

worked-out examples based on the many formulae appearing in the various chapters. These exercises provide the reader with a working knowledge of their use and a feeling for numbers, magnitudes and dimensions involved.

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Chlorophylls and Bacteriochlorophylls: Biochemistry, Biophysics, Functions and Applications. B. Grimm *et al.* (eds). Springer. 2006. 603 pp.

Research on the chemistry of chlorophylls (Chls) and bacteriochlorophylls (BChls), the most abundant pigments of plants, algae, cyanobacteria and photosynthetic bacteria, has attracted the attention of the Nobel Committee and has led to three Nobel prizes in chemistry to: Richard Wilstätter (1915), Hans Fischer (1930) and Robert Burns Woodward (1965). In the energy-demanding world, that now shows a lot of interest in alternate sources of energy, other than the fossil fuel, this edited book on Chls that absorb and utilize solar energy is most timely. The practical applications of solar energy absorption and its conversion to food and fuel by Chls and BChls; its importance in climate change especially in global warming in high CO₂ regimes, and the medical applications of Chls and BChls, especially in photodynamic therapy of cancer, will continue to be an intensive research field in the present century. Many of these applications are included in this volume. The book will give im-

petus to further research in several other emerging areas of photosynthesis, which are of both ecological and biomedical nature.

This book is a part (vol. 25) of the *Advances in Photosynthesis and Respiration Series* (Series Editor, Govindjee). It has 37 chapters dealing with Chls and BChls, written by 70 established authors in the field. In 1991 Hugo Scheer had edited a book *Chlorophylls*, that was published by CRC Press, Boca Raton, Florida. The current book is also an edited volume, but covers a much greater depth than the earlier book. It contains several colour plates and reviews recent progress in the current status of knowledge of metabolism, spectroscopy, chemistry of Chl and BChl and their assembly in pigment-protein complexes.

An introductory overview of occurrence, absorption and emission maxima, structure and function of different forms of Chls and BChls, is included in a thorough chapter (Scheer) that will serve as a quick reference for graduate students and scientists working on tetrapyrroles. The next five chapters elucidate in detail the conformational flexibility, chemical synthesis, and chemical modifications of chlorophylls (Senge *et al.*); chemistry, absorption spectra, separation and distribution of chlorophyll *c* (Zapata *et al.*); unusual tetrapyrrole pigments of photosynthetic antennae and reaction centres in photosynthetic bacteria and plants (Kobayashi *et al.*); heavy metal-chlorophylls (Küpper *et al.*), and absorption and fluorescence properties, mass spectra and NMR spectra of several forms of Chl and BChl (Kobayashi *et al.*). These chapters describing the synthesis, detailed chemistry and spectroscopic properties of several unusual Chls, will immensely help researchers working in the field. The book also provides exhaustive information on spectrophotometric and spectrofluorometric estimation of Chls and BChls (Porra); separation of different chlorophylls and carotenoids using High Performance Light Chromatography (Garrido and Zapta), and others by simple open-column chromatographic methods (Shioi). These chapters will be helpful to researchers working on purification of plant pigments. Chl biosynthesis is nicely presented (Rüdiger and Grimm); up-to-date information on 5-aminolevulinic acid biosynthesis and structural details of enzymes involved in its synthesis are also available (Beale, Jahn *et al.*), as

well as biosynthesis of protochlorophyllide and protoheme (Yaronskaya and Grimm) and finally the formation Chl *a*, Chl *b* and BChl (Rüdiger, Friggard *et al.*). The involvement of tetrapyrroles in cellular regulation, especially their role in inter-organellar signalling, is covered in the book (Beck and Grimm), as well as Chl catabolism that deals mostly with the biochemistry of Chl degradation products (Kräutler and Hörtensteiner). A chapter on the evolution of Chl, BChl and oxygenic photosynthesis (Larkum) is thought-provoking and will be of great interest to all biologists.

Several chapters in the book on the topic of the 'Native environment', and the various techniques to understand it, follow: Physical properties of protein-BChl interaction (Allen and Williams); magic angle spinning NMR of the chlorosomes (de Boer and deGroot); single molecule spectroscopy of pigment-protein complexes from purple bacteria (Köhler and Aartsma); Raman spectroscopy of bacteriochlorins (Koyama *et al.*), and mapping of global ring currents of porphyrins and chlorins (Steiner and Fowler) are other rare chapters, nicely elucidated along with appropriate figures.

Chls and BChls are always complexed with proteins in living organisms. The book rightly addresses the problem of assembly of Chl-protein and BChl-protein complexes and supramolecular organization of these complexes in plants and bacteria (Noy *et al.*, Nango, Paulsen, and Garcia-Martin *et al.*). Four chapters cover the functions of Chls and BChls. The excitation energy transfer within Chls (Leupold *et al.*); carotenoids to Chls (Koyama and Kakitani); electron transfer in the photosynthetic reaction centre (Wachtveitl and Zinth); utilization of the solar energy by Chl and protective functions of Chl (Melkozernov and Blankenship); utilization of Chl *a* fluorescence as a signature of photosynthesis (Nedbal and Koblížek); monitoring Chl in the ocean from outer space by remote sensing (Morel) and geochemistry of Chl (Keely) are nicely described and critically discussed in the book.

A significant aspect of the book is the discussion of the use of Chl, BChl and their biosynthetic intermediates to therapeutic research, especially in photodynamic therapy of cancer. Two chapters (Brandis *et al.*) will be useful to researchers working in the area of photomedicine.

BOOK REVIEWS

More information on this book and others in the *Advances in Photosynthesis and Respiration Series* is available at Govindjee's photosynthesis page (<http://www.life.uiuc.edu/govindjee>). Further, readers can find complete references to all the chapters in this book at: <http://www.life.uiuc.edu/govindjee/References/Volume%2025%20By%20Chapter.htm>

A unique feature of this book is the inclusion of a useful website for supplementary material (<http://epub.ub.uni-muenchen.de/archive/00000776/>). Eight colour plates presented in the front matter of the book, that include structural organization of several photosynthetic pigment-protein complexes of bacteria, cyanobacteria and higher plants, will be helpful to students and researchers for an

understanding of the apparatus that performs photosynthesis. As an added bonus, Govindjee has not only provided a brief history of the field, but a list of all the published books on Chls and BChls.

Overall this is an interesting, useful and timely book related, although indirectly, to the solution of the world's energy problems. I recommend it to graduate students and scientists working on chemistry, biochemistry, molecular biology, biophysics, photo-medicine, remote sensing and molecular evolution of Chl, BChl, carotenoids and photosynthetic processes. In view of the high price of this book (US\$ 279; Euro 245; British Pounds 176), I recommend that major science libraries and research institutions acquire it for the use of students and

teachers alike. I also recommend this book to members of the International Society of Photosynthesis Research (<http://www.photosynthesisresearch.org/>), since they got 25% discount. Finally, I would very much like to see Springer producing additional, inexpensive paperback editions of this and other *Advances in Photosynthesis and Respiration Series* of books for students and scientists in the developing countries.

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