Foreword

Over the past 50 years, molecular microbiology has provided fundamental contributions not only to the understanding of microbiology as a unique discipline but also to the understanding of what makes a living cell. In 1945 Schrödinger in his famous lecture ''What is life?'' addressed the challenging task of defining the properties of a necessary (e.g. minimal/required) information-containing system. More than half a century later, we can state that many aspects of this fundamental question ''What is life?'' have been answered. This series of great discoveries started with the elucidation of the DNA structure by F. Crick and J. Watson more than 50 years ago and was subsequently expanded by the exploration of the basic mechanisms of DNA replication and gene expression. These scientific achievements were complemented and fostered by the development of crucial techniques, such as gene cloning, DNA sequencing and PCR. The discoveries culminated in an event that will certainly have a fixed position in future text books of science history: the first complete elucidation of a genome sequence of a living organism, *Haemophilus influenzae*, in 1995. At the beginning of 2006, the complete genomes of nearly 300 bacterial species are available. Knowledge of the complete genome sequence is an essential prerequisite in order to gain a comprehensive understanding of the molecular mechanisms of life. The genome sequence, however, only provides the ''blueprint'' of life, not life itself. Now, functional genomics such as transcriptomics, proteomics, metabolomics and bioinformatics are required to bring the blueprint of life to the real life of living organisms. The combination of the expertise and accumulated knowledge in the traditional disciplines such as microbiology, biochemistry, molecular genetics and molecular biology with this panoramic view of the recent ''omics technologies'' on the cell as an entity will enable/facilitate a new quality in the understanding of what makes a cell viable. Because of their low complexity, single-cell bacterial systems such as *Escherichia coli*, *Bacillus subtilis* and others constitute perfect model systems for tackling such an ambitious goal as understanding life as an entity. The unexpected finding that, even in the best analyzed model organisms such as *Escherichia coli*, one-third of all genes codes for proteins with still unknown functions emphasizes the challenge and indicates that many pages of the ''bible of life'' are still empty.

There is a comprehensive literature on the entire field of molecular microbiology, from the structure, flexibility and stability of bacterial genomes to the various facets of the regulation of gene expression, a field that even in bacteria includes mechan-

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isms of not only transcriptional initiation but also transcriptional elongation and termination and regulation at the posttranscriptional, translational and posttranslational level. Even if the first description of the regulation of a bacterial operon, the *lac*-operon in *E. coli* by Jacob and Monod, was a milestone in the history of microbiology, honored by the Nobel Price in 1965, we had however to realize that this regulation mechanism represents only one of hundreds of mechanisms evolved during the three billion years that bacteria have populated our planet. For those involved in teaching students, it is difficult to keep up with the pace of the development of all these different fields of molecular microbiology. A textbook covering all these aspects of molecular microbiology is equally useful for teachers and students in microbiology at universities, because this very genuine, innovative and essential new field of microbiology needs more space in the teaching programs for life science students.

Wolfgang Schumann, professor for genetics at the University Bayreuth, accepted the challenge of writing a textbook on molecular bacteriology. For many years, he has lectured students of biology and biochemistry on the genetics and molecular biology of bacteria. He is appreciated as an expert in molecular genetics and bacterial gene regulation and his contributions to many fields of molecular genetics, e.g. the mechanisms of heat induction in Gram-positive bacteria and the discovery of the CIRCE element (to mention only some of them), are accepted worldwide.

I have always been impressed by his detailed knowledge of the scientific literature on quite different fields of molecular microbiology. This is one reason which convinced me that Wolfgang Schumann is the right person to take over this ambitious task. I have already used the chance to read some of the chapters of this book in preparing my lectures at the University of Greifswald this year. I enjoyed this reading, very conveniently providing me with an excellent survey. Assessing the recent literature critically and in detail an essential part of the training of young students has been done in an excellent way. All essential aspects of molecular bacteriology (which might be extended by a similar textbook by other experts on the molecular microbiology of Archaea or eukaryotic microorganisms) have been addressed in a very authentic, comprehensive manner and have been illustrated by a lot of impressive and useful figures.

This book covers the most essential chapters in molecular microbiology, starting with the structure of the bacterial cell via the organization of bacterial chromosomes to the bacterial cell cycle, followed by chapters on molecular genetics, recombination and mutations and their repair. A comprehensive chapter deals with the various mechanisms of gene regulation, followed by a description of the role of chaperones in protein quality control and protein secretion mechanisms. An extra chapter on stress genes and their regulation is a reflection of the specific research interests of the author. A final chapter on gene transfer makes the book complete. I just missed a chapter on the prokaryotic development of bacteria, including endospore-forming bacteria such as *B. subtilis*, heterocyst formation in *Anabaena* and the dimorphic life cycle of *Caulobacter crescentus*, to mention some.

All in all, this new book offers an actual, comprehensive view of the present state of the art in the field of molecular bacteriology. It is a very valuable source of information not only for students, but also for scientists who wish to become acquainted with one of the most exciting fields of current microbiology.

Greifswald, 04.04.2006 Michael Hecker