

Preface

Endosymbiosis is a key process in the evolution of the eukaryotic cells and thus a central theme in biology. The approach chosen in this book puts emphasis and focus on the plant kingdom. The driving force for plastid endosymbiosis was the gain of autotrophy with photosynthesis as the base for higher forms of life on our planet. A eukaryotic host cell engulfed a cyanobacterium or a eukaryotic alga resulting after long-lasting and highly complex adaptations in phototrophic organisms harboring primary, secondary, or tertiary plastids, respectively. In the case of mitochondria, no candidate for an anaerobic eukaryotic host cell that would engulf an α -proteobacterium has yet been found and hypotheses involving merging of two prokaryotes, an archaeobacterium and an α -proteobacterium, received attention in the past years. Franz Lang gives a balanced view on these possibilities.

My own chapter tries to convince you about the single primary endosymbiotic event and the monophyly of the kingdom “Plantae.” Good evidence for that comes from the recently sequenced genome of *Cyanophora* (the peptidoglycan-surrounded muroplasts being the biochemical proof for cyanobacterial ancestry) as put forward by Bhattacharya and colleagues. The acquisition of metabolite transporters (Facchinelli and Weber) and the concerted merging of host and endosymbiont reserve carbohydrate biosynthesis and degradation (Steven Ball) are crucial for the successful onset of an endosymbiosis. The evolution of plastid protein import (Sommer and Schleiff) is juxtaposed to the second chapter on mitochondria (Hewitt and colleagues) dealing with the same issue. It is amazing how similar apparatus could be created from a quite different set of subunits.

Also, intermediate stages of organelle evolution are better documented at present for plastids than for mitochondria: Yoon and colleagues describe the “plastid in the making” of *Paulinella* and Adler and colleagues a novel nitrogen-fixing organelle-to-be of *Rhopalodia*. Another asset of plastids is the complex plastids that have no parallels in mitochondria, where no secondary and tertiary endosymbioses are known. Three chapters deal with several aspects of secondary endosymbioses: Tanifuji and Archibald depict the nucleomorph, the vestigial nucleus of the primary host cell (and as such the biochemical proof for the correctness of the model) in cryptomonads and chlorarachnids; Grosche and colleagues illustrate the problems

encountered by plastid-targeted proteins in complex plastids; Linares and colleagues present a novel organism, *Chromera*, the first phototrophic relative to apicomplexans. Tertiary endosymbioses are dealt with by Gagat and colleagues in a comprehensive chapter on dinoflagellates with their various types of plastids, genuine, exchanged, or stolen. These superimposed secondary and tertiary endosymbioses are mainly responsible for algal biodiversity and speciation. Finally, Wägele and Martin answer the long-prevailing question of a tertiary endosymbiosis between animals (sea slugs) and algae to the negative: the longevity of plastids in *Elysia* is striking—but they are just kleptoplastids.

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