Preface

We live in a bacterial world. Bacteria have inhabited this planet for a few billion years longer than humans, and they have made themselves at home in every corner of it. From oceans to deserts, from frozen glaciers to hydrothermal vents, few environments are apparently too hostile for them to occupy and exploit. This of course also includes our own body tissues, and those of the animals and plants we rely on for our nutrition. They are even, unless especially treated, in the water that we drink. We have never known a world without them, but for most of our history we were completely unaware of their existence. Only 350 years ago—after nearly 200,000 years of evolution in their presence—did human technology advance to produce an optical microscope and enable us to begin to appreciate the extent of their proliferation, and the impact they have upon our lives.

The bacterial cell wall is central to their successful lifestyle. It not only gives their cells shape and rigidity but also provides a physical barrier through which every transaction between the cell contents and the external environment must take place. This is a crucial role in a single-celled organism. The habitat of bacteria can be diverse, unpredictable, and often hostile, and a major function of the cell wall is to enable cells to persist through, or adapt and respond to, changes in this environment. The integrity of the cell wall is consequently essential for bacterial survival, and efficient homeostatic mechanisms have evolved for monitoring and maintaining it. Not surprisingly, finding chemicals which are capable of overwhelming these mechanisms to inflict lethal damage to the cell wall has also developed as an important method for killing the bacteria which cause us harm. Tremendous effort has therefore been expended on researching and understanding bacterial cell wall homeostasis, and this volume is intended to bring together the most widely used and important protocols currently being employed in this field. In Chapter 1 we see how modern microscopy techniques, and other biophysical methods, are being used to characterize the subcellular structure of the bacterial cell wall and to visualize some of the machinery responsible for its construction and maintenance. Chapter 2 considers the high-throughput approaches which can be used both to identify all the genes and proteins that participate in the correct functioning of an organism's cell wall and to characterize the genome-wide changes in gene expression occurring in response to cell wall stressors. Protocols for assaying individual gene products for specific cell wall functions or identifying chemicals with inhibitory activity against the cell wall are detailed in Chapters 3 and 4, while later chapters cover methods for analyzing the nonprotein components of the cell wall, and the increasing use of computational approaches for predicting and modeling cell wall-related functions and processes. It is our hope that this volume serves to emphasize the diversity of the research taking place into bacterial cell wall homeostasis, and how the integration of information from across multiple disciplines is going to be essential if a holistic understanding of this important process is to be obtained.

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