Preface

Life on Earth has radiated to fill virtually every conceivable habitat and niche. In each of these, organisms must interact with their environment and deal with some degree of variation in environmental parameters including temperature, pressure, oxygen and water availability, and variation in the levels of ions, metals and numerous potentially toxic compounds. To some extent, variation in these parameters is accommodated with ease, but beyond certain limits, stress is imposed, stimulating the organism to make metabolic adjustments that will hopefully counteract the negative effects of stress.

Studies of the interactions between organisms, their organs and cells and the changes in environmental parameters encompass an enormous part of modern biology and medicine, for most of life is, in fact, a continuous interplay between environmental stimulus and cellular response. Some areas of metabolic response to stress have been particularly well explored, including the adaptive responses of cellular energy metabolism, enzyme regulation, and protein or membrane structure. Indeed, the field of comparative biochemistry has, over the last 40 years, made huge strides in understanding how metabolism can be adapted or protected in order to allow life to persist in changing environments and at environmental extremes.

Less well-explored, at present, is the role that gene expression plays in response and adaptation to environmental stress. Clearly, stress-induced changes in protein types or protein concentrations must have arisen due to changes in the expression of appropriate genes. However, only recently have advances in molecular biology finally allowed the regulation of gene expression to be explored in a manner comparable to the studies of enzyme/protein regulation that have been ongoing for many years. Furthermore, the availability of simple techniques for screening and identifying genes that are induced or upregulated in response to stress offers the potential for identifying the full range of cellular adjustments that constitute the response to any given stress. Previous investigations of stress effects on organisms have frequently focused primarily on metabolic responses that have readily 'visible' or measurable consequences and then traced these back to the underlying regulation of the responsible proteins and genes. For example, the accumulation of huge quantities of glycerol (often 2 molar or more) by cold-hardy insects has focused an enormous amount of research on subzero survival onto the metabolic regulation of low molecular weight carbohydrate antifreezes. However, the potential flaw in such an approach is that not all of the important metabolic responses to stress may have effects that are readily detectable or that fit our preconceived notions of the areas of metabolism that should show adaptation under any given stress. Here, new techniques for screening stress-induced changes in gene expression have great merit for helping us to identify all the many gene and protein responses that constitute the integrated response to stress by any given cell or organism. The importance of this approach is amply illustrated in several of the chapters in this book.

Recognition of the growing importance of studies of gene expression for understanding organismal response to environmental stresses prompted the organization of

the symposium 'Environmental Stress and Gene Regulation' at the 1998 meeting of the Society for Experimental Biology in York. The symposium brought together a diverse group of researchers including those from both medical and biological backgrounds and with interests in diverse animal systems and different forms of environmental stress (low or high temperature, freezing, oxygen limitation, oxyradical toxicity). What they had in common was their current focus on gene expression and gene regulation to answer questions about how organisms adapt to stresses that are imposed upon them. I hope that the symposium gave its audience a greater appreciation of the current molecular biological techniques and approaches that are available for studying organismal response to stress, as well as a view of some of the most exciting new frontiers of biological research such as the fascinating new developments in oxygen and oxyradical regulation of gene expression.

What struck me about the York meeting was the large number of papers presented in other symposia by researchers in many different disciplines whose work had also focused on stress-induced gene expression. This certainly reinforced for me the central role that studies of gene expression and gene regulation will take as biochemistry enters the new millennium.

I would like to thank all of the authors for their excellent contributions to this book. In particular, I extend my gratitude to those authors who were not participants in the original symposium but whose presentations in other symposia at York highlighted interesting additional areas of gene expression responses to stress. Their contributions, which of necessity had to be written within a very short timeframe, have broadened the volume to include temperature-induced changes in gene expression in fish, invertebrates and plants and a fascinating analysis of the role of programmed cell death in plant responses to environmental stress. I would also like to thank my wife, Janet M. Storey, for her help and attention to detail during the editing process.

Kenneth B. Storey