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LETTER TO THE EDITOR

Book review: "Photoprotection, photoinhibition, gene regulation, and environment" edited by Barbara Demmig-Adams, William W. Adams III and Autar K. Mattoo (Vol 21 in the Series "Advances in photosynthesis and respiration" by Govindjee). Springer, The Netherlands. ISBN: 1-4020-3564-0; hardcopy; US$ 227 or 170 Euros. Members of ISPR receive 25% discount

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We were entering the long-awaited summer-light period here in "the North Pole" when I was invited to write a review of the newly published book "Photoprotection, Photoinhibition, Gene Regulation, and Environment" edited by Barbara Demmig-Adams, William W. Adams III and Autar K. Mattoo. This new book is Volume 21 in the series "Advances in Photosynthesis and Respiration" edited by Govindjee. Since all the topics are important to my own research, I decided to familiarize myself with the contents of the book during a few holidays I could afford this summer. The contents immediately gave a good impression of handling the topics in a comprehensive way and revealed that the authors of various chapters are leading scientists in their fields. The first theme of the book is how plants suffer from and avoid the harmful effects of light and the second one how light masters the acclimation of plants via different antioxidant mechanisms and signalling cascades in response to contrasting environments. In the end the regulatory aspects of the programmed cell death and leaf senescence are discussed.

On a sunny evening, when the sun hardly sets here in Finland, I started with the first Chapter "A Random Walk To and Through the Xanthophyll Cycle" written by Harry Y. Yamamoto, the pioneer in the field. It was fascinating to read the history about the discovery of the xanthophyll cycle and how the present view of the chemistry and function of carotenoids in photoprotective energy dissipation in leaves has developed. Chapter 2 "Photoinhinition: Then and Now" is written by Barry Osmond and Britta Förster. It gives a wide perspective to the topic emphasising the importance of proper dealing of plants with excess light in their natural environments and reveals the balanced mechanisms involved. Chapter 3 by Marvin Edelman and Autar K. Mattoo follows the same historical style of description focusing on the rapidly turning-over D1 protein in Photosystem II. The three chapters impressed me strongly. To me, coming to the field without knowing the history of the research in detail, it was like reading a good detective book, finding out how the field has developed, indeed very exciting! The authors of the three first chapters are pioneers in their fields and internationally highly esteemed researchers - reading their "stories" and personal experiences in science is simply exciting and shows the importance of international collaboration in testing the scientific ideas that will lead to major breakthroughs. These historical and personal reviews should be a guideline for young scientists in the promotion of their careers. I will strongly recommend my students and colleagues to read these chapters.

The rest of the chapters are not written with such a personal touch as the first three but the same scientific excitement continues throughout the book. Photoprotection by thermal energy dissipation and its relation to photoinhibition are reviewed from several aspects with

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strong emphasis on natural environments and the diversity of mechanisms depending on plant species and their environments. Various types of antenna quenching as well as the reaction centre quenching are successfully discussed and previous confusing terminology in relation to photoinhibition now becomes clearer to the reader. Chapters 4–6 and 11 give an excellent overview to anyone working in the field or entering the field of thermal energy dissipation, and provoke us to consider the integrative view of photoprotection and photoinhibition. Evolutionary description of various LHC family proteins involved in energy dissipation helps in comparisons of the various oxygenic organisms. The question whether thermal energy dissipation decreases plant productivity is also raised, although it still seems to be too premature to give the final answers.

Chapters 7, 12 and 13 concentrate on photoinhibition and the damage–repair cycle of Photosystem II, ranging from UV effects particularly in aquatic environments to visible light induced photoinhibition. Actual molecular mechanisms of photoinhibition are given only a minor consideration but an impression that controversial opinions still exist in the field becomes clear from the contributions of different authors. Mechanisms on PSII repair are thoroughly reviewed using results both from research with algae and higher plants as well as with cyanobacteria. The repair process is described as the most sensitive part of the photoinhibition cycle of PSII and its fantastic function and design are demonstrated to keep the photosynthetic apparatus functional under all light conditions. Partially connected to Photosystem II repair cycle, chapter 8 gives an interesting overview on chloroplast protein phosphorylation and the possible involvements of the phosphorylation–dephosphorylation cascades in many regulatory aspects of photosynthesis.

Chapter 9 gives a general overview of high light induced processes from photoprotection to cyclic PSI and the regulation of nuclear gene expression. Thus, it is a good introductory chapter for the more detailed descriptions in the texts that follow. Chapter 14 moves to Photosystem I and to alternative electron transfer pathways, the cyclic electron transfer around PSI and the water–water cycle. I give high credits to this chapter in presenting clearly the possible mechanisms of different cyclic modes of electron transfer and in describing the benefits of alternative electron transfer routes in contributing to the dissipation of thermal energy, in production of ''extra'' ATP for CO_2 assimilation, and possibly also in energy dissipation in PSI. Extensive antioxidant system for the water–water cycle is likewise reviewed. Chapters 15 and 16 continue in bringing to the picture the function of reactive oxygen species (ROS) and the role of the sometimes paradoxical antioxidant metabolism in the coordination of different signalling pathways during communication of plants with environmental cues. Understanding of the signalling cascades is becoming more comprehensive, yet also much more complicated. New challenges for research are raised by the demonstrated cross-talk between ROS, the redox buffers glutathione and ascorbate, and the various plant hormones. Chapter 19 gives an extensive overview on relatively novel proteins, peroxiredoxins, and their role in detoxifying photosynthesis-produced H_2O_2 and in redox signalling. Chapter 20 focuses on the role of lipoxygenases in programmed cell death, which in turn is intimately related to ROS and antioxidant metabolism.

Redox signalling is a hot topic of many chapters in the book, yet the mechanisms how the information is relayed from chloroplasts to the nucleus still remain largely unknown. The involvement of post-transcriptional regulation mechanisms is also considered. Solving of these questions indeed calls for further investigation. Mechanistically, a somewhat more detailed picture is developing on the redox regulation of gene expression inside chloroplasts, as reviewed in chapter 17.

Chapters 18 and 21 focus more on developmental aspects than environmental constrains. The former one concentrates on retrograde signalling during leaf development by describing the Mg–protochlorophyllide route. Chapter 21 gives a much broader overview on light regulation of plastid biogenesis and gene expression from greening to senescence, including signalling via photoreceptors, hormones and chlorophyll biosynthesis intermediates.

I certainly do not regret using my beautiful summer holidays for reading this book. In the end I was full of new ideas for experiments to be conducted and to be discussed with my students and colleagues. Many pieces of the puzzle found their right place when I progressed with reading the various chapters. Yet, the contents of the book illustrate a huge diversity among species and environments and raises many unanswered questions as well as emphasizes still many controversial opinions among researchers. I particularly liked that many issues of photoprotection, photoinhibition and gene expression were discussed both from the cyanobacterial and eucaryotic i.e plant and algal point of view. It also becomes clear that we are approaching the systems biology way of research to understand the complicated signalling pathways the photosyn-

thetic organisms have evolved to cope with their environments.

I sincerely recommend the book for anyone interested in plant acclimation to the environment, including both senior scientists already familiar with the topics of the book and younger scientists just entering the field. You will certainly find more pieces to your specific scientific puzzle and you will get inspirations in thinking of challenging experiments to be conducted in order to complete the particular puzzle you are working with in the field of plant acclimation to varying environments.

For further details on the book, see http://www.life.uiuc.edu/govindjee/newbook/Vol%2021.html and its ONLINE 'Announcement (DOI 10.1007/s11120-006-9066-8, dated July 8, 2006)' in 'Photosynthesis Research'. It is important to mention that members of the International Society of Research (ISPR) receive 25% discount (http://www.springer.com/ISPR).