Foreword

Stress biology – from molecules to populations and environment

All living systems are under continuous stress of one kind or the other because of the dynamic nature of the biotic and abiotic environments in which they live. In a way, the essence of evolution lies in the incorporation of opportunistic changes that enable populations to survive in the stressful environment. Organisms respond to stress in a variety of ways but a fundamental strategy, which is conserved from bacteria to man, is the response mounted by the individual cell to stressful conditions. The nature and consequences of cellular responses to stress are major issues that comprise the field of stress biology. Stress being a key factor in evolution, stress biology impinges on a wide variety of sub-disciplines. These range from molecular and biophysical studies on the nature of the genes (and their products that get activated under conditions of cellular stress) to ecological and evolutionary correlates of dynamic changes in the environment, to biotechnological and clinical applications of the understanding of stress genes and their products. As in many other areas, the different fields of enquiry have often been pursued independently of each other. Obviously an integration of approaches would permit a better appreciation of the issues involved and thus provide better definitions for more in-depth research. With this in view, the International Union of Biological Sciences (IUBS), Paris, under its TAIB (Towards an Integrative Biology) programme, organized a one day symposium entitled "Stress Biology –From Molecules to Populations and Environment" on 21st January 2004 during its 27th General Assembly at Cairo, with S C Lakhotia and J-C Monolou as the conveners. The following lectures were delivered at this symposium:

(i) Erwin Beck: Plant Resistance to Cold Stress
(ii) R Bijlsma: Genes and Stress in Fragmented Landscapes
(iii) J Clegg: Habitat Diversity and Biochemical Adaptation to Stress in Encysted Embryos of the Crustacean, *Artemia*
(iv) Martin Feder: Evolution of Stress-inducible Molecular Chaperone Expression
(v) K N Ganeshaiah: Stress, Symmetry and Sex: Adaptive Responses of Organisms to Stress
(vi) Tyrone B Hayes: Evolution of the Stress Response in Amphibians: Responses to Natural and Unnatural Environmental Changes
(vii) S C Lakhotia: Role of a Non-coding RNA in Cellular Adaptation to Stress-induced Changes in Transcription and RNA-processing
(viii) Volker Loeschcke: Environmental Stress Resistance: From Candidate Genes Over QTLs to Micro-arrays
(ix) L Nover: Heat Stress Transcription Factors and Heat Stress Granules: The Complex Response of Plants to Stress
(x) Patrick Silan: Disturbances and Functioning of Host-Parasite Systems: A Multiscale Approach
(xi) Michèle Trémolières: Plant Response Strategies to Stress and Disturbance: The Case of Aquatic Plants

This interface between those dealing with the molecular biology of stress-related genes and their products and those interested in ecological and evolutionary aspects of environmental factors provided an integrative platform for a better understanding of stress biology. Five of the papers presented at the symposium are included in this special section.

Beck *et al*'s paper examines the roles of photoperiod and cold temperature in triggering frost-tolerance and the biochemical routes involved in either case in pine trees. The paper by Trémolières

discusses the effects of stress and disturbance on aquatic ecosystems. Continuing with plant systems, Baniwal *et al*'s paper provides an overview of the intriguing multiplicity of the heat shock transcription factors (Hsf) that characterize most plant species. Is the unusually high diversity of Hsfs related to the unique ecological challenges faced by immobile plants? This interesting question requires an approach that integrates molecular studies with ecological and evolutionary aspects.

Tanguay *et al* have studied some of the molecular bases for adaptation of an interesting crustacean, *Artemia* to diverse extreme habitats. The encysted embryos can tolerate hypersalinity and survive in deserts, tropics and mountains. In addition, this organism shows a high resistance to ultraviolet radiations. The last paper in this series, by Loeschcke *et al*, deals with molecular approaches to studies on resistance to climatic and genetic stress in natural populations of *Drosophila* collected across climatic gradients as well as in selection lines maintained in the laboratory.

These papers provide a flavour of the advantages of an integrative approach to study stress biology from molecules to populations.

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