# Preface

The *Encyclopedia of Plant Physiology* series has turned several times to the topic of photosynthesis. In the original series, two volumes edited by A. PIRSON and published in 1960 provided a broad overview of the entire field. Although the New Series has devoted three volumes to the same topic, the overall breadth of the coverage has had to be restricted to allow for greater in-depth treatment of three major areas of modern photosynthesis research: I. Photosynthetic Electron Transport and Photophosphorylation (Volume 5 edited by A. TREBST and M. AVRON, and published in 1977); II. Photosynthetic Carbon Metabolism and Related Processes (Volume 6 edited by M. GIBBS and E. LATZKO, and published in 1979); and III. Photosynthetic Membranes and Light-Harvesting Systems (this volume).

As we approached the organization of the current volume, we chose a set of topics for coverage that would complement the earlier volumes, as well as provide updates of areas that have seen major advances in recent years. In addition, we wanted to emphasize the following changes in the study of photosynthetic systems which have become increasingly important since 1977: the trend toward increased integration of biochemical and biophysical approaches to study photosynthetic membranes and light-harvesting systems, and a renewed appreciation of the structural parameters of membrane organization.

Due to the increased complexity of the field, we also decided to try a new format for our volume to better serve the following two purposes. First, we believe a review volume on photosynthetic membranes should serve as a reference source for nonspecialists interested in obtaining an overview of both oxygenic and anoxygenic photosynthesis. This need has been answered by the inclusion of five introductory chapters which summarize the main broad topic areas of the volume. We also recognize that a review volume should provide insight to the "state of the art" in specific research areas which have seen major recent advances. To this end, Chapters 6 through 11 have been organized such that each consists of a number of minireviews related to a common theme. All of the 43 minireviews are authored by highly regarded specialists, and focus on recent research highlights and interpretations of significant new findings. Great emphasis has been placed on the integration of the materials covered in the introductory chapters and in the minireviews. Extensive cross-referencing has been used to allow easy transitions by the reader from a general to a specialized coverage of a topic. Similarly, all minireviews contain references to the appropriate introductory chapters, as well as to other minireviews.

With students in mind, the authors of the introductory chapters have stressed integrative and comparative aspects of their topics. This type of approach is becoming more and more relevant in photosynthesis research, thanks to the convergence of information coming from structural, biophysical, and biochemical studies. Indeed, it is truly exciting to witness the progress being made toward the goal of a molecular understanding of the diverse biophysical and biochemical reactions associated with photosynthetic membranes and light-harvesting systems.

The specialized chapters in this volume begin with the topic of light harvesting by photosynthetic membranes. The minireviews of Chapter 6 summarize biochemical and structural studies of light-harvesting assemblages, with emphasis on the light-harvesting components of bacteria and algae, since higher plant chloroplast components are extensively reviewed in Chapter 3. Whereas Chapter 6 emphasizes the biochemical diversity in light-harvesting systems, Chapter 7 consists of minireviews which discuss unifying concepts governing light-harvesting events. All authors in this section are concerned with photon absorption and structural parameters of the pigment bed that determine the efficiency of excitation energy transfer to reaction centers.

The most fundamental result of photosynthetic light reactions is the conversion of excitation energy, derived from absorbed light, into stable chemical form. This occurs in the reaction center (RC). In the last 5 years there have been major advancements in the understanding of these processes – especially by those groups who have focused their work on photosynthetic bacteria. The identity of the cofactors (chlorophyll, pheophytin, quinones, etc.) involved in the initial charge separations and the events involved in charge stabilization are now highly defined. The minireviews of Chapter 8 present various aspects of this rapidly moving field, ranging from energetic considerations of the RC to discussions of similarities and differences among the different types of protein which comprise different reaction centers.

Chapter 9 makes a transition from the highly defined bacterial reaction centers into the less well understood photosystems I and II of green plants. The inclusion of several minireviews devoted to the complexity of reactions in photosystem II, for example, reflects the wide diversity in studies of a system capable of extracting electrons from water and catalyzing a stable charge separation that results in reduction of the plastoquinone pool. These studies extend from detailed understanding of the primary reactions to physiological adaptation of the process to light and chemical (herbicide) stresses.

The reaction centers of prokaryotic and eukaryotic photosynthetic membranes produce high energy electrons which are utilized in electron transport reactions. The energy released in these reactions is coupled to ATP synthesis. The membrane components and processes involved in the energy-coupling reactions are the topic of Chapter 10. Minireviews in this section are strongly biochemical in emphasis, with special reference to the structural organization of membranes and the protein complexes which mediate proton translocation and ATP biosynthesis. Specific enzymes involved in electron transport and inhibitors which affect them are reviewed in light of information obtained since 1977.

The last chapter of this volume (Chap. 11) deals with the use of integrative approaches to study processes associated with control of photosynthetic membrane assembly and maintenance. Chapter 11 includes subject material ranging from comparative structural analysis of photosynthetic membranes (developmental diversity) to the use of physical analysis of membranes or simulated membrane systems to characterize functional components. The minireviews of this chapter will be of increasing value as the field of membrane biosynthesis and assembly matures to use more information about physical and biochemical features of the photosynthetic membranes. We can anticipate the advent of use of genetic engineering tools to manipulate photosynthetic membranes, and the rapid expansion of knowledge in this area.

In summary, this volume is a selection of both overview chapters and numerous topical speciality reviews. It should be useful as a reference source and as a teaching aid for individuals interested in the rapidly expanding field of photosynthetic membranes.

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