Preface

> "On any possible, reasonable or fair criterion, bacteria are – and always have been – the dominant forms of life on Earth."
>
> – Stephen Jay Gould

Nearly 4 billion years of evolution have produced a captivating array of organisms that live in a variety of environments both exotic and mundane to us. The exotic environments have a special appeal for understanding how organisms, microorganisms in particular, push the physicochemical boundaries of biomolecules and are able to thrive. How evolution has resulted in and continues to shape the microbial genes, genomes, species, and communities in these extreme environments is certainly a drama of epic proportions that microbiologists are continuing to unravel and describe.

This volume explores the current state of knowledge about microbial evolution under extreme conditions and addresses the following questions: What is known about the processes of evolution that produce extremophiles and adaptations to extreme conditions? Can this knowledge be applied to other systems? What is the broader relevance? What remains unknown and requires future research? These questions are addressed from the perspectives of different extreme environments, organisms, and evolutionary processes. The information compiled in this volume reveals that there are disparate levels of knowledge about the different extreme environments and their inhabitants; yet, as noted in many of the chapters, genomics and metagenomics are having a significant impact on our understanding of microorganisms and microbial processes, including evolution, in extreme environments. It seems that microbial evolution and ecology are poised for a significant gain in comprehension through the synthesis and integration of data and hypotheses that will likely lead to new insights into evolution, as well as the redefinition of species and extreme environments. It is my hope that this volume will facilitate that synthesis and advance understanding of the evolution of microorganisms and evolution in general.

When I accepted the invitation to edit this volume, I didn't appreciate what an undertaking it would be. I was concerned that there was not enough material for an entire volume yet inspired to attempt a broader look at "extreme" environments, since extremophile is to some degree an anthropocentric term. What resulted has reminded me that there is so much to learn and that microorganisms are fascinatingly complex.