

Preface

Energy and life. These are the phenomena of objective reality, subjective notions, and simply the words of our language. It has been already over 2000 years that philosophers have been arguing about the essence of these terms. Scientists have been trying to comprehend them for centuries. It has been already for many decades that the positive emotional impact of these words has been used in the advertising industry to attract consumers' attention. Millions of people use the words "energy" and "life" every day while being satisfied with only an illusion of intuitive understanding of their meaning.

What is the secret of such popularity? We would like to suggest that evolution of human language has been determined by the success of those individuals who could attract wide attention to the notions that proved to be the most essential for the very existence of the society as a whole and its individual representatives. Advantages of civilization allow modern people to avoid many problems that previous generations had to face. This makes it possible to change the system of priorities. "Energy and life" seem to be not of such a crucial importance today—both for an individual and human society in general. Emotional attractiveness encoded in the language can be viewed today as a historical step on the path that was taken by people so as to understand Nature around them as well as themselves. The years 1961–1995 witnessed achievement of unbelievable progress in understanding of the molecular mechanisms of energy supply. This fact could create the illusion that practically everything has already been discovered in , and the next generations of biologists would better choose some other areas of scientific research.

But with the arrival of year 1996 there appeared the first publications on a completely new role of mitochondria—energy transforming organelles of animal, plant, and fungal cells—in the destiny of these cells. Mitochondria were found to play a key role in the processes leading to programmed cell death. They are not only the main energy providers for this process (and this fact leads to a new approach to the problem of "energy and death" that was previously viewed mainly in connection to nuclear weapons), but also serve as extremely powerful facilitators of lethal signals. Hence there appeared a new area of research connected to

the role of mitochondria in the programmed elimination of tissue parts, organs, and even the whole organisms. This discovery led to a substantial increase in the number of scientific publications on mitochondria-related issues. The number of such articles in the first decade of the twenty-first century was about 2.5 times higher than in the last decade of the previous century.

We hope this book will become the contemporary textbook on bioenergetics. Most of it is based on the course of lectures on that has been presented by one of the book's authors (V. P. S.) to Moscow State University students over the last 40 years. This course embraces fundamental data on molecular mechanisms of accumulation of energy and its usage in mitochondrial, chloroplast, and bacterial membranes. These issues have already been reviewed in the previous textbook by the first author (Skulachev VP (1988) *Membrane Bioenergetics*. Springer, Berlin), but the present book includes also a number of new aspects, e.g. evolution of bioenergetic mechanisms, toxicology and physiology of reactive oxygen species, their role in programmed death phenomena, such as apoptosis, mitoptosis and phenoptosis (aging), as well as some other topics.

Principles of Bioenergetics

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