Preface

The evolutionary "invention" of a system that enabled water-splitting into molecular dioxygen and metabolically bound hydrogen was the "Big-Bang" in the development of the biosphere. This event occurred about three billion years ago at the level of cyanobacteria and enriched the hitherto essentially anoxic terrestrial atmosphere with O_2 which had dramatic global consequences: (1) the efficiency of free energy exploitation from food increased by more than a factor of ten through the possibility of aerobic respiration thus opening the "thermodynamic door" for the development and sustenance of all higher forms of life, (2) the ozone layer was formed and provided the essential protective umbrella to UV radiation as prerequisite for populating the land with plants and animals, and (3) the oxidation of minerals gave rise to large-scale changes of the earth crust including geological phenomena. At the same time most of the existing organisms were killed due to oxidative degradation (in geological terms called "the O_2 cataclysm or O_2 catastrophe") unless they were able to develop suitable protective mechanisms or to find anaerobic ecological niches for survival.

Cyanobacteria have effectively colonized our whole planet. They are rather flexible in adaptation to a great variety of different environments and even capable of occupying arctic water bodies, or hot (alkaline) springs by forming the significant family of thermophilic organisms. A unique and common characteristics of all species is their "dual nature" of a prokaryotic (bacterial) cell structure and an O_2-evolving photosynthesis which is typical for (green) plants. Accordingly, the cyanobacteria can be classified in two ways, i.e. either as blue-green or *cyano*-bacteria or as (prokaryotic) blue-green algae (plants). In the past, both terms have been used but nowadays the term cyanobacteria—introduced about 50 years ago by the leading French-Canadian microbiologist Roger Y. Stanier—is universally accepted in the biological literature of nomenclature and systematics.

Due to the paramount importance for our entire biosphere it is not surprising and highly justified that several books and monographs on cyanobacteria have been published in recent years, and specialized scientific meetings and congresses exclusively or predominantly devoted to cyanobacteria are being regularly organized. Therefore the question arises: Why another book on this subject? Mainly two reasons should be mentioned: (a) A book is missing which focuses on *bioenergetics* of cyanobacteria

primarily addressing questions of energy conversion by the fundamental bioenergetic processes: (Oxygenic) photosynthesis, (aerobic) respiration, and (anaerobic) fermentation which uniquely occur together in these prokaryotic cells, and (b) thermophilic cyanobacteria offer the most suitable material for high resolution structure analyses of Photosystem I and II and other electron transport complexes by X-ray crystallography (for example, at present the structure of Photosystem II at atomic resolution is only known for these organisms). These achievements during the last decade represent a milestone in our understanding of the complexes which are crucial for solar energy exploitation through photosynthetic water splitting.

Based on these considerations we feel confident that it is worth publishing this book and sincerely hope that it will find a positive resonance. It represents an ambitious attempt to achieve the goal of a synoptic state-of-the-art picture on the bioenergetics of cyanobacteria by casting together the mosaics of detailed knowledge described by leading experts in the field. It contains 24 chapters written by 51 authors from Austria, Finland, France, Germany, India, Israel, Japan, Netherlands, Portugal, Spain, UK and USA. The book is aimed at reaching a broad audience ranging from students to experienced scientists in chemistry, physics, biology and physiology. It is devided into seven parts: **Part I** offers in seven chapters a general description of cyanobacteria and their environment, with occasional historic and philosophic excursions into the phenomenon of life as such, the living cell and our universe. **Part II** contains three chapters on the history and function of electron transport and ATP-synthesis including brand-new results on *Gloeobacter*. Details on the oxygenic photosynthesis and aerobic respiration are outlined in **Part III** by presenting five chapters. **Part IV** focuses in two chapters on electron entry systems. **Part V** addresses in five chapters the connection between the various electron transfer complexes, and **Part VI** in three chapters reactions of terminal oxidation. The book finishes in **Part VII** by a single chapter which describes most recent progress with tools for genetic manipulation of cyanobacteria.

We have many people to thank. First of all, the authors for their efforts to offer the readers excellent chapters and for their positive response to our suggestions. Without their invaluable cooperation there would be no book. The book has grown out from a pertinent discussion of Govindjee with one of us (G.A.P.) in March 2007 and the editors want to express their particular thanks to Govindjee for his untiring encouragement during the years. We also gratefully acknowledge the editorial staff of Springer, especially Dr. Jacco Flipsen and Mrs. Ineke Ravesloot, for their generous help in all respects. Last, but not the least, we also thank Martin Pairer, BOKU—University of Natural Resources and Life Sciences, Vienna, who has taken the utmost care in achieving a uniform style of all manuscripts and to satisfy all editorial requirements set by Springer, Dordrecht. We made all efforts to reach the goal of presenting a book which may significantly contribute to the deepening and broadening of scientific knowledge and interest in cyanobacteria.

We wish all the readers a pleasant and stimulating journey through the fascinating "world" of the bioenergetics of cyanobacteria. It is our sincere hope that this book will entice young people into this exciting research area with the aim to address successfully the challenging problems of high relevance that are still waiting for satisfactory answers.

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