

Preface

Photosynthesis, the driving force for life on earth, has been studied by biochemists, biophysicists, plant physiologists, and agronomists. Similarly, lipids have attracted the attention of researchers in plant physiology, photosynthesis and agronomy. Moreover, even though glycolipids are among the most abundant natural compounds in the biosphere, glycolipids in chloroplast membranes were discovered only in the 1950s. Subsequently, however, studies of glycolipids have proceeded at an exponentially increasing rate and copious information is now available on the chemical structures and physico-chemical properties of glycerolipids, as well as on their occurrence and distribution among many genera of cyanobacteria, algae, mosses, and higher plants. Considerable efforts have been made to elucidate the biosynthetic pathways to glycerolipids and fatty acids and, more recently, interest in glycerolipids has shifted towards their roles in the structures and the functions of the thylakoid and chloroplast envelope membranes. In addition, the development of the methods and concepts of molecular biology has yielded answers to many questions that are related to the genes and enzymes that participate in the synthesis of membrane and storage lipids and in the regulation of such synthesis.

Several excellent books are available that deal with recent research on photosynthesis, and there are also a number of books that summarize recent progress in plant-lipid research. In 1998, Paul-André Siegenthaler and one of us (NM) edited a book entitled "Lipids in Photosynthesis: Structure, Function and Genetics" in the "Advances in Photosynthesis and Respiration" (series editor, Govindjee). This book emphasized the importance of lipids in photosynthetic processes and the importance of photosynthesis in the synthesis of lipids. In the years following the publication of this earlier volume, great advances have been made in this area of research. In particular, genetic and genomic approaches revealed the importance of individual lipid species in photosynthesis and its regulation. We hope that researchers and students of photosynthesis will read it to gain a fuller

appreciation of the new findings and concepts that have accumulated over the past decade. Readers will also find updated information about various lipids, such as the major phospholipids and sphingolipids that appear to be involved in the regulation of photosynthesis. This book is intended for a wide audience but it is designed specifically for advanced undergraduate and graduate students and for researchers in photosynthesis who are interested in the functions and roles of membrane and storage lipids.

Chapter 1 provides a brief overview of findings made during the last decade by exploitation of newly available information and techniques, such as genome sequences, mutagenesis and transgenes, and physical and electron-microscopic methods. Readers are directed to appropriate chapters in which each specific topic is covered in depth. We have also made an effort to provide cross-references between chapters to help readers access all relevant materials on each specific topic.

The other chapters encompass several major themes: The structure, molecular organization, and biosynthesis of fatty acids in plants (Chapter 2); the structure, composition and biosynthesis of membrane glycerolipids in higher plant chloroplasts (Chapter 3), in plant mitochondria (Chapter 4), in lower plants, algae, lichens and mosses (Chapter 6), in the green alga *Chlamydomonas reinhardtii* (Chapter 7), and in cyanobacteria (Chapter 8); the structure, composition, and biosynthesis of membrane nonglycerolipids, namely, sphingolipids in photosynthetic organisms (Chapter 5) and heterocyst-specific glycolipids in cyanobacteria (Chapter 9); the molecular structural organization of glycerolipids in the photosynthetic apparatus (Chapter 10); the roles of glycerolipids in the photosynthetic membranes of higher plants and cyanobacteria (Chapters 11 and 12); the dynamics and architecture of thylakoid membranes with emphasis on their lipids (Chapters 13 and 14); the genetic manipulation of the unsaturation of membrane lipids and its effects on gene expression and photosynthesis (Chapters 15 and 17); lipid trafficking

in chloroplasts and cells of higher plants (Chapter 16); the genetic manipulation of the biosynthesis of triacylglycerol in plant seeds (Chapter 19); the functions of products of oxidation of membrane lipids as signaling molecules in higher plants (Chapter 18); and, finally, the development of advanced methods, such as mass spectrometry, for the analysis of lipids from photosynthetic organisms (Chapter 20).

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Hajime Wada
The University of Tokyo
Tokyo, Japan

Norio Murata
National Institute for Basic Biology
Okazaki, Japan