Preface

From a macroscopic standpoint, the environment where we live maintains constancy to some extent. This means the environment has a buffering capacity for various types of impacts. Bacterial metabolic capacity, which plays an important role in the global material cycle, contributes largely to the buffering capacity for huge and unintended release of various chemicals. Recently, however, the prosperity and globalization of material civilization has led not only to severe local contamination by hazardous chemicals, but also to continuous increment of contaminant concentrations worldwide. To solve such urgent global issues, bacterial functions that are involved in biodegradation of hazardous chemicals have been analyzed. The term "biodegradative bacteria" refers to the bacteria that have the ability to degrade such xenobiotic (man-made) and/or hazardous chemicals.

Since the 1980s, following on the development of microbial genetics, molecular genetic research techniques have been applied to the investigation of the function of biodegradative bacteria. This research has resulted in the cloning of many genes and gene clusters involved in the biodegradation of various types of contaminated chemicals. Similarly, many enzymes involved in unique biodegradative reactions with recalcitrant hazardous chemicals have been analyzed to understand why biodegradative bacteria can decompose corresponding chemicals. These analyses have provided an understanding of the structural bases of such novel reactions for xenobiotic chemicals. As readers may know, the recent development of genome-wide investigative techniques has largely promoted the comprehensive interpretation of a whole-cell system of biodegradative bacteria. The degradative capacity of bacteria for xenobiotic compounds may be developed through the adaptive change of native enzymatic function and/or recruitment of genes or gene clusters accounting for the new metabolic capacities. Therefore, analyses of biodegradative bacteria can be said to have partially dealt with the rapid evolution process of bacteria in natural ecosystems. From the application point of view, to remediate actual contaminated sites by the biodegradative capacity of bacteria, it is quite important to know or to control the behavior of biodegradative bacteria in the environment. These are quite difficult issues, however, because there are numerous bacterial strains and diverse environmental conditions in actual contaminated sites. Thus, in situ analyses of biodegradative bacterial function should include investigation by recently developed molecular ecological techniques.

As mentioned earlier, analyses of biodegradative bacteria include various types of studies, such as genetics, enzymology, genomics, cell physiology, ecology, and evolutional biology. In another words, the targets investigated in research on biodegradative bacteria include single molecules, single cell systems, bacterial consortia (interaction with surrounding microorganisms), and interaction with surrounding biotic and abiotic materials. Such complexity makes the research on biodegradative bacteria difficult but quite interesting.

Biodegradative Bacteria consists of three parts, each consisting of five to seven chapters: (1) Genetic and genomic systems, (2) Degradative enzyme systems, and (3) Bacterial behavior in natural environmental systems. The reader will find that the scope of the various chapters is not uniform. In our opinion, they all are fascinating, however. We hope this book will contribute to readers' knowledge of how far biodegradative bacteria research has progressed and how various recent technical innovations have led to such progress. To all the authors who in spite of their numerous other duties found time to review the novel work in their field, we express our gratitude. We are also grateful to Springer Japan and especially to Kaoru Hashimoto and Yoshiko Shikano of the editorial staff for their support and counsel.

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http://www.springer.com/978-4-431-54519-4

Biodegradative Bacteria
How Bacteria Degrade, Survive, Adapt, and Evolve
Nojiri, H.; Tsuda, M.; Fukuda, M.; Kamagata, Y. (Eds.)
2014, VIII, 358 p. 79 illus., 22 illus. in color., Hardcover
ISBN: 978-4-431-54519-4