Biological Research, Human Evolution and Unification Thought

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The fact that human beings could go beyond the limits of the earth is one of the most significant scientific and technological achievements of humankind in the 20th century. Theoretical and practical cosmonautics began in Russia, and the key steps in the process of opening up space were made here. It is also significant that in the middle of the last century a unique cosmic trend of scientific thought and philosophy was established in Russia. The representatives of this trend were such scientists as K.E. Tsiolkovsky, V.I. Vernadsky, A.L.Chizhevsky, N.G. Kholodny, and V.F. Kuprevich. The teaching about the earth's biosphere and noosphere, the form of biosphere, in the present time has laid the foundation for our concept concerning the world and its structure.

The noosphere concept based on Vernadsky's studies acknowledges the unity of human beings and the biosphere. It is stipulated by the progress in space research, which raised the problem of biospheric and cosmic evolution. The biosphere is the intermediate station for the cosmic powers affecting our planet. According to Vernadsky, interaction between the biosphere and humankind has formed a new informational and energetic field, an environment for the development of the present geological and cosmic stage in our planet's evolution.

The development in the sphere of cosmonautics is stipulated by the predominant model of social development, since, on the one hand, it provides the resources for progress in the field of space research, and on the other hand, it defines the goals and objectives of human activities in the cosmos.

The first model is focused on developing cosmonautics for the sake of pragmatic purposes, including military needs. However, since this area is not so developed, it does not significantly affect the ecological balance on the earth.

The second model is very favorable for developing the major aspects of cosmonautics. But dynamic development of society within the framework of this model will inevitably result in breaking the environmental balance.

The third model leads cosmonautics in the direction of reinforcing the ecological safety of the earth.

The term "biosphere of the earth," i.e., the sphere of life, was introduced to biology by Lamarck in the beginning of the 19th century, and to geology by Suess at the end of the 19th century; later it was broadened by Vernadsky, who defined it "as a planetary phenomenon of cosmic nature." Based on this concept, in 1927 the French mathematician Le Roy introduced the term "noosphere" as a name for the present stage which the biosphere is passing through in the geological sense.

Vernadsky successfully developed this idea, pointing out that the noosphere is a new geological phenomenon. In this sphere human beings "for the first time become the greatest geological power. ...Human beings change dramatically the surface of the planet -- the biosphere. ...The noosphere is the latest stage among the many stages in the process of evolution of the biosphere." Chizhevsky exposed the fact that physical and chemical processes taking place on the earth are very closely connected to the activities of cosmic powers, which profoundly affect the vital processes in the biosphere. The biosphere of the earth in respect to space is an open system both in thermodynamic and informational aspect. It can explain many phenomena in physical, chemical, biological, and social processes.

Informational influence upon the biosphere is carried out through fields of various nature, and the most efficient among them is the gravitational field. All the key events on the earth are connected to the degree of tension of the gravitational field. In the process of their development all the biological objects on the earth are influenced by a range of stationary factors, such as atmosphere pressure, gas compounds of the atmosphere, temperature, gravitational forces. They developed special mechanisms in order to maintain parameters (temperature, pressure, etc.) on the level most suitable for the objects. A gravitational factor is the least changing; however, it can be one of the most substantial factors. Gravitation on the earth is not a constant; it changes periodically, as a planet is moving along its galactic orbit. The earth as a part of the

solar system makes a full circle around the center of the galaxy every 150 to 200 million years; this period considered one galactic year. Now the earth has approached the perigalactic in its galactic orbit; thus we are living under circumstances of maximum gravitation. Since it takes millions of years for galactic changes to take place, they can be an important selection factor in organic nature. It is important to remember that the period when gravitation changed coincides with the key events in the evolution of the organic world. Thus, when gravitation was low, the first organisms (protozoa) emerged on the land (at the end of the Devonian period). A phase when gravitation increased coincides with the period when the gigantic reptiles -- dinosaurs and ichthyosaurus -- became extinct. Now big animals live in water, where the buoyancy of water resists the power of gravitation. Gravitation affects all living beings; it played an important role in the evolution of life on the earth.

Today we see that the modern noosphere is becoming more dependent on the level of production of new technologies, natural resources and their reproduction. Under these circumstances ecological ideas prevail in the social sphere, and the importance of the social sphere is growing. In their extreme form, such ideas as cessation of production, rejection of power-consuming technologies in industry and modern technologies in agriculture may lead society to the idea of a non-technological civilization, and to degradation. For this reason the significance of the modeling noospheric processes is growing. Such modeling can be accomplished in biotechnological complexes, which exist in our country and in the United States; these centers are designed to solve the important problems in space programs. In fact, these complexes are biotechnical ecological systems varying according to the degree of their isolation in terms of essential materials normally needed to support human life.

A spaceship is also a closed biotechnical ecological system, where human beings live and work, carrying out fundamental scientific research which ultimately allows humankind to go beyond the limits of the earth and settle on other planets. This is the reason why so much attention is given to biological experiments in manned astronautics.

The space age commenced the experimental studies on the force of gravity and its influence on the human body. A wide range of experiments under the circumstances of space flight was carried out in the space stations "Salyut" and "Mir." Today many of these results are considered unique phenomena. By investigating their mechanisms we will be able to apply them for our practical needs.

The first results of biological research conducted on the simplest organisms, plants, insects, water animals and birds demonstrate that the environment of outer space and space flight (cosmic rays, weightlessness, the gaseous composition of the artificial atmosphere, the disruption of the circadian rhythm, the changes in the electric and magnetic fields, etc.) lead to visible changes in the regimen and the level of metabolism, the structure of cell tissues, cells themselves, and the cell organelles, genetic effects, and other changes. However, these changes do not exceed the level of tolerance of the organism.

Furthermore, it was theoretically demonstrated that weightlessness affects the internal cell processes that distribute the particles in cells. Thus, the effect of the influence of massive forces can only take place in the case of cells of a diameter exceeding 10 microns. We conducted investigations that demonstrate the gravitational dependency of processes and systems of chemical reactions whose process is accompanied by a phase transition. In order to evaluate the observed effects owing to the influence of the factor of space flight on the course of chemical reactions, model systems were selected consisting of the biopolymers gelatin and agar and polyacrylamide gels.

Gels synthesized under conditions of weightlessness were utilized for electrophoresis separation of complex protein mixes: proteins of blood plasma, cell nuclear protein histones and various forms of cytochrome C. A significant change in the electrophoretic characteristics of polyacrylamide gels was demonstrated under circumstances of space flight. Likewise, changes were detected in a series of physical chemical properties of the gel: the parameters of NMR spectra of the character of small angular deflections of X-rays and others. In this way it is demonstrated that chemical systems involving reactions accompanied by phase transition are sensitive to gravitation in circumstances of weightlessness.

Investigations were conducted regarding the possibility of carrying out synthesis of biologically important nucleotides in the conditions of outer space, in which the source of energy for the reaction was the local ultraviolet radiation from the sun, ionizing radiation, and temperature. Dry mixes of chemical substances were placed in vacuum ampules: adenine-ribose, adenine-deoxyribose and thymine-deoxyribose. As a result of these investigations it was demonstrated that, when the dry mixes of chemical substances were exposed to outer space, substances similar to nucleotides were spontaneously synthesized. The products so synthesized differed from natural nucleotides in molecular weight and peak UV absorption spectra.

More than 100 experiments were conducted with higher plant species. The subjects of investigation were peas, lettuce, cabbage, radish, and of course the model plants arabidopsis and crepis. Back in 1981 on the "Salyut" space station, the first seeds of arabidopsis were produced in an experiment growing the plants all the way from seed to seed. For comparison, we may state that the first such seeds were produced by the Americans only in 2000, from the plant brassica on the orbital space station "Mir."

We conducted investigations with tissue cultures of agriculture and medicinal plants. It is well known that the seeds of many agricultural plants are infected by viruses. This is a plight of all countries, since it leads to loss of harvest. Therefore, in order to obtain pure seminal material, we used cultures of plant tissues. This is one of the most important areas of research for space biologists. For example, during the Soviet-British space flight the first potatoes were obtained from tissue cultures. Also, tissue cultures of the medicinal plants ginseng, saffron, and sorbit (a low-calorie sugar substitute) were investigated. A heightening of the biological activity of the cultures of medicinal herbs was detected in many of these experiments.

We have been continuously elaborating new technologies for improving the growth of plants in weightlessness with the purpose of using these for systems of enhancing human lives. In the first place, in the "Oasis" space orange orchard we applied the stimulation of electrical fields to the plants, based on the hypothesis that the geotropic behavior of plants is related to the bioelectric polarity of plant tissue. Our supposition was in part confirmed: Under the influence of an artificial electrical field, plants grew better in conditions of weightlessness, restored the normal balance of their mineral and biochemical constituency, yet still there appeared no flowers and no seeds, as before. Then we applied an artificial gravitational field by using an on-board centrifuge. In this way we confirmed the hypothesis that, in the physiological sense, a centrifugal gradient is adequate and tantamount to natural gravitation: The plant shoots properly oriented themselves in reference to the vector of centrifugal force. In another laboratory setup, i.e., a magnetogravistat, we studied the effects of various orientations of different types of magnetic fields and found that their influence upon the growth of flax compensates for the absence of gravitational force.

As a result of the experiments we have conducted, Russia has established leadership in the field of space biology in the following areas: the first extended-duration cultured plants, the first root plants, the first seeds, even the first two-year-old dwarf trees on the "Mir" station. ...These have led us to conclude that it is unlikely that we will be able to obtain flowers and fruits in outer space.

It appears that this circumstance is connected with the effect on the plants of the reduced partial pressures of the relevant gases (oxygen, nitrogen, carbon dioxide) in the artificially generated atmosphere in the presence of human beings and the conditions of humidity in the zone of plant growth.

Our scientists proposed the hypothesis that the growth and development of descendants of the seeds born in space will differ from the descendants of earthly seeds.

In order to confirm this, an experiment was conducted in the vegetation module "Svetoblock" ("Greenhouse Component"), isolated from the atmosphere of the cabin of the space station, using sprouts of a dwarf variety of familiar wheat. The experiment was run for 157 days. Two wheat plants were raised in space to the stage of producing ears with kernels and then returned to the earth, where they were continued in their growth to full fruition. Two full ears were obtained yielding a total of 28 seeds.

The seeds were subjected to X-ray analysis, which showed that there were changes in the structures of the seeds in the process of their formation. Changes were revealed in the forms of the internal membranes of the seeds and in the formation of distinct layers which did not appear in the control specimens. The spiral pattern of leaves of descendants of the "space" seeds revealed disorientation and a curled or rolled-up configuration. Furthermore, the following generation likewise preserved this disorientation, and the seeds also preserved the same alterations.

We proposed the hypothesis that, although the DNA of the cell structures of the familiar plants had not changed, the degree of its twisting may have been altered, and this might effect the initial stages of the growth of the plants, i.e., the plants "remembered" the conditions under which they had been formed in the weightless state.

The discovery of this "memory" in seeds has practical significance for the technology of cultivating seeds on prolonged space voyages or on other planets in the future. In terms of the possibility of producing

seeds in space, S.P. Korolev wrote of the key question: "Will we use seeds produced in space, or will we bring seeds along in store?"

In terms of the question of conducting further biological research on orbital stations, it is deemed worthy to note that during 25 years of manned space flight, 850 biological experiments have been conducted twice as many as have been conducted by all other nations put together. These investigations show that in the environment of weightlessness the organism experiences pressure from many different factors of external conditions unlike those on earth along an entire series of parameters: electric, magnetic, and electromagnetic fields. If we take into account the global influence of cosmic rays of different kinds, on the human individual as well as on humanity as a whole, we would recommend the importance of working out methods to shield human beings from their negative influence.

The creation of biospheres in space or artificial biotechnical systems with full or partial control of the circulation of substances of the type prevalent on earth may turn out to be one of the paths toward resolution of this challenge. Polymers synthesized in space may be used for the construction of strong and lightweight materials for use in the biosphere in space. Synthetic gels may serve as molecular sieves, matrices for obtaining highly purified biopreparats. For example, using "space gels" on the earth, a solution of erythroprotein was obtained that was 13 times purer than a similar substance from the pharmaceutical industry. The heightening of biological activity of ginseng plant cell tissue cultures at the Kirov Biochemical Factory during the period of one year obtained cultures whose activity was five times greater than the control specimens, thus giving us the capacity to produce qualitatively new medicinal substances. Biocrystals have been grown in space, and new breeds of microorganisms have been generated which have no equivalent on earth -- these and other developments promise unprecedented possibilities for the pharmaceutical industry.

Many space technologies can be used on earth to help solve ecological or agricultural problems. Highefficiency fluorescent lamps with extraordinarily high yield and artificial substances based on polymer materials enable us to establish agricultural production in a shielded area within the space of one year. In addition, in closed biological-technical complexes we can evaluate the results of various sources of atmospheric or soil pollution, and forecast the potential consequence of the destruction of the ozone layer or the greenhouse effect.

The mastery of space will lead to further evolution of our human species, Homo sapiens, as we begin to realize our place on the earth, which looks so fragile when seen from outer space, and our purpose of existence in the universe. The geocentric views of Descartes, Newton and Bacon, in which human beings held a special place in the evolution of organic and inorganic nature, were replaced by the Cosmic Paradigm, which is based on the idea of the indissoluble oneness of nature, technologies and human society on the earth and in space.

From the point of view of Unification Thought, human beings and all things relate to each other as subject and object. Human beings are the owners of creation, and creation is an object of joy and beauty for human beings and is owned by them. Unification Thought recognizes the fact that the human being integrates the objects of creation; he is a microcosm, so he possesses all the structures, elements and qualities of creation.

Due to the knowledge obtained with the help of scientific methods, we have an opportunity to look at our planet from afar, and realize that the earth is a wholesome natural system, abiding in outer space, a unique entity, a part of creation existing in accord with the universal laws.