Advances in Photosynthesis and Respiration. Govindjee. Series Editor. Light Harvesting Antennas in Photosynthesis. Beverly R. Green and William Parson (eds). Kluwer Academic Publishers. Vol. 13. 2003. 43 pp. ISBN-O-7923-6335-3. Price $ 231.

Photosynthetic organisms (bacteria, algae and higher plants) silently do a miracle – they convert light energy into high energy chemicals by which they support and maintain the life and environment on earth. No wonder, this process of conversion of solar energy into chemical energy by plants has the unusual stoichiometry involving 8–12 quanta and about 2400 chlorophylls (chls), per O_2 evolved, as shown below:

$$6\,CO_2 + 12\,H_2O \xrightarrow{\text{(8 quanta, 2400 chl)}} O_2 + 6\,H_2O + \text{Sugar}\,\{C_6H_{12}O_6\}.$$

The discovery of the participation of as many as 2400 chls for the evolution of one molecule of O_2 was made in 1932, by a teacher and his students, Robert Emerson and William Arnold. They showed that algal cells needed the participation of 2400 chls to evolve one molecule of oxygen when they were exposed to optimum conditions (high intensity saturating light flashes given between optimal dark intervals). Since as many as 8 to 12 quanta are required for one molecule of O_2, it becomes clear that plants use chlorophyll antenna to harvest quanta for photosynthesis. These glittering green antennas signal the safe sustenance of life on earth. The book under review tells in totality the story of these antennas. Edited by two eminent scientists who have themselves contributed immensely to our current understanding of the structure and function of various types of light harvesting antenna, this story has been presented beautifully in this volume. This 17 chapter-volume is authored by 31 scientists besides the two editors, many of whom are well-known names in photosynthesis research.

The 17 chapters have been grouped into three parts: the first four chapters (in part I) introduce the antenna types and their general structures, antenna pigments and their spectroscopic characteristics. The part II has seven chapters that deal with the structure and function of antenna of purple bacteria, photosystem I and II, cyanobacteria, red algae and chl *a* containing algae. The remaining six chapters in the third part discuss the biogenesis, regulation and adaptation of these various types of light harvesting systems (LHS) of photosynthetic bacteria and plants. Of the four chapters in part I, the first chapter not only introduces the different types of photosynthetic prokaryotic and eukaryotic (chloroplasts) antennas, their genesis and evolution, but also gives an inspiring picture on the complete content of the book. The second chapter on the pigments contains a 'mine full' of information on the various kinds of antenna-chromophore – the chlorophylls, phycobillins and carotenoids, their structure, physicochemical properties and the analytical methods used to study antenna-chromophores. The author also draws attention to the various modes of modification, both genetic and chemical, of antenna-chromophores that alter their spectroscopic and redox properties. This chapter should be useful to teachers who teach plant biochemistry. The next chapter is on the spectroscopic characterization of the antenna, a chapter that the reviewer feels should be liked by biologists interested in optical or spectroscopic tools and techniques. In chapter 3, the evolution of antenna from the earliest anaerobic prokaryotes to the chloroplasts of photosynthetic antennas through gene depletion, diversions, acquisitions and losses, as well as the sequences of endosymbiotic events that led to the development of green-antenna of chloroplasts have been presented. This is a very lively chapter and will provide interesting material for courses on plant biology, microbiology, biochemistry and genetics.

The next seven chapters, in part II, give the structure–function interrelations of the light harvesting antenna-system of purple bacteria (chapter 5), green bacteria (chapter 6), the phycobillisomes of cyanophyta and rhodophyta (chapters 9, 10) and that of photosystem I (chapter 7) and photosystem II (chapter 8) of green chloroplasts and light harvesting system (LHS), chlorophyll *c* containing antenna which are found in diverse classes of algae (heterokonts, cryptophytes and dinoflagellates). Each of these chapters gives not only the structure–function uniqueness of that specific LHS, but also their specializations, as well as their biogenesis, assembly and evolution. The third part discusses the biogenesis, regulation and adaptation of light harvesting (LH) antennas and these aspects are of interest to the researchers in India as some of the Indian laboratories are working on light harvesting potentials, under stress conditions, of the algae, cyanobacteria and crop plants. Even the simple LH structure of purple bacteria has complex multilevel regulatory path of gene expression of LH complex, and a variety of environmental factors like O_2 and light intensity influence the process (chapter 16). In this book, one finds interesting focus on the pathways of translocation of nuclear proteins into thylakoids, site of thylakoid protein transport, regulation by chl-synthesis, the expression of LHC genes (chapter 12). Chapter 17 depicts environmental regulation of biogenesis of phycobilisomes (PBS) especially by nutrient status and the organization and expression of PBS genes as well as the photobiology of the complementary chromatic adaptation which is regulated by a photoreceptor that seems to control the genes encoding PBS.

There are three chapters that discuss the adaptation of LHS of plants, algae and cyanobacteria. Of these, chapter 13 discusses the application of a popular fluorometric technique called Pulse Amplitude Modulated (PAM) chl *a* fluorescence. Since most of chl *a* fluorescence at room temperature is emitted by LH antenna, this PAM technique is a powerful tool for *in vivo* studies of a variety of photosynthetic regulatory processes. However, it would have been useful if some discussions in this chapter on the light emission characteristics of specific LHC components of photosystem I and II were presented as valuable data exist on this topic in the literature.

The adaptation and acclimation of plants to environment involves the adjustment of the light gathering-LHS. Thus, light harvesting for photochemistry needs to be regulated for energy utilization by the metabolic-mills of photosynthetic organisms. This balancing of energy budget is termed 'photostasis' which is important for plants not only during growth and development, but also in adapting to limitations and stresses in degradation and repair of parts. The chapter on photoacclimation of LHS in eukaryotic algae (chapter 15) shall be of interest to researchers working on coastal ecosystems in India. In this chapter, the authors give the salient information on remote sensing of phytoplankton pigments, the spectral irradiance of aquatic ecosystems, to the physiological responses to spectral changes and evolution of photosynthetic irradiance response by estimating effective absorption cross section. The physicochemical response to the variations in spectral irradiance become observable in terms of net synthesis of LHC which has been evaluated along with the contributions of different physical factors to this process.

I feel that a short overview on the crystal structure of membrane proteins and of some selected antenna would have been within the scope of this volume. Also, addition of a chapter giving salient preparative methodology for characterizing LHS in different organisms would have been valuable since 'biodiversity' is a frontline research area in biology.

In my opinion, the new and most striking features of this book are (i) comprehensive overviews on all aspects from structure to evolution of all types of photosynthetic antenna; (ii) structural and functional beauties of these antenna; (iii) the regulatory roles that these light harvesting systems play in maintaining efficient light energy harvest and utilization by the organisms; and (iv) extremely attractive illustrations that give deep insights into the topics that could aid the subject teachers in the classrooms. An interesting new feature of the AIPH series is the inclusion of writeups on the Editors and the Series Editor. Such personal information will be of great interest to students.

In conclusion, this volume is a magnificent addition to the already successful AIPH series. The content of this book is sure to find its place in the courses in plant biophysics, biochemistry, microbiology and biotechnology. My major point of concern is how this important book shall be available to the students who need it the most because it is too expensive even for college libraries in India. We must explore means and methods to solve this problem because 'new biology' is becoming very attractive. Despite this, I recommend all biologists to read the interesting story of the golden green antenna that collects light for conversion into chemical energy that not only sustains life, but also makes our world worthy of living.

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Sivaramakrishna Chandrasekhar

Sivaramakrishna Chandrasekhar, the well-known liquid-crystal physicist died on Monday, the 8 March 2004, after a brief illness. He was 73. He is survived by his wife, a son and a daughter.

Chandrasekhar was born on 6 August 1930 at Calcutta. He received his M Sc degree in physics with first rank from Nagpur University in 1951. Subsequently, he joined the Raman Research Institute (RRI), Bangalore to work for his doctoral degree in physics under the guidance of his maternal uncle, C. V. Raman. The main topic of his research was related to optical rotatory dispersion measurements on several crystals. He received the D Sc degree from Nagpur University in 1954.

In 1954 he went to the Cavendish Laboratory as an 1851 exhibition scholar and obtained a second doctorate degree from Cambridge University mainly for his work on the corrections for extinction in neutron and X-ray scattering from crystals. His subsequent postdoctoral work in the University College and the Royal Institution at London also dealt with crystallographic problems. He returned to India in 1961 as the first Head of the Department of Physics, which had just been started in the University of Mysore at Mysore. It was here that he turned his attention to liquid crystals, a subject which at that time was just coming out of a long hybernation.

Liquid crystals made of rod-like molecules had been discovered in 1888, and many compounds had been synthesized in Halle in Germany in the 1920s and 30s. Some physical studies had been undertaken by the German and Russian schools during that era, but the subject later languished till the mid-fifties. Starting in the late fifties, the systematic synthetic effort by Gray in the UK and the physical studies by Maier in Germany (including the well-known Maier–Saupe or MS theory) started a revival of the subject. Chandrasekhar and his co-workers made contributions to the application of the dynamical theory of reflections to study the fascinating optical properties of cholesteric liquid crystals which have a helical structure with a pitch which is usually ~ 0.5 μm, and to the extensions of the molecular theory of nematic liquid crystals beyond the MS model. (On a personal note, I could add that I joined him as the first Ph D student to work on liquid crystals towards the end of 1965.)

Chandrasekhar was invited to establish a liquid crystal laboratory in RRI after DST started supporting it in 1971. The move had a highly positive impact on his productivity. Along with a couple of former students who moved with him to RRI, he could, in a short time, develop a laboratory with all the essential facilities needed for research in the chosen area. Realizing that cutting-edge research would not be possible without an in-house capacity to produce new materials, a synthe-