Two-Component Signal Transduction
Two-Component Signal Transduction

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Preface

Cells must sense and respond to their environment, a process that requires signal transduction across biological membranes. A major mechanism of signal transduction, widespread in bacteria, is the so-called two-component system that has adopted phosphorylation as a means of information transfer. Two-component systems are central to much of the cellular physiology that results from alterations in the environment. Starvation for phosphate or nitrogen, responses to oxygen limitation, and adaptation to new carbon and nitrogen sources are but a few of the environmental insults that cells overcome with modified cellular physiology mediated by two-component systems. Pathogenesis requires two-component modification of cellular physiology as well. There is no doubt that cells sense when they need to express virulence factors, but in most cases what is sensed remains obscure. It is unlikely that any pathogen can survive the varied and changing environments of the human body without involving at least one two-component pathway.

We are only now beginning to understand the bacterial cell cycle and the role of cell-cell communication in population dynamics and development. Yet we can cite examples in which two-component switches process signals required to trigger these events. Because two-component systems form networks that involve more than one system and show dependencies and hierarchies, they are easily adapted for very complex processes. In fact, two-component systems are so widespread, and so important, that without them bacteria would be rendered the equivalent of deaf, dumb, and blind.

In this book we have tried to highlight the global nature of two-component systems and summarize the enormous progress that has been made in less than a decade in our understanding of how these systems work. The book is divided into several sections, each of which deals with a particular aspect of two-component regulation. A few two-component systems have been studied in depth by several investigative groups, and these systems form a reservoir of information about how these systems function. Although some of the systems are complex, the two-component paradigm forms the basis for a common information flow.
Scientists studying microbial physiology, pathogenesis, motility and chemotaxis development, or a variety of other behavioral characteristics of bacteria need to be aware of and understand two-component signal transduction. The functions of two-component systems in eukaryotes such as yeasts and plants are now being appreciated, and astute investigators of these systems will take advantage of the vast knowledge base in bacteria. This book was therefore designed to appeal to the wide variety of disciplines in which signal transduction is a vital component and knowledge of its mechanism is essential.

For those of us who have witnessed the virtual explosion of information on two-component systems in the ten years since we became aware of their existence, the amount of knowledge accumulated seems enormous. Despite this progress, many fundamental issues regarding two-component systems still remain unresolved. We hope that this book will help focus attention on these critical problems and stimulate research to solve them.

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