The book addresses an important issue related to the search for means and methods of obtaining analogues of natural dormancy (hypobiosis) in warm-blooded organisms and of reversible cryonic states (cryobiosis) in free-living cells.

In the first part of the book, the author unveils the neurochemical mechanisms underlying the development of states of natural dormancy. On the basis of these regularities, analogues of known states of natural dormancy were simulated and reproduced in five species of warm-blooded animals. Direct analogues of different kinds of dormancy were simulated, and original variants unclaimed by nature were developed. It turned out that the reorganization of body functions during the development of any kind of dormancy (and hypobiosis) is based on the switching off of the tissue bioenergetics of succinate-type tissue respiration (STTR), which ensured the formation of warm-blooded organisms in the course of evolution.

The methods of switching off the bioenergetics of STTR elaborated by the author transfer a warm-blooded organism to the basic bioenergetics of cold-blooded animals, the Krebs cycle. The metabolic level in this case declines to 50%, and ideal homoiotherms lose all properties of a warm-blooded organism (thermoregulation, fever and inflammation processes, emotions, stress responses, etc.) without a considerable disturbance of behavioral reactions. The poikilothermy developing in this case permits, under certain conditions, the formation of continuous (for many days) and reversible prolonged states of hypobiosis within any set temperature range (from normothermia to temperatures close to 0°C).

Any kind of obtained hypobiosis activates the functional mechanisms of autoregulation of an organism leading to changes in the processes of gas exchange, the structure of the lipid matrix of cellular membranes, and immune and reactive properties of the body. Such a functional reorganization results in a drastic increase in the resistant properties of an organism to the impact of diverse damaging factors (chemical, physical, immunotoxic, etc.).

Timofeev has experimentally supported the possibility of using states of hypobiosis as a means of protection of a homoiotherm in different spheres of emergency, rehabilitative, and applied medicine. The efficiency of protection of the body can be used successfully not only in radical methods of treatment (surgery and transplantation science) but also for conservative treatment (therapy, nervous diseases, psychiatry, oncology, obstetrics, etc.). In hypobiosis, as in states of natural dormancy, a high level of immunotoxic resistance arises. In addition to blocking infection development, in organ transplantation the immune protection of both the transplant and the recipient considerably increases. It is noteworthy that switching off the powerful bioenergetics of STTR makes it possible to block the development of malignant tumors and increase more than twofold the resistance to the damaging impact of γ radiation.

As the author’s data indicate, the property of the functional superresistance of the body appearing during hypobiosis can be widely used as a preventive means for the protection of the body at plants having a potential danger of mass injury to people (nuclear power plants, chemical plants, mines, etc.), as well as for providing emergency assistance in the case of various accidents and disasters (aviation, motor vehicle, railroad, etc.), earthquakes, shipwrecks in a cold sea, radiation damage, threatened oxygen deficiency in submarines or spaceships, etc. It should be taken into account that the time of the development of hypometabolic states is counted in minutes and the development of a pathological process (for instance, in the case of Rausch syndrome or after γ irradiation) in hours, which enables preventive protection of the body to be carried out after the impact of an injury factor.

The second part of the book deals with the experimental search for ways to create states of cryobiosis at the cellular level under conditions of moderately low negative temperatures (0 to −10, −20, or −30°C). The author has completely abandoned the traditional ways of solving this problem, which are usually reduced to the replacement of liquid fractions by glycerol solutions and freezing of a biological object at liquid nitrogen temperatures. All similar methods of obtaining cryonic states, in the author’s opinion, are absolutely and in many ways irreversible for the foreseeable future.
For simulating cryonic states, the author used the known property of the protoplasm of a cellular structure that it, under certain conditions, can be transferred into a state of supercooling under moderately low temperatures. The protoplasm in this case retains a liquid structure and is not subjected to the cold lyophilization that is inevitable under liquid nitrogen temperatures. The author successfully eliminates the danger of damage to tissue structures by processes of peroxidation emerging in this case by the creation of an artificial anoxic medium. In the end, the author succeeded in obtaining a completely reversible prolonged state of cryobiosis in an anoxic medium and under moderately low temperatures with an free-living cell.

In the case of the expected in the near future solution of the problem of creating cryoprotectors (vitrifiers) for living organisms, these studies can be used as a basis for practical realization of obtaining reversible states of cryobiosis in higher forms of biological life under moderately low temperatures.

Thus, the book embraces the entire spectrum of diverse temperature levels of life minimization, which can be of considerable interest for both biological science and practical medicine.

Undoubtedly, the book by Timofeev¹, a well-known physiologist, Doctor of Science (Med.), a specialist in the field of aviation and space medicine, and head of the Laboratory of Nanocytophysiology of the Institute of Nanotechnologies of the International Conversion Foundation, will be of considerable interest for readers.

V. I. Medvedev

¹E-mail: VNTim@mail.ru; phone: (495) 190-06-75.