

CONTENTS

<i>Preface</i>	<i>xi</i>
<i>Contributors</i>	<i>xv</i>
1. A Time to Scatter Genes and a Time to Gather Them: Evolution of Photosynthesis Genes in Bacteria	1
Armen Y. Mulkidjanian, Michael Y. Galperin	
1. Introduction	1
2. Photosynthesis Genes of Cyanobacteria and Plants	3
3. Evolution of the Photosynthesis Gene Set	5
4. Photosynthesis and the Emergence of Life	21
Acknowledgements	26
References	26
2. Molecular Markers for Photosynthetic Bacteria and Insights into the Origin and Spread of Photosynthesis	37
Radhey S. Gupta	
1. Introduction	38
2. Molecular Signatures for Different Phyla of Photosynthetic Bacteria	41
3. Origin and Spread of Photosynthesis Based Upon Molecular Signatures in Key BChl Biosynthesis Proteins	52
Abbreviations	59
Acknowledgements	59
References	60
3. Properties and Evolutionary Implications of the Heliobacterial Genome	67
W. Matthew Sattley, Wesley D. Swingley	
1. Introduction	68
2. Heliobacterial Photosynthesis	76
3. Heliobacteria as 'Phototrophic Clostridia'	87
4. Thoughts on Heliobacteria and the Evolution of Photosynthesis	91
Acknowledgements	93
References	93

4. Green Bacteria: Insights into Green Bacterial Evolution through Genomic Analyses	99
Donald A. Bryant, Zhenfeng Liu	
1. Introduction	100
2. Sulfur Metabolism	105
3. Reverse TCA Cycle	106
4. Bacteriochlorophyll Biosynthesis in Green Bacteria	108
5. Chlorosome Structure and Assembly	116
6. Type-1 RCs	120
7. Evolution of Green Bacteria	123
8. Granick Hypothesis	126
9. Thoughts on Evolution of Photosynthesis	130
Abbreviations	138
Acknowledgements	139
References	139
5. Comparison of Photosynthesis Gene Clusters Retrieved from Total Genome Sequences of Purple Bacteria	151
Sakiko Nagashima, Kenji V. P. Nagashima	
1. Introduction	152
2. Retrieval of Photosynthesis Gene Sequences of Purple Bacteria From Genomic DNA Databases	154
3. Sequence Comparison of Photosynthetic Gene Products	160
4. Comparison of Gene Arrangements in PGCs of Purple Bacteria	164
5. Phylogenetic Analyses of Genes in PGCs and Horizontal Gene Transfer	167
6. Conclusion and Perspectives	173
Acknowledgements	174
References	174
6. The Living Genome of a Purple Nonsulfur Photosynthetic Bacterium: Overview of the <i>Rhodobacter sphaeroides</i> Transcriptome Landscapes	179
Mark Gomelsky, Jill H. Zeilstra-Ryalls	
1. Transcriptomics as a Tool to Assess Metabolic Changes and Understand Regulatory Networks	180
2. Metabolic Versatility Requires Transcriptome Flexibility: <i>R. sphaeroides</i> Transcriptome Landscapes of Diverse Growth Modes	181

3. The Effects of O ₂ and Light: A Transcriptome Perspective	187
4. The Key O ₂ - and Light-Responsive Regulons	189
5. Conclusions and Perspectives	196
Acknowledgements	197
References	198
7. The Evolution of the Purple Photosynthetic Bacterial Light-Harvesting System	205
Sarah L. Henry, Richard J. Cogdell	
1. Introduction	205
2. Method	214
3. Results of the Phylogenetic Analysis	215
4. Discussion	221
Supplementary Data	224
Acknowledgements	224
References	224
8. Role and Evolution of Endogenous Plasmids in Photosynthetic Bacteria	227
John C. Willison, Jean-Pierre Magnin	
1. Introduction	228
2. Occurrence and Distribution of Endogenous Plasmids in the Anaerobic Anoxygenic Phototrophic Bacteria	230
3. Functional Roles of Endogenous Plasmids in Phototrophic Bacteria	243
4. Evolution of Endogenous Plasmids	256
5. Conclusions and Perspectives	259
Acknowledgements	260
References	260
9. Evolution of Bacteriophytochromes in Photosynthetic Bacteria	267
Miroslav Papiz, Dom Bellini	
1. Introduction	268
2. Variation in the Bacteriophytochrome Output Domains	269
3. Distribution of the Different Types of Bacteriophytochromes	275
4. Bacteriophytochromes in <i>Rhodospseudomonas palustris</i>	277
5. Future Perspectives	283
Acknowledgements	284
References	284

10. Iron Homeostasis in the <i>Rhodobacter</i> Genus	289
Sébastien Zappa, Carl E. Bauer	
1. Introduction	290
2. Ferrous Iron Uptake	292
3. Ferric Iron Uptake	299
4. Iron ABC Transporters	303
5. Heme Iron Usage	304
6. Managing Iron Toxicity	308
7. Iron Homeostasis Regulators	313
8. Conclusion	317
References	319
 11. Genes Associated with the Peculiar Phenotypes of the Aerobic Anoxygenic Phototrophs	 327
Vladimir Yurkov, Elizabeth Hughes	
1. Introduction	328
2. Abundance and Diversity Through Culturing and Sequencing	330
3. Phylogeny and Speculations on Evolution	335
4. Nutritional Requirements, Carbon Metabolism and the Associated Metabolic Pathways	338
5. Photosynthetic Pigments and their Association with the Photosynthetic Operon	343
6. Photosynthetic Apparatus Organisation and Genes	346
7. Unsolved Mysteries and Concluding Remarks	353
Acknowledgements	353
References	353
 12. Evolutionary Divergence of Marine Aerobic Anoxygenic Phototrophic Bacteria as Seen from Diverse Organisations of Their Photosynthesis Gene Clusters	 359
Qiang Zheng, Michal Koblížek, J. Thomas Beatty, Nianzhi Jiao	
1. Introduction	360
2. Diverse Structures of PGCs	362
3. Expression of PGC	369
4. Evolution of AAPB	373
5. Summary and Future Perspectives	379
Acknowledgement	380
References	380

13. Regressive Evolution of Photosynthesis in the *Roseobacter* Clade 385

Michal Koblížek, Yonghui Zeng, Aleš Horák, Miroslav Oborník

1. Introduction	386
2. Photosynthesis Gene Cluster	389
3. The Mode of Evolution	391
4. Horizontal Gene Transfer	395
5. When Did Roseobacters Evolve?	396
6. Evolutionary Scenario	398
7. Conclusions	401
Acknowledgements	402
References	402

Index	407
-------	-----