Preface

This volume contains the reviews of recent advances on three major topics of bioenergetics written by participants of the International Symposium on Bioenergetics: Structure and Function of Energy Transducing Systems held in Nagoya, Japan, May 1–4, 1986. The symposium was organized in response to a request made to those interested in the subject in Japan by Dr. Sergio Papa, chairman of the Bioenergetics Interest Group of the International Union of Biochemistry. The aim of the symposium was to exchange ideas and information among not only specialized researchers but also basic and clinical scientists interested in recent achievements in this field, and to gain a clear perspective of the structural fundamentals and the mechanism of the energy transducing systems. The editors therefore requested each of the participants to present a synopsis of recent accomplishments on each topic rather than a simple summary of their own work.

The mechanism by which organisms obtain the energy required to

maintain their life has long been a subject of interest for many scientists, and bioenergetics has been a major field of biological science. The subjects dealt with in bioenergetics are quite different from those dealt with in orthodox biochemistry: they are tightly embedded in the membrane and rarely amenable to ordinary analytical methods. It has often been said that bioenergeticians are very contentious. This is probably because they lacked reliable methodology for their subjects; as a result, the data they obtained were sometimes ambivalent and could be interpreted by several hypotheses. The development in bioenergetics achieved thus far is due to their effort in seeking new approaches to unravel the energy-transducing systems. Recently there have been advance in techniques, such as new purification methods, structural analysis of membrane proteins, and newly developed biotechnology, which have provided us with detailed information on the architecture of the energy transducing systems. It is now possible for us to discuss the function of these systems on the basis of their structure.

The volume is divided in three parts, representing three days of presentations and discussion on the three aspects of progress in bioenergetics.

The first, structure and function of the energy transducing system, is an area in which impressive advances have been made in elucidating the roles of components in the respiratory chain in energy transduction. Comprehensive and updated information is presented on the site I energy coupling in bacterial systems, structure and function of NADH:Q reductase and QH_2:cytochrome *c* reductase in *Neurospora* mitochondria, and the mechanisms of electron transfer and energy transduction in the three-subunit cytochrome bc_1 complex, an enzyme with simple structure discovered recently in *Paracoccus denitrificans*. The roles of ubiquinone in electron transfer and energy transduction were characterized from its lateral diffusion in the inner mitochondrial membrane or from its binding sites in the mitochondrial electron-transfer complexes. These discussions have been supplemented by a proposal of fundamental assembly of the electron-transport complexes and F_0F_1-ATPase, a supramolecule that participates in the energy transduction in the membrane.

Molecular approaches have provided us detailed information on the

molecular architecture and mechanism of energy transduction. The second part of this volume addresses membrane proteins from various systems. They include ADP-ATP translocator from brown adipose tissue, ion pumps and light energy transducers from bacteria or mammalian tissues, and H^+-ATPase from *E. coli*, photosynthetic or thermophilic bacteria, chloroplast, yeast, and mammalian or human mitochondria which were studied by function-directed mutagenesis or various cell biological approaches. These discussions have been supplemented by the characterization of transport of protein components of energy transducing complexes into mitochondria.

Finally, in the third part of this volume, hypotheses for the mechanism of energy transduction are discussed in the light of the structural data presented in the preceding parts. In spite of the immense body of ongoing research, however, the primary events in electron transfer and energy transduction are still the object of conjecture. This part focuses on reappraisal of the chemiosmotic hypothesis. These discussions are based on the results of new approaches to estimate the H^+-conductivity of F_0 of the ATPase, conformational interaction between F_1 and F_0 of mitochondrial ATP synthase, and the proton-motive activity of the cytochrome chain.

Bioenergetics can be said to have begun when Lavoisier discovered the combustion of foodstuff in the body with oxygen. He actually measured respiration of a human. However, recent bioenergeticians have hereafter sought for simpler and simpler materials as experimental systems and ultimately have reached such bacterial membrane systems as bacteriorhodopsin in the purple membrane of *Harobacteria*. Meanwhile, defects in the energy transducing system in the cells have been recognized by clinical researchers as a cause of various disorders generically termed mitochondrial cytopathy. The mitochondrial energy transducing system in human is structurally more complex than that in bacteria and is genetically under the dual control of both the nuclear DNA and the mitochondrial DNA. The nucleo-mitochondrial interaction in the biosynthesis of mitochondrial enzymes is one of the most interesting topics in this field. The knowledge gained in the study of simpler systems on the relationship between structure and function in energy transduction is fundamental for the elucidation of the disorder in human. We hope

that this volume will contribute to future progress in both fundamental and applied studies of bioenergetics by summarizing the achievements currently in the forefront of the field.

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