Preface

Surface and envelope processes play a fundamental role in the interplay between bacteria and their environment and in the successful adaptation of these microorganisms to a variety of ecological niches. A bacterial cell perceives and interacts with its habitat, be it a human host, a decaying leaf, or the surface of a coral, through processes that must involve its outermost barriers. In many cases, surface-exposed appendages, such as pili or adhesins, anchor the bacterium to a substratum, oftentimes a eukaryotic cell. Many of these cell-surface appendages have proven to be essential virulence factors, whose absence severely compromises or completely impedes the pathogen's ability to establish an infection. Bacteria can be surrounded by additional material, such as exopolysaccharides or capsules, and can display an extremely complex array of macromolecules in their outermost layer. The presence and the composition of these external layers are also key factors in the pathogenic process or the formation of bacterial communities inside hosts or in the environment.

But the role of the cell surface is not limited to the physical contact with the outside world. Lipid bilayers provide cellular integrity and protection against the chemical hazards of the external milieu. Cell walls play important roles in cell viability and morphogenesis. Membrane proteins such as transporters, channels, and receptors allow detection of signals and the regulated flow of organic and inorganic material across membranes. Membrane proteins of the cell envelope are also participants in the vast array of secretion systems and biosynthetic machineries utilized for the targeting, secretion, or surface presentation of external structures, toxins, and enzymes. Subcellular compartments, such as the periplasm, play important roles in the biogenesis of surface components, stress response, and transport across the envelope. Because of the complexity and variety of the macromolecular makeup of the bacterial envelope, microbiologists have been engaged for decades—and will continue to be for years to come—in deciphering its composition, understanding its biogenesis, and examining its regulation in response to external conditions.

In recent years, Molecular Microbiology is emerging as one of the cutting-edge disciplines in the biological sciences, thanks to the multidisciplinary and integrative approaches taken by investigators seeking to understand the intricacies of the microbial world and how it affects human health and the biosphere. In particular, recent advances in structural biology, proteomics, and imaging techniques, together with the traditional biochemical and genetic approaches, provide for an exciting look into the structure, function, and regulation of the bacterial cell envelope. These trends and the variety of techniques applied to the study of bacterial cell surfaces are reflected in this volume. In *Bacterial Cell Surfaces: Methods and Protocols*, the reader will find examples of traditional and innovative tools for the study of protein structure and function and enzymatic activities, the purification and analysis of macromolecules and their complexes, and the investigation of regulatory mechanisms and cell biological processes. The book is aimed at the microbiologist, biochemist, or cell biologist, whether a beginner graduate student, or a veteran experimentalist, who wishes to learn new methodologies and take advantage of the years of research and protocol optimization from the best laboratories.

Chapters in this book are contributed by highly recognized experts in a wide variety of topics that pertain to bacterial cell surfaces and the bacterial envelope. My rationale in the choice of areas was to provide a comprehensive view to the field, while at the same time, carefully selecting the leading laboratories in the various areas of specialization. For the purpose of this book, the bacterial cell surface was operationally defined as any structure or compartment external to the cytoplasmic membrane, and thus, safe for a chapter on electrophysiology of bacterial channels, the vast number of processes inherent exclusively to the plasma membrane is not addressed in this volume. After a couple of introductory chapters which provide reviews of the bacterial cell surface and a history of its microscopic investigation, the book is organized in a directional fashion with topics dealing with purely external structures at first, followed by investigations of components that are progressively more "inward" across the cell envelope, such as outer membrane, cell walls, and periplasm. Gram-negative bacteria are well represented, but a few chapters are focused on Gram-positive bacteria and Mycobacteria.

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