# *At the Frontiers of the Unexplored*

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Several years ago a laboratory of space biology was established at the Institute of Cytology, USSR Academy of Sciences. The head of the laboratory is Prof. Lev Konstantinovich Losina-Losinsky (Doctor of Biology).

For many years this scientist has been investigating the influence of low temperatures on living organisms. Even among the multicellular, highly organized beings there are species with some remarkable properties of resistance to cold: under some conditions they are capable of standing temperatures of 148-238° below zero (F.), and in some cases even temperatures approaching absolute zero. After thawing, such organisms can continue living and developing.

What is the mechanism of such resistance to cold? For a long time it was considered that in the process of freezing only the water in the intercellular space turns into ice crystals. In this case the ice crystals ruptured the cell walls, and the recovery of the vital functions of the organism became impossible.

With the help of a technique worked out in the space laboratory, Losina-Losinsky managed to see what was taking place in a freezing cell. He used the luminescent effect instead of ordinary lighting. In this case the outlines of the cell proper disappeared, but its nucleus glowed in a bright green light. Under the influence of low temperatures cellular division appeared in the nucleus, with the ice crystals forming inside the nucleus. In "untrained" cells this was an irreversible process. And in the cells which had grown accustomed to cold the nucleus continued to live after they thawed, which meant that the cells could sustain low and extra-low temperatures without any harm to themselves, including the low temperatures of outer space. Metabolism terminated in the cell during the process, and the cell, so to say, went to sleep.

The research done in the space biology laboratory helps to bring us closer to the time when people will be able to delay or even stop vital processes at will. Thus, man will be able to triumph over time and subjugate its march to his will. Naturally, so far this is only a dream. However, a walk in space also looked like a dream a short time ago.

It is quite obvious that our present concepts of the frontiers of life can be substantially expanded. Terrestrial beings are very sensitive to penetrating and ultraviolet rays, and exposure to space radiation is deadly for them. At the same time, it appears that the absence of oxygen in the surrounding medium makes the cells more resistant to radiation. Moreover, it has been proved experimentally that bacteria and the simplest single-cell organisms can be "trained," by small doses of radiation exposure, to become adapted to X-rays and ultraviolet rays. And their offspring will be able to sustain without any consequences radiation exposure deadly for the parents.

When single-cell organisms are exposed to large doses of ultraviolet radiation, they fall ill and even die. However, if the ultraviolet exposure is followed by an ordinary light exposure, the disease either does not take hold or passes in a light form. This phenomenon has been called photoreactivation. It shows how important it is to study the influence of the physical and chemical factors which we may encounter in outer space or during visits to other worlds. These factors should be studied in combination and interaction with one another. It is actually this problem that is being tackled now by the laboratory staff.

"One of the most important problems of space biology," says Losina-Losinsky, "is the solution of the problem of the possibility of the existence of life on other planets and in other worlds. The physical conditions there are quite different than those we have to deal with on the earth. That is why space biologists are interested in the general properties of living matter and in the conditions under which this matter can exist.

How is one to determine the degree in which living matter can become adapted to the surrounding medium? It is difficult to answer this question by studying the highly organized and complex organisms which become adapted to terrestrial conditions as a result of the process of evolution lasting for millions of years. It is certainly much more rational and simple to do this kind of investigation with separate cells or single-cell organisms.

In the billions of years of the earth's history there was never a combination of living matter more perfect than protein. In spite of the great variety of the conditions of existence on the globe, the foundation of all living beings on our planet, without exception, consists of protein. Mother Nature goes about her business in an extremely zealous and thrifty way. Therefore, there is no reason to assume that the earth is an exception in this respect. The appearance and development of life on other planets or in other worlds should proceed in the same way as has been the case on the earth.

However, does this mean that every planet is bound to have life on it? Yes, barring the assumption that outer space is impenetrable for life. Still, we know now that low temperatures are really not a completely insurmountable obstacle. In other words, life can continue and even develop actively under conditions which do not exist on the earth but apparently prevail on some other planet, for instance, such as Mars.

Every new space flight of the cosmonauts makes it possible for us to come ever closer to understanding the things which man will have to encounter in outer space, on other planets or in other worlds. Particularly important for space biologists was the space flight, when Alexei Leonov left, for the first time, the confines of a spaceship cabin and was face to face with space.

The research done by the Soviet space scientists has shed quite a different light on the possibilities of living beings, moving from one world to another.

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