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Announcement

Advances in Photosynthesis and Respiration, Volume 19: '*Chlorophyll* a *Fluorescence: A Signature of Photosynthesis*', edited by George C. Papageorgiou and Govindjee

I am delighted to announce the publication, in the *Advances in Photosynthesis and Respiration* (AIPH) series, of the first book that focuses on red light that plants, algae and cyanobacteria emit when exposed to UV and visible light. This new volume, *Chlorophyll* a *Fluorescence: A Signature of Photosynthesis,* has been edited by George C. Papageorgiou and Govindjee. The other two recent Volumes 17 and 18 (edited by David Day et al. and Hans Lambers and Miquel Ribas-Carbo, respectively) deal with several aspects of 'Plant Respiration.' Volume 19 is a sequel to the 18 volumes in the AIPH series.

Published volumes

(1) *Molecular Biology of Cyanobacteria* (Donald A. Bryant, editor, 1994);
(2) *Anoxygenic Photosynthetic Bacteria* (Robert E. Blankenship, Michael T. Madigan and Carl E. Bauer, editors, 1995);
(3) *Biophysical Techniques in Photosynthesis* (Jan Amesz* and Arnold J. Hoff*, editors, 1996);
(4) *Oxygenic Photosynthesis: The Light Reactions* (Donald R. Ort and Charles F. Yocum, editors, 1996);
(5) *Photosynthesis and the Environment* (Neil R. Baker, editor, 1996);
(6) *Lipids in Photosynthesis: Structure, Function and Genetics* (Paul-André Siegenthaler and Norio Murata, editors, 1998);
(7) *The Molecular Biology of Chloroplasts and Mitochondria in Chlamydomonas* (Jean David Rochaix, Michel Goldschmidt-Clermont and Sabeeha Merchant, editors, 1998);
(8) *The Photochemistry of Carotenoids* (Harry A. Frank, Andrew J. Young, George Britton and Richard J. Cogdell, editors, 1999);
(9) *Photosynthesis: Physiology and Metabolism* (Richard C. Leegood, Thomas D. Sharkey and Susanne von Caemmerer, editors, 2000);
(10) *Photosynthesis: Photobiochemistry and Photobiophysics* (Bacon Ke, author, 2001);
(11) *Regulation of Photosynthesis* (Eva-Mari Aro and Bertil Andersson, editors, 2001);
(12) *Photosynthetic Nitrogen Assimilation and Associated Carbon and Respiratory Metabolism* (Christine Foyer and Graham Noctor, editors, 2002);
(13) *Light Harvesting Antennas* (Beverley Green and William Parson, editors, 2003);
(14) *Photosynthesis in Algae* (Anthony Larkum, Susan Douglas and John Raven, editors, 2003);
(15) *Respiration in Archaea and Bacteria: Diversity of Prokaryotic Electron Transport Carriers* (Davide Zannoni, editor, 2004);
(16) *Respiration in Archaea and Bacteria: Diversity of Prokaryotic Respiratory System* (Davide Zannoni, editor, 2004);
(17) *Plant Mitochondria: From Genome to Function* (David A. Day, Harvey Millar and James Whelan, editors, 2004); and
(18) *Plant Respiration. From Cell to Ecosystem* (Hans Lambers and Miquel Ribas-Carbo, editors, 2005).

See http://www.springeronline.com for further information and to order these books. Please note that the members of the International Society of Photosynthesis Research, ISPR (http://www.photosynthesisresearch.org) and authors of chapters in AIPH Series receive special discounts.

Chlorophyll *a* fluorescence: a signature of photosynthesis

Chlorophyll (Chl) *a*, a green pigment of plants, algae and cyanobacteria, is central to oxygenic

*Deceased.

photosynthesis. Photosynthesis is a web of coupled partial processes initiated by the absorption of visible light and conversion of photon energy to energy stored as redox potential, the transmembrane voltage and proton concentration, and of the free energy stored in ATP synthesis. Partial processes include the splitting of water to molecular O_2 (which escapes to the atmosphere) and to electrons and protons, which participate directly in the electrochemical reactions through which redox and proton gradients are coupled to phosphorylation and to fixation of CO_2 to sugars. Chlorophyll, as the major chromophore of pigment-protein systems, is engaged in photon harvesting, in the regulated distribution of excitation energy, and in its primary conversion to redox potential and proton gradient. Although it performs these tasks with high quantum efficiency, a small fraction of absorbed photons is re-emitted as red fluorescence. This fraction varies with metabolic state, and provides the basis for the measurement of photosynthesis through fluorescence.

The goal of this book is to equip readers with sufficient theory to enable them to interpret the information from measurements of Chl *a* fluorescence, and to facilitate the use of relatively inexpensive, portable fluorometers that permit field applications in agriculture, and applications in biochemistry, biophysics, physiology and ecology. It deals with successful applications of the use of Chl fluorescence as a convenient, non-invasive, highly sensitive, rapid and quantitative probe of some of the partial processes of photosynthesis. The detailed studies in the laboratory have been extended to measurements of total photosynthesis of cells, leaves, plants and plant ecosystems. The book also explains mechanisms of 'photo-protection' in plants (against excessive light), and regulation of the photosynthetic machinery in response to temperature extremes, drought, heavy metal stress and UV stress. Further, it discusses newer findings using modern technologies such as fluorescence imaging of leaves and cells and remotely sensed fluorescence (from terrestrial, air-borne, and satellite bases). The book provides a solid foundation of the basic theory, and applications of the rich information contained in Chl fluorescence signal as it relates to photosynthesis and plant productivity. Research scientists, graduate students, and advanced undergraduates in integrative biology, cellular and molecular biology, plant biology, biochemistry, biophysics, plant physiology, global ecology and agriculture, will find this book invaluable in advancing and consolidating their knowledge of photosynthesis and Chl *a* fluorescence.

This book is dedicated to a pioneer of Chlorophyll *a* Fluorescence: Louis N. M. Duysens (of Oegstgeest, The Netherlands). It has 31 chapters, written by 59 authors from 18 countries. Govindjee (USA) discusses a bit of basics and history (Chapter 1); G.C. Papageorgiou (Greece) presents information on fluorescence of photosynthetic pigments (Chapter 2); N.R. Baker and K. Oxborough (UK) show how one can exploit Chl *a* fluorescence to probe photosynthetic productivity (Chapter 3); and R.M. Clegg (USA) provides the basics of excitation energy migration and transfer (Chapter 4). This is followed by discussions by R. van Grondelle and B. Gobets (The Netherlands) on transfer and trapping of energy in plant photosystems (Chapter 5); by W.J. Vredenberg (The Netherlands) on a three-state model of Photosystem II (PS II) where pheophytin plays an important role in controlling Chl fluorescence (Chapter 6); and by M. Mimuro (Japan) on energy migration and trapping in cyanobacteria (Chapter 7). V. Shinkarev (USA) discusses the relationship between PS II reactions and Chl fluorescence in multiple flashes of light (Chapter 8); and S. Itoh and K. Sugiura (Japan) summarize information on fluorescence of Photosystem (PS) I (Chapter 9). D.M. Kramer, T.J. Avenson, A. Kanazawa, J.A. Cruz, B. Ivanov and G. Edwards (USA and Russia) discuss the regulation of the photosynthetic electron transfer (Chapter 10). This is followed by a presentation by U. Schreiber (Germany) of the Pulse Amplitude Modulation (PAM) Fluorometry and its application to photosynthesis (Chapter 11); R.J. Strasser, M. Tsimilli-Michael and A. Srivastava (Switzerland, Cyprus and USA) present a detailed analysis of the Kautsky curve (Chl *a* fluorescence transient or induction) (Chapter 12); E. Tyystjärvi and I. Vass (Finland and Hungary) discuss the relationship of fluorescence with delayed light emission and thermoluminescence (Chapter 13). L. Nedbal and J. Whitmarsh (The Czech Republic and USA) show and discuss fluorescence imaging of leaves and fruits (Chapter 14), whereas K. Oxborough (UK) presents the use of fluorescence imaging to monitor photosynthetic performance (Chapter 15). This is followed by the

chapter of I. Moya and Z. Cerovic (France) on the remote sensing of Chl fluorescence; and of J.F. Allen and C. Mullineaux (Sweden and UK) on the state-transitions in plants, algae and cyanobacteria (Chapter 17). Non-photochemical quenching (NPQ) of chlorophyll fluorescence and its role in photoprotection is a theme covered in several chapters: G.H. Krause and P. Jahns (Germany) characterize it (Chapter 18); D. Bruce and S. Vasil'ev (Canada) discuss the multiple dissipation processes (Chapter 19); T. Golan, X-P. Li, P. Müller-Moule and K.K. Niyogi (USA) show how one can exploit mutants to study NPQ (Chapter 20). A.M. Gilmore (Australia and USA) summarizes the use of global analysis of time and wavelength-resolved fluorescence in probing energy dissipation mechanisms (Chapter 21); and W.W. Adams III and B. Demmig-Adams (USA) emphasize the use of Chl fluorescence in monitoring plant responses to the environment (Chapter 22); M. Tevini (Germany) focuses on the ultraviolet light effects on plant responses (Chapter 23); N.G. Bukhov and R. Carpentier (Russia and Canada) discuss the effects of water stress on plant responses (Chapter 24), whereas M.K. Joshi and P. Mohanty (India) focus on the heavy metal stress on plants (Chapter 25). G.C. Papagergiou and K. Stamatakis (Greece) summarize the use of Chl fluorescence in monitoring water and solute transport in cyanobacterial cells (Chapter 26); J.K. Hoober and J. Argyroudi-Akoyunoglou (USA and Greece) address the assembly of the light harvesting complexes of Photosystem II and discuss the role of Chl *b* (Chapter 27); H.K. Lichtenthaler and F. Babani (Germany and Albania) discuss the use of Chl fluorescence in monitoring light adaptation and senescence in plants (Chapter 28). This is followed by chapters on productivity of ecosystems: terrestrial (Chapter 29 by J. Cavender-Bares and F. Bazzaz, USA); marine (Chapter 30 by P.G. Falkowski, M. Koblizek, M. Gurbunov and Z. Kolber, USA); and inland waters (Chapter 31 by J. Raven and S.C, Maberly, Scotland, UK).

The current book (ISBN: 1-4020-3217-X) has xxxii + 852 pages, with 8 pages of colored plates; it is the most extensive and comprehensive book on the basics and the applications of Chl *a* fluorescence in plant biology. It is available in a hardcover as well as an 'e-book'. The website of Springer for this 'Chlorophyll *a* Fluorescence' book is at http:// www.springeronline.com/sgw/cda/frontpage/0,11855,4-10030-22-36570283-0,00.html. Table of Contents of this book as well as that of all the *Advances in Photosynthesis and Respiration* books are available at http://www.life.uiuc.edu/govindjee/photosynSeries/ttocs.html.

Other chlorophyll *a* fluorescence books

There are only three other books that deal solely with 'chlorophyll *a* fluorescence': (1) 1986: *Light Emission by Plants and Bacteria* (638 pages; Govindjee, J. Amesz and D.C. Fork, editors), Academic Press, New York; (2) 1988: *Applications of Chlorophyll Fluorescence in Photosynthesis Research*, Stress Physiology, Hydrobiology and Remote Sensing (384 pages; H.K. Lichtenthaler, editor), Kluwer Academic Publishers, Dordrecht; (3) 2003: *Practical Applications of Chlorophyll Fluorescence in Plant Biology* (280 pages; J.R. DeEll and P.M.A. Toivonen, editors), Kluwer Academic Publishers, Dordrecht. The three books are multi-authored: Govindjee et al. (1986) deal with both basics and applications. The focus of books edited by Lichtenthaler (1988) and of DeEll and Toivonen (2003), however, is mainly applications, although some basics are also provided.

The scope of the series

Advances in Photosynthesis and Respiration is a book series that provides, at regular intervals, a comprehensive and state-of-the-art account of research in various areas of photosynthesis and respiration. Photosynthesis is the process by which higher plants, algae, and certain species of bacteria transform and store solar energy in the form of energy-rich organic molecules. These compounds are in turn used as the energy source for all growth and reproduction in these and almost all other organisms. As such, virtually all life on this planet ultimately depends on photosynthetic energy conversion. Respiration, which occurs in mitochondria and in bacterial membranes, utilizes energy present in organic molecules to fuel a wide range of metabolic reactions critical for cell growth and development. In addition, many photosynthetic organisms engage in energetically wasteful *photorespiration* that begins in the chloroplast with an oxygenation reaction catalyzed by the same

enzyme responsible for capturing CO_2 in photosynthesis. This series of books spans topics from physics to agronomy and medicine, from femtosecond (10^{-15} s) processes to season-long production, from the photophysics of reaction centers, through the electrochemistry of intermediate electron transfer, to the physiology of whole organisms, and from X-ray crystallography of proteins to the morphology of organelles and intact organisms. The intent of the series is to offer beginning researchers, advanced undergraduate students, graduate students, and even research specialists, a comprehensive, up-to-date picture of the remarkable advances across the full scope of research on bioenergetics and carbon metabolism.

Future books

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

(1) *Discoveries in Photosynthesis* (Govindjee, J. Thomas Beatty, Howard Gest and John F. Allen, editors);
(2) *Chlorophylls and Bacteriochlorophylls: Biochemistry, Biophysics and Biological Function* (Bernhard Grimm, Robert J. Porra, Wolfhart Rüdiger and Hugo Scheer, editors);
(3) *Photosystem II: The Water/Plastoquinone Oxido-reductase in Photosynthesis* (Thomas J. Wydrzynski and Kimiyuki Satoh, editors);
(4) *Photosystem I: The Plastocyanin/Ferredoxin Oxidoreductase in Oxygenic Photosynthesis* (John Golbeck, editor);
(5) *Photoprotection, Photoinhibition, Gene Regulation and Environment* (Barbara Demmig-Adams, William W. Adams III and Autar Mattoo, editors);
(6) *Photosynthesis: A Comprehensive Treatise; Biochemistry, Biophysics, Physiology and Molecular Biology,* Part 1 (Julian Eaton-Rye and Baishnab Tripathy, editors)
(7) *Photosynthesis: A Comprehensive Treatise; Biochemistry, Biophysics, Physiology and Molecular Biology,* Part 2 (Baishnab Tripathy and Julian Eaton-Rye, editors); and
(8) *The Structure and Function of Plastids* (Kenneth Hoober and Robert Wise, editors).

In addition to these contracted books, we are interested in publishing several more books. Topics under consideration are: Biophysical Techniques, Part 2; Molecular Biology of Cyanobacteria, Part 2; Molecular Biology of Stress in Plants; The Cytochromes; Protein Complexes of Photosynthesis and Respiration; Protonation and ATP Synthesis; Proteomics and Functional Genomics; Global Aspects of Photosynthesis and Respiration; and Artificial Photosynthesis.

Readers are requested 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).

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 express my heartfelt thanks and appreciation to George C. Papageorgiou (co-editor of the current volume) for the highest quality and friendliness of his editorial work. Both of us are grateful to Larry Orr for typesetting this book and for the preparation of the Index; we are indebted to him for his friendly reminders on the rules of the Series. We thank all the authors of Volume 19: without their authoritative chapters, there will be no book. We owe Noeline Gibson (of Springer) special thanks for her friendly and wonderful working connection with the production of this book. Thanks are also due to Jacco Flipsen (also of Springer), Jeff Haas (Director of Information Technology, Life Sciences, University of Illinois, UIUC) and Evan DeLucia (Head of Plant Biology, UIUC) for their support. I am most grateful to Nancy Kiang (of NASA, Goddard Space Center) for the cover of this book. My wife Rajni Govindjee deserves my special thanks for tolerating my work habits and for her help when I needed it most. Our daughter Anita Govindjee and her husband Morten Christiansen; our son Sanjay Govindjee and his wife Marilyn Govindjee provided facilities at different times during the preparation of this book.

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George C. Papageorgiou and Govindjee (eds): Chlorophyll Fluorescence: A Signature of Photosynthesis, pp 1â€“42. Â Chlorophyll (Chl) ï¬‚uorescence is a non-destructive intrinsic probe of several aspects of oxygenic photosynthesis. In this chapter, the goal is to bring to the readers the basics of Chl ï¬‚uorescence, a bit of history, itâ€™s potential. in understanding primary photophysical events (excitation energy transfer; charge separation), and secondary. reactions (electron transport). This chapter is an extension of an earlier overview by the author (Govindjee, 1995). References are made to selected original and historical papers and reviews in order to lead the readers.