

Preface

The very origin of the plastid is clouded in mystery, even though the evidence is clear that the wide diversity of plastids is a historical consequence resulting from a single event, in which an evolving eukaryotic cell captured a photosynthetic prokaryotic cell. The product of this event—all algae and plants, the primary producers in all ecosystems—was one of the major outcomes of evolution. Core metabolic processes such as amino acid and fatty acid synthesis, and the ability to synthesize secondary products such as carotenoids, enzyme cofactors and antioxidants, were provided by the prokaryotic endosymbiont. ATP formation via oxidative phosphorylation was provided by another, earlier endosymbiont. The principal contributions of the eukaryotic nucleus, which was derived from an Archean organism, were the mechanisms of expression of the nuclear genome—nuclear transcription and cytosolic translation. Somehow, this latter organism was able to co-opt the genetic information of the respiratory and photosynthetic prokaryotes for its own use. Thus, the endosymbiotic events, first to produce the mitochondrion and then the plastid, were essential for the development of modern, complex organisms.

Most of the volumes in this series emphasize mechanisms related to photosynthesis or respiration. We all recognize that photosynthesis in the chloroplast is the most fundamental process in biology and provides the major foodstuff on which almost all organisms depend for survival. However, the plastid is, in addition, essential for many other processes, which are highlighted in this volume. For instance, the herbicide glyphosate, although not an inhibitor of photosynthesis, is highly toxic to all photosynthetic organisms. This is because glyphosate inhibits aromatic amino acid synthesis, an essential but non-photosynthetic function of plastids. We considered the ability of the plastid to provide

these other, important functions worthy of attention. An astonishing feature of this volume is the phenomenal amount of research that has been done over the past several decades to understand these other, non-photosynthetic plastid functions.

It has been almost 40 years since John T.O. Kirk and Richard A.E. Tilney-Bassett published the first comprehensive treatment of plastid biology: "The Plastids: Their Chemistry, Structure, Growth and Inheritance", 1967, W.H. Freeman. While photosynthesis and chloroplasts (and indeed each of the topics covered in this volume) have received their due attention in the ensuing four decades, no single volume has brought together the amazing variety of plastid types and the remarkable diversity of plastid functions. We felt it was time for a modern synthesis of plastid biology and it was with this goal in mind we selected the topics and authors for this volume. We sought to produce a volume that is comprehensive without being encyclopedic; complete but readable; synthetic with even a touch of thought-provoking speculation, where warranted; a book that both beginning and experienced plant scientists will want to read, not one that will only reluctantly be referred to when absolutely necessary.

First, and foremost, we thank our 57 co-authors who have given their time and expertise to the writing of the chapters contained herein. Without them this volume would not have been possible. (For details, see the *Table of Contents* and *From the Series Editor*.) We hope that the scope of this volume will provide a framework in which new studies of the plastid can be launched and anyone interested in research in plastid biology would do well to start with the information provided by these authors. We also wish to thank senior series editor Govindjee as his efforts and vision have been instrumental in bringing this project to completion.

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