Photosynthesis. Plastid biology, energy conversion and carbon assimilation

When one thinks about plants one invariably thinks about photosynthesis. Photosynthesis has long been a central theme of plant science, driven by early curiosity and discoveries that led to research momentum in this area. Many of the mysteries of plants could be explained, it was thought, if this central driving force could be understood. Years of research have revealed the complexity and intricacy of the molecular detail of photosynthetic processes at one level, together with their integration with the whole plant and interface with the environment at the other. We are at a time when there is renewed interest in photosynthesis, particularly as a means to improve crop yields, and the book is very timely.

Photosynthesis. Plastid biology, energy conversion and carbon assimilation is volume 34 of Springer’s series ‘Advances in Photosynthesis and Respiration’; these two subjects have been grouped together because of the similarities in the protein complexes and bioenergetics machinery involved. It is a substantial volume and is organised into eight parts, which are subdivided into 33 chapters. The eight sections start with ‘The photosynthetic world’ and then go on to encompass ‘Plastid biochemistry and physiology’ (part 2), ‘Photosynthetic responses of plants to environmental stress’ (part 3), ‘Energy conversion’ (part 4), ‘Carbon assimilation, sucrose synthesis and transport’ (part 5), ‘Climate change and photosynthesis’ (part 6), a ‘Historical perspective’ (part 7) and a section on ‘The career of Govindjee’ (part 8), to whom the book is dedicated. Most weight in the book is given to light reactions and energy conversion processes, with about a fifth of the content covering carbon metabolism and leaf level processes. This balance reflects the career of Govindjee, whose research focused on light reactions of photosynthesis and discoveries in photosystem II in particular. The chapter on ‘Early pioneers of photosynthesis research’ provides a fascinating insight into the long history of inquiry into photosynthesis. This interesting section shows how ideas change and develop over time and provides an interesting context for current understanding in the field. In-depth analysis of the career ofGovindjee follows, showing the tremendous productivity and insightfulness of one man. Apart from an interesting chapter on ‘Artificial photosynthesis’, this is very much a book about fundamental plant science. Topics in photosynthesis that are not given special attention and dealt with in depth are C4 photosynthesis, Crassulacean Acid Metabolism, photosynthetic nitrogen assimilation, photorespiration, starch metabolism and the impact of leaf and canopy architecture on photosynthesis; neither are applied aspects such as photosynthetic improvement or crop science dealt with in detail. It would be more-or-less impossible to cover all aspects of photosynthesis in one book and readers can find excellent coverage of these topics elsewhere. What the book does cover, however, which is substantial, it does very well.

One feature of the book is the breadth of photosynthetic organisms that are covered. This begins in the first chapter, ‘The photosynthetic world’, which presents a broad, global introduction to photosynthesis that goes on to compare and characterise the diversity of different photosynthetic organisms, including the reaction centres involved and their evolution, making the point that a single endosymbiotic event gave rise to the plastids of all eukaryotic autotrophs. This theme continues in Part II, which covers the origin, evolution and division of plastids, articulating that science has been able to decipher in a few decades what nature has taken millions of years to achieve.

Substantial detail resides in these chapters, which makes them a valuable resource for students and teachers, appealing to advanced undergraduates, postgraduates and researchers, particularly those with an interest in light reactions of photosynthesis. Although some of the technical detail may be beyond that necessary for undergraduates, the comprehensive nature of the chapters makes this a rich resource. The book is well laid out with clear diagrams and plenty of room for annotation of the text. Each chapter essentially serves as a up-to-date review article of each field covered and ends with a comprehensive list of references, including primary research papers that will be valuable should readers wish to read source material in depth; not many text books provide such a large bibliography.

In summary, this is an excellent treatise that covers fundamental aspects of the photosynthetic processes from pigments, light harvesting and energy conversion, effects of environmental stress on the photosynthetic system, through to CO2 fixation and synthesis and transport of sucrose. The book ends with an interesting historical account of the development of ideas in photosynthesis followed by a section on the career of Govindjee. Diagrams are clear, with some use of colour, and the text is well laid out. Each chapter ends with a useful bibliography to enable further investigation of primary sources. The book will be a valuable resource for advanced students, teachers and researchers of photosynthesis.

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