

Preface

A complete book on chloroplast would contain a vast number of chapters! We chose to focus on interactions between the chloroplast and its immediate as well as distant environments, with a first chapter on plastid evolution. When we received the manuscripts, also the chapters related to communication and/or physical interactions between chloroplasts and their surroundings maintained this temporal interaction as a background theme. Communication, physical interactions, evolution – but hardly anything on photosynthesis or pigments. The latter topics are probably the most clearly obvious ones for a chloroplast book, but here also lies our rationale behind the choice of chapter subjects; we want to present chloroplasts in a different perspective. The recent rapid evolvement of the presented research areas, largely made possible by the development of molecular techniques and genetic screens of an increasing number of plant model systems, makes the interactive theme timely. We are truly grateful to all the contributing authors for providing exciting chapters!

The first two chapters set the stage: in the first, the evolution of plastids is presented and the structural, functional and genomic variations among plastids of land plants and algae are described in an evolutionary context. Double membrane-bound plastids, which are believed to derive directly from a cyanobacterial endosymbiont, as well as plastids of a more complex ancestry with more than two delimiting membranes are covered. The former kind, well studied in land plants and green algae, is the main object in the following chapters. The second chapter defines the borderline, the chloroplast envelope. A current state-of-the-art list of chloroplast envelope proteins is presented, which, together with the lipid setup of this membrane system, reflects the prokaryotic origin of the chloroplast as well as its integration into the host cell.

Three chapters focus on transport across the envelope. The reduced genome of the chloroplast, compared to its ancestors, necessitates import of nuclear-encoded proteins from the cytoplasm. Chapter three presents the protein import machinery and its constituents in the two envelope membranes and how import is regulated and the chloroplast protein level maintained. Several of the imported proteins are involved in chloroplast lipid metabolism and the fourth chapter presents the interdependence of the chloroplast and the rest of the cell in providing lipid constituents to all membranes, within or outside plastids, during various environmental conditions.

This and the following chapter, on metabolite transporters, share an evolutionary feature, that plastids have acquired the role of sole provider of certain compounds once synthesized in the host cell, such as fatty acids and certain amino acids. The metabolite transport chapter uses an evolutionary perspective to present the vast array of metabolite transporters that connect chloroplast metabolism with that of the surrounding cell and also address the specific features of apicoplast transporter systems.

Transport of proteins, lipids and metabolites between plastids and the surrounding cell is regulated by feedback controls at several levels, stemming from intracellular as well as external conditions. The last four chapters cover different aspects of communication between chloroplasts and their surroundings. Plastid-nucleus signalling is the topic of the sixth chapter, with focus on the retrograde information flow, from the plastid to the nucleus, through different pathways. The next chapter presents plastid division at the molecular and cellular level with emphasis on the integration of the host and former endosymbiont and the roles of environmental and endogenous signals in controlling the process. Chapter eight also deals with communication and the chloroplast as a physical entity. The focus is on chloroplast movement and positioning in relation to light quality and quantity, where cytosolic components are involved in motility changes to optimize chloroplast function and survival. Sensing the environment and communication are also central themes of the final chapter. Here the focus switches to the involvement of chloroplasts as providers of metabolites that benefit plant individuals and communities, and the examples include defence coordination compounds and attractants for pollinators and seed dispersal.

Again, we are greatly indebted to all authors! We also extend our thanks to all colleagues in Göteborg and elsewhere who helped us with the review process, to the series editor David G. Robinson for trust and encouragement and last but not least to Anette Lindqvist, Christina Eckey and Elumalai Balamurugan of Springer-Verlag for continuous and patient support and help.

August 2008

Anna Stina Sandelius
Henrik Aronsson

The Chloroplast

Interactions with the Environment

Sandelius, A.S.; Aronsson, H. (Eds.)

2009, XIV, 300 p. 30 illus., 4 illus. in color., Hardcover

ISBN: 978-3-540-68692-7