Book Review Draft of Volume 21, by Sudhir Kumar Sopory, for Current Science

Phtotoprotection, Photoinhibition, Gene Regulation and Environment
Eds: B.Demming-Adams, W.W.Adams III and A.K. Mattoo, Volume 21, Advances in Photosynthesis and Respiration (Series Editor : Govindjee), Springer, Dordrecht, 2006.

Over the years our research work has moved from *photomorphogenesis* to the area of *stress biology* and that was one reason, when approached by the editors of this book, I was initially reluctant to review it. Once in my hands, and I started reading the chapters, I found that there was much overlap with my current interests. The reading expanded my own concepts and taught me how one could look at the plant biology from an overall perspective with reference to plant adaptation mechanisms under normal and stress environment. In fact the front cover of the book says it all. From the title , the picture and the names of the editors and the series editor, one gets an idea of what is expected within the hard covers of the book. The three editors (B.Demmig-Adams, W.W.Adams and A.K.Mattoo) have contributed chapters in one of the book that I and Govindjee edited, along with G.S. Singhal, G. Renger and K-D.Irrgang (Concepts in Photobiology, Narosa) and hence I knew their work and strengths. I have also worked in the laboratory of one of the editor (AKM) .The reading of this book also took me back to some of the work I was associated with the D1 protein and plastid signaling (in R.G.Herrmann's lab in Munich, Germany). I therefore started reading each chapter to broaden my interests and understanding. However, I must confess that it is difficult for me to comment on all the chapters and therefore I present here an overview of the whole book in general.

The complete table of content is available at :
<http://www.life.uiuc.edu/govindjee/References/Volume%2021%20By%20Chapter.htm>,
whereas other information is available at:
<http://www.life.uiuc.edu/govindjee/newbook/Vol%2021.html>.

The book has 21 chapters, xxi +380 pages (its ISBN is: 978-1-4020-3564-7). In the first chapter, H.Y. Yamamoto presents his personal experiences about his work and achievements in the studies of Xanthophyll cycle. It is a wonderful reading that describes how the concepts and the field developed as new technologies were used.

Of the other chapters, seven of those cover various aspects of photoinhibition, six are on photoprotection, and others are in the area of signal mechanisms and gene expression. Included in the third category are three chapters on antioxidants and Reactive Oxygen Species (ROS) signaling, two chapters on redox and gene expression and one chapter each on plastid signaling and photosynthetic gene expression.

The chapter on photoinhibition by B. Osmond and B. Förster brings out a "holistic view of photoinhibition from the molecule to the biosphere—" In this chapter though

different hypothesis have been described: studies with mutants in Chlamydomonas showed an important role of the D1 protein. Among other topics, the biogenesis and the role of chloroplast coded D1 protein have been studied in the laboratory of M. Edelman (in Rehovot, Israel) and A.K.Mattoo (USDA, Beltsville, USA) who have summarized the excitements of their research for the last 25 years on this protein in chapter 3. I was fortunate to have been associated with their research during my sabbatical at USDA. At that time the discovery of 32Kda * was made which was later found out by T.D..Elich et al. to be a phosphorylated form of D1 protein. In a chapter by B. Demming-Adams et al., mechanism of thermal dissipation under favorable and unfavorable environmental conditions has been explained. The role of the PsbS protein and a relationship of thermal dissipation in Zeaxanthin and Antheraxanthin - and phosphorylation of the D1 protein is shown especially with reference to the evergreens "which seem to have greater propensity for photoinhibition than plants with shorter-lived leaves". In the following chapter, William Adams et al. describe the consequences of photoinhibtion and mechanisms of photoprotection. The role of Xanthophyll cycle and zeaxanthin – dependent energy dissipation has been clearly described in the process of photoprotection. How photoinhibtion and photoprotection mechanisms operate under abiotic stresses like drought and salinity and under iron and nitrogen deficiency has been covered in a chapter by F. Morales et al.

From an ecological perspective, another interesting question, i.e., whether the photoinhibtion mechanisms are the same in the terrestrial and aqauatic environement, has been answered with examples by D.P. Hader using UV light as a causative agent for photoinhibtion. It seems that although the broad mechanism may be similar in most organisms, yet microalgae have developed several strategies for protection against excessive light stress like production of carotenoids, mycosporine- like amino acids and other chemicals which have not yet been fully identified. Two other chapters that deal in details about the photoprotection mechanisms, especially at the molecular level are by H.S.Jung and K.K.Niyogi and by S. Jansson. The latter chapter deals with different systems, algae, liverworts, mosses, ferns and conifers, and brings out the role of Light harvesting complexes (LHC's) and also of "Quenching proteins". The details of reaction center quenching versus antenna quenching are, however, discussed by N.P.A. Huner et al.; these authors describe reaction center quenching in different systems, from alga to higher plants, and mechanisms of quenching , again bringing out the role of the D1 protein in focus. In their chapter, Jung and Niyogi, besides discussing the production of ELIP (Early Light Induced Proteins) and Heat Shock Proteins (HSPs) etc under high light stress, have also brought out the role of antioxidants, like carotenoids, ascorbate and tocopherols in photoprotection . The role of antioxidants has, however, been discussed in more details by C.Foyer et al. .This chapter and also that by C.Mullineaux et al. have brought the importance of generation of ROS and antioxidant signalling in relation to inducing antioxidant defence system in chloroplasts. The involvement of lipoxygenases and role of antioxidants in controlling lipoxygenase mediated apoptosis has been discussed by M. Maccarrone.

The other chapter on photoinhibition and Photosystem II (PSII) damage and repair is by K. Yokthongwattana and A. Melis. They have again brought out the role of Zeaxanthin , Hsp-70 and in addition a new component-- a chloroplast targeted sulfate permease. The other chapter on PS II repair by Y. Nishiyama et al. has looked at similar processes under light, oxidative, salt and low temperature stress. The role of redox signaling and peroxiredoxins has been discussed by K.J. Dietz et al. Though many chapters have discussed the role of PSII, the editors have not overlooked the role of PSI. The importance of Cyclic electron flow around PSI and water-water cycle and their respective roles in stress responses have been discussed in a chapter by T. Endo and K. Asada. (For complete information on PSII and PSI, I recommend the readers to consult volume 22 (edited by T.Wydrzynski and K. Satoh) and 24 (edited by J. Golbeck), respectively: <http://www.life.uiuc.edu/govindjee/newbook/Vol%2022.html> and <http://www.life.uiuc.edu/govindjee/newbook/Vol%2024.html>.)

The mechanisms of gene expression have been discussed in a few chapters in great details. As mentioned above, one of these is by C. Mullineaux et al. The other one, by S. Baginsky and G. Link gives an overall picture of regulation of chloroplast gene expression under changes in the redox status of the cell and brings out the regulation at both the transcriptional and the post-transcriptional level. The chapter by R.M. Larkin has, in addition, brought out the concept of plastid –to nucleus signaling. This concept was initially started in the laboratory of Hans Mohr whom I had the privilege to know personally. This was followed up by other workers including Ralf Oelmüller with whom I have worked together in the laboratory of Herrmann. The last chapter by C. and S. Reinbothe covers the regulation of photosynthetic gene expression during development and senescence.

A brief introduction to the various chapters in the book, as illustrated above, should give the reader of this book a clear impression that the task of integrating various themes of photoinhibition, photoprotection and gene expression has been well achieved by the Editors and the Series Editor . This book has volumes of information. The chapters have built in concepts, based on data, and contain well illustrated explanatory diagrams. The contents of each chapter can be grasped effortlessly and are easy to understand. I recommend this book to everyone working in the area of photosynthesis, stress biology, molecular biology of organelles and plant molecular biology. Further, I recommend it highly to all the biology libraries of the universities and research institutions, especially when Bioenergy and Global issues are at our door steps.

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