photosynthesis* (2001; edited by Eva-Mari Aro and Bertil Andersson, from Finland and Sweden). The current volume follows the 20 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);
- *Volume 2: Anoxygenic Photosynthetic Bacteria* (62 Chapters; 1331 pages; 1995; edited by Robert E. Blankenship, Michael T. Madigan and Carl E. Bauer, from USA);
- *Volume 3: Biophysical Techniques in Photosynthesis* (24 Chapters; 411 pages; 1996; edited by the late Jan Ames and the late Arnold J. Hoff, from The Netherlands);
- *Volume 4: Oxygenic Photosynthesis: The Light Reactions* (34 Chapters; 682 pages; 1996; edited by Donald R. Ort and Charles F. Yocum, from USA);
- *Volume 5: Photosynthesis and the Environment* (20 Chapters; 491 pages; 1996; edited by Neil R. Baker, from UK);
- *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);
- *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);
- *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);
- *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);
- *Volume 10: Photosynthesis: Photobiochemistry and Photobiophysics* (36 Chapters; 763 pages; 2001; authored by Bacon Ke, from USA);
- *Volume 11: Regulation of Photosynthesis* (32 Chapters; 613 pages; 2001; edited by Eva-Mari Aro and Bertil Andersson, from Finland and Sweden);
- *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);
- *Volume 13: Light Harvesting Antennas* (17 Chapters; 513 pages; 2003; edited by Beverley Green and William Parson, from Canada and USA);
- *Volume 14: Photosynthesis in Algae* (19 Chapters; 479 pages; 2003; edited by Anthony Larkum, Susan Douglas and John Raven, from Australia, Canada and UK);
- *Volume 15: Respiration in Archaea and Bacteria: Diversity of Prokaryotic Electron Transport Carriers* (13 Chapters; 326 pages; 2004; edited by Davide Zannoni, from Italy);
- *Volume 16: Respiration in Archaea and Bacteria 2: Diversity of Prokaryotic Respiratory Systems* (13 Chapters; 310 pages; 2004; edited by Davide Zannoni, from Italy);
- *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);

- *Volume 18: Plant Respiration: From Cell to Ecosystem* (13 Chapters; 250 pages; 2005; edited by Hans Lambers, and Miquel Ribas-Carbo, 2005; from Australia and Spain).
- *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); and
- *Volume 20: Discoveries in Photosynthesis* (111 Chapters; 1262 pages; 2005; edited by Govindjee, J. Thomas Beatty, Howard Gest and John F. Allen, from USA, Canada and Sweden (& UK)).

In addition, *Volume 22* (Photosystem II: The Light-Driven Water: Plastoquinone Oxidoreductase (34 Chapters, xxvii + 16 color plates + 786 pp., edited by Thomas J. Wydrzynski and Kimiyuki Satoh, from Australia and USA) has already been published in 2005).

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/>>).

Photoprotection, Photoinhibition, Gene Regulation, and Environment

This book was edited by three outstanding authorities in the areas of Photoprotection, Photoinhibition, Gene Regulation, and Environment: Barbara Demmig-Adams and William W. Adams III (both at the University of Colorado, Boulder, Colorado) and Autar K. Mattoo (Henry A. Wallace Beltsville Agricultural Research Center, Beltsville, Maryland).

The topic of the book, as provided by our 3 distinguished editors, is: "*Photoprotection, Photoinhibition, Gene Regulation, and Environment*"; it examines the processes whereby plants monitor environmental conditions and orchestrate their response to change, an ability paramount to the life of all plants. 'Excess light', absorbed by the light-harvesting systems of photosynthetic organisms, is an integrative indicator of the environment, communicating the presence of intense light and any conditions unfavorable

for growth and photosynthesis. Key plant responses are photoprotection and photoinhibition. In this volume, the dual role of photoprotective responses in the preservation of leaf integrity and in redox signaling networks modulating stress acclimation, growth, and development is addressed. In addition, the still unresolved impact of photoinhibition on plant survival and productivity is discussed. Specific topics include dissipation of excess energy via thermal and other pathways, scavenging of reactive oxygen by antioxidants, proteins key to photoprotection and photoinhibition, peroxidation of lipids, as well as signaling by reactive oxygen, lipid-derived messengers, and other messengers that modulate gene expression. Approaches include biochemical, physiological, genetic, molecular, and field studies, addressing intense visible and ultraviolet light, winter conditions, nutrient deficiency, drought, and salinity. This book is directed toward advanced undergraduate students, graduate students, and researchers interested in Plant Ecology, Stress Physiology, Plant Biochemistry, Integrative Biology, and Photobiology."

"*Photoprotection, Photoinhibition, Gene Regulation, and Environment*" has 21 authoritative Chapters, and is authored by 57 international authorities from 16 countries. The book begins with three perspectives: Harry Yamamoto (USA) presents a random walk to and through the xanthophyll cycle (*Chapter 1*); Barry Osmond and Britta Förster (Australia) provide an account of Photoinhibition: then and now (*Chapter 2*); Marvin Edelman and Autar Mattoo (Israel and USA) discuss the past and future perspectives of the involvement of the D1 protein in photoinhibition (*Chapter 3*). These perspectives are followed by 18 chapters. In *Chapter 4*, Barbara Demmig-Adams, Volker Ebbert, Ryan Zarter and William Adams (USA) summarize characteristics and species-dependent employment of flexible versus sustained thermal dissipation and photoinhibition. Then, William Adams, C. Ryan Zarter, Kristine Mueh, Véronique Amiard and Barbara Demmig-Adams (USA) discuss details of energy dissipation and photoinhibition as a continuum of protection (*Chapter 5*). In *Chapter 6*, Fermín Morales, Anunciación Abadía and Javier Abadía (Spain) discuss photoinhibition and photoprotection under nutrient deficiencies, drought, and salinity. This is followed by a summary, by Donat-P. Häder (Germany), of photoinhibition and UV responses in the aquatic environment (*Chapter 7*); and a discussion, by Alexander V. Vener (Sweden), of phosphorylation of thylakoid proteins (*Chapter 8*). In *Chapter 9*, Hou-Sung Jung

and Krishna K. Niyogi (USA) provide a molecular analysis of photoprotection of photosynthesis. Stefan Jansson (Sweden) discusses the saga of a protein family involved in light harvesting and photoprotection (*Chapter 10*). In *Chapter 11*, a team of 10 authors (Norman Huner, Alexander Ivanov, Prafullachandra Sane, Tessa Pockock, Marianna Król, Andrius Balseris, Dominic Rosso, Leonid Savitch, Vaughan Hurry and Gunnar Öquist (Canada, Sweden and India) discuss the role of reaction center quenching versus antenna quenching in the photoprotection of Photosystem II. Then, Kittisak Yokthongwattana and Anastasios Melis (Thailand and USA) discuss, in *Chapter 12*, the mechanism of a Photosystem II damage and repair cycle involved in photoinhibition (and its recovery) in oxygenic photosynthesis. Subsequently, regulation by environmental conditions of the repair of Photosystem II in cyanobacteria is discussed by Yoshitaka Nishiyama, Suleyman Allahverdiev and Norio Murata (Japan and Russia) in *Chapter 13*. Tsuyoshi Endo and Kozi Asada (Japan) provide, in *Chapter 14*, an understanding of the role of cyclic electron flow and the so-called water-water cycle in photoprotection, particularly around Photosystem I. This is followed by *Chapter 15* on the integration of signaling in antioxidant defenses by Philip Mullineaux, Stanislaw Karpinski and Gary Creissen (UK and Sweden). *Chapter 16*, by Christine Foyer, Achim Trebst and Graham Noctor (UK, Germany and France), deals with signaling and integration of defense functions of tocopherol, ascorbate, and glutathione. Then, in *Chapter 17*, Sacha Baginsky and Gerhard Link (Switzerland and Germany) discuss redox regulation of chloroplast gene expression. Robert Larkin (USA) provides, in *Chapter 18*, a summary of intracellular signaling and chlorophyll synthesis. Nine authors (Karl-Josef Dietz, Tina Stork, Iris Finkemeier, Petra Lamkemeyer, Wen-Xue Li, Mohamed El-Tayeb, Klaus-Peter Michel, Elfriede Pistorius, and Margarete Baier), from Germany and Egypt, discuss, in *Chapter 19*, the role of peroxiredoxins in oxygenic photosynthesis of cyanobacteria and of higher plants and pose the question of the importance of peroxide detoxification or redox sensing in the process. *Chapter 20*, by Mauro Maccarrone (Italy), reviews lipoxygenases, apoptosis, and the role of antioxidants. The book ends appropriately with *Chapter 21*, by Christiane Reinbothe and Steffen Reinbothe (Germany and France), on the regulation of photosynthetic gene expression by the environment from the seedling de-etiolation stage to leaf senescence.

A Bit of Early History – From there to here

“It is a noble employment to rescue from oblivion those who deserve to be remembered” (Pliny the Younger, Letters V).

In 1996, the grand young man of Photosynthesis Jack Myers wrote about the findings in his PhD thesis 65 years ago (Country boy to scientist. *Photosynth. Res.* 50: 195–208, 1996.) *“Cranking up for my first real experiments was an exciting day. Carefully pipette a cell sample into the Warburg vessel and let it come to temperature in darkness. Then turn on the projection lamp to give a bright light spot already measured at 38 000 foot-candles, almost 4 times as bright as sunlight. . . . That first experiment was a complete bust. There was only a short burst of the increasing pressure I expected. Thereafter, the pressure change became negative in evidence of oxygen uptake. Something was wrong. So I repeated the procedure with the same result. Only when the intensity was much reduced (1000 foot-candles, by wire screens) did I see the expected high and steady rate of oxygen evolution. Though it took a lot of confirming and polishing experiments, that was an exciting day in the life of a young photosynthetiker. I had made a discovery. I knew something unknown to anyone else in the world. That had been my romantic vision of the fruit of research. And it has not changed in the sixty years since.”* This experiment was published by Jack Myers and George O. Burr (Some effects of high light intensity in *Chlorella*. *Jour. Gen. Physiol.* 24: 45–67, 1940)—the discovery of inhibition of photosynthesis by high light, the phenomenon of photoinhibition, but without its name. Only in 1956, did Bessel Kok (On the inhibition of photosynthesis by intense light. *Biochim. Biophys. Acta* 21: 234–244, 1956) characterize this phenomenon in an elegant manner. Itzhak Ohad and his coworkers (N. Adir, H. Zer, S. Scochat and I. Ohad: Photoinhibition—a historical perspective. *Photosynth. Res.* 76: 343–370, 2003) have written a current history of photoinhibition. In addition, I mention the personal perspective by Barbara Demmig-Adams (Linking the xanthophyll cycle with thermal energy dissipation. *Photosynth. Res.* 76: 73–80, 2003). Photographs shown in these two latter papers and in Govindjee and Manfredo Seufferheld (Non-photochemical quenching of chlorophyll a fluorescence: early history and characterization of two xanthophyll cycle mutants of *Chlamydomonas reinhardtii*. *Funct. Plant Biol.* 29: 1141–1155, 2002) are worth seeing and enjoying. And while much important work on

the role of the xanthophyll cycle has been done over many years, it is only now that the nature of the role of zeaxanthin in the de-excitation of chlorophyll is being identified (see N.E. Holt, D. Zigmantas, L. Valkunas, X.-P. Li, K.K. Niyogi and G.R. Fleming: Carotenoid cation formation and the regulation of photosynthetic light harvesting. *Science* 307: 433–436, 2005).

There have been many books, many chapters in several books, many reviews, and an enormous number of papers in the field of ‘*Photoinhibition and Photoprotection*’. I do mention, for historical reasons, an edited book, published 18 years ago, in ‘Topics of Photosynthesis’ (Volume 9, Series Editor James Barber): David Kyle, Barry Osmond and Charles Arntzen (eds) (1987) ‘Photoinhibition’, Elsevier, Amsterdam (307 pages; Foreword is by Jack Myers; it has 11 Chapters, including chapters by C.B. Osmond, G. Öquist, K. Asada and N. Murata who are also authors in the current book).

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):

- **Photosystem I: The Light-Driven Plastocyanin: Ferredoxin Oxidoreductase** (Editor: John Golbeck);
- **The Structure and Function of Plastids** (Editors: Robert Wise and J. Kenneth Hooper);
- **Chlorophylls and Bacteriochlorophylls: Biochemistry, Biophysics, Functions and Applications** (Editors: Bernhard Grimm, Robert J. Porra, Wolfhart Rüdiger and Hugo Scheer);
- **Biophysical Techniques in Photosynthesis. 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:

- Anoxygenic Photosynthetic Bacteria. II
- Chloroplast Bioengineering
- Molecular Biology of Cyanobacteria. II.
- Protonation and ATP Synthases
- Genomics and Proteomics
- Protein Complexes of Respiration and Photosynthesis
- Sulfur Metabolism in Photosynthetic Organisms

Other books, under discussion, are: Molecular Biology of Stress in Plants; Global Aspects of Photosynthesis and Respiration; and Artificial Photosynthesis. Readers are encouraged to send their suggestions for these and 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).

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.

I take this opportunity to thank Barbara Demmig-Adams, William W. Adams III, and Autar K. Mattoo for their outstanding and painstaking editorial work. I thank all the 57 authors of volume 21: without their authoritative chapters, there would be no such volume. I owe Jacco Flipsen and Noeline Gibson (both of Springer) special thanks for their friendly working relation with us that led to the production of this book. Thanks are also due to Jeff Haas (Director of Information Technology, Life Sciences, University of Illinois at Urbana-Champaign, UIUC), Evan DeLucia (Head, Department of Plant Biology, UIUC) and my dear wife Rajni Govindjee for their constant support.

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