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# TRANSLATION

CERTAIN RESULTS OF THE DEVELOPMENT OF SPACE BIOLOGY

By

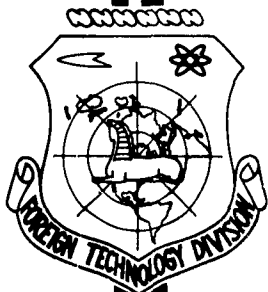
G. P. Mikhaylovskiy

## FOREIGN TECHNOLOGY DIVISION

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## UNEDITED ROUGH DRAFT TRANSLATION

CERTAIN RESULTS OF THE DEVELOPMENT OF SPACE  
BIOLOGY

BY: G. P. Mikhaylovskiy

English Pages: 7

SOURCE: Vestnik akademiy nauk SSSR, Dekabr'  
1962, pp.105-108

T-54  
S/30-62-0-12

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## CERTAIN RESULTS OF THE DEVELOPMENT OF SPACE BIOLOGY

G. P. Mikhaylovskiy

The protracted group flight of the ships Vostok 3 and Vostok 4 was a great new step in the conquest of space. It was an experiment unprecedented in perfection of preparation and organization in which space biology and medicine took a major role. A large number of the most complex questions associated with maintaining both the normal vital activity of cosmonauts during flights of many days' duration and its complete safety by developing medical supervision, and the cosmonauts' training and preparation were solved.

Certain results of the great, and sustained effort which was made by Soviet research biologists was discussed at the October 1st and 2nd session of the Section of Biological Sciences of the Academy of Sciences of the USSR which was dedicated to the fifth anniversary of the first artificial earth satellite.

This is now the second session on the problems of space biology organized by the Academy of Sciences of the USSR (the first took place in the fall of 1961). The huge scope of investigations, the wide circle of specialists participating in them, and the rapid pace of development of the science make necessary regular meetings of

scientists for the exchange of information and an extensive discussion of the problems of space biology.

Opening the session, Academician-Secretary of the Section of Biological Sciences, N. M. Susakyan in his opening address pointed out that Soviet studies in the area of space biology were a great contribution to man's study and conquest of space. He cited as the fundamental problems of present-day space biology the study of the effects of extreme flight factors on living organisms, the research and development of biological bases for safeguarding space flights and life on the planets, and study of the conditions and forms of extraterrestrial life.

Sisakyan emphasised that the most urgent problem of medico-biological research is to assure the safety of space flights.

Copious factual material obtained as the result of biological experiments carried out in satelloids, and of scientific studies made during the flights of the cosmonauts in the Vostok flights was presented in the report of V. I. Yazdovskiy and O. G. Gazenko.

Analysis of the material of all of the space flights made by animals or humans provides a foundation for supposing that the complex factors which affected the living organisms in these flights did not give rise to any pathological reactions. This, however, does not mean that space flight is perfectly safe. In the first place, this conclusion is based only on flights of limited duration (up to four days) over a definite orbit. Secondly, the possibility, however slight, of the rise of various dangerous situations such as decompression, excessive G-loading, disturbances in the operating conditions of the temperature control system, etc., exceeding those for which they were designed is not included. Third, cosmic space may confront

the cosmonaut at any moment with unexpected surprises (a sharp increase in the intensity of space radiation, etc.). All of this poses to scientists the problem of even more profoundly studying the factors of space flight and their effect on living organisms.

Special attention must be paid to factors which are characterized by lengthy and continuous action, i.e., above all to weightlessness and cosmic radiation, neither of which can be simulated on earth. This makes it necessary to conduct special experiments with animals which apparently must continue to play the role of "space scouts". The general character of space flight factors (e.g., their biological influence) is presented in the report of Yu. M. Volynkin and P. P. Saksonov.

As is shown by the experience of Soviet and American cosmonauts, brief orbital flights below the radiation belts are safe with respect to radiation when there is no increased solar activity (V. V. Antipov, N. N. Dobrov and P. P. Saksonov). There is, however, experimental data on the change in reactivity of the different systems in the living organism in connection with the complex effect of cosmic radiation and other factors of space flight (summation of the effect of different stimuli, the non-specificity of response reactions, etc.). Hence the problem of small doses of ionizing radiation takes on special importance, inasmuch as the biological nature of the reactions which arise in response to the effect of this constant factor of the space environment has been insufficiently studied (A. V. Lebedinskiy and Yu. G. Nefedov).

As is known, study of the influence of the factors of space flight on living organisms presumes the collection of information on the various aspects of the behavior and condition of animals and

man under flight conditions. Therefore biological telemetry has become one of the basic methodological procedures of space biology, a young scientific trend which provides for the use of radio channels for the transmission of medico-biological information from on board a spacecraft to the earth. Biological measurements during space flight may be divided into three categories: medical supervision, i.e., continuous, dynamic observation of the condition of the cosmonaut; medical research, i.e., study of specific reactions of the organism in flight; and biological display (I. T. Akulinichev, R. M. Bayevskiy and O. G. Gazenko).

In the medico-biological studies of Soviet scientists in the last year a large place was allotted to the study of the reactivity of the vestibular apparatus; this was cooked to a significant degree by data from the flight of G. S. Titov, according to which to the cosmonaut experienced effects reminiscent of sea sickness. In order to clarify the mechanism of vestibular derangement during weightlessness investigations were made of the vestibular analyzer at several levels including the cellular and molecular (Ya. A. Vinnikov et al.). Very delicate investigations were undertaken using a microelectrode technique (O. G. Gazenko, Yegorov, et al.). Study of the effect of positive and negative angles of acceleration of different magnitudes on the vestibular-autonomic reflexes made it possible to propose methods of evaluating the reactivity of the vestibular analyzer (A. B. Lebedinskiy et al.).

At present the question of the possibility of adaptation of the vestibular apparatus and the mechanism of this adaptation is receiving extensive consideration (N. N. Gurovskiy, M. D. Emel'yanov and Ye. A. Petrov). It should be noted that the pilots A. G. Nikolayev and P. R. Popovich demonstrated the importance of special training for cosmonauts.



According to preliminary data no clear displacements in the condition of the vestibular apparatus of either of the cosmonauts appeared during the many-day group space flight.

Methods of chemical regeneration of air are currently being used to guarantee livable conditions in the cabins of space craft, the essence of which is the enriching of the atmosphere of the cabin with oxygen and the removal of carbon dioxide by passing an air stream through a special highly active regenerating substance. However, the supply of this substance in the craft cannot be unlimited and in flights of long duration, e.g., greater than 30 days, this method of providing vital conditions on board a space craft apparently loses its value. For space flights of such duration methods of regenerating the gaseous medium by photolysis of carbon dioxide gas or the electrolysis of water appear promising (A. D. Seryapin, V. P. Dzedzichuk). Lengthy manned space flights and the possibility of man living on other planets will, however, to a significant degree depend on advances in creating so-called closed ecological systems (A. A. Nichiporovich, V. Ye. Semenenko, et al.), built on the principle of a biological cycle of substances in a plant-animal symbiosis (including man).

If in the first stages gas exchange was considered the main link, at present the man's food supply ration which also determines the structure and ratio of the elements of the given system must now be acknowledged as such a link. These considerations alter the specific significance in them of Chlorella, to which was earlier assigned one of the important roles. Chlorella must in these systems yield to higher plants which are suppliers of carbohydrates which have great significance in man's food supply. It cannot by its chemical composition completely balance man's food ration but is obviously

capable of serving as a source of fodder for animals which will be on board spacecraft. Our scientists have obtained significant results in increasing the productivity of *Chlorella* (A. F. Kleshnin).

The achievements of astronautics make it possible to pose the question of interplanetary voyages as a real prospect in the not too distant future. This very fact already demands a deeper look into the question of the possibilities, conditions and characteristics of extraterrestrial forms of life. Consideration of this question usually proceeds from the presently available information on the physical and chemical conditions peculiar to celestial bodies, and the question is resolved from the standpoint of the possibility of the existence of terrestrial organisms under these conditions. However, it would obviously be more correct to base judgement concerning the possibility of extraterrestrial life on a study of the general process of development of matter, so as to determine whether that complex form of motion of matter which we call life could have arisen and developed on one or another of the celestial bodies during the process of its evolution (A. I. Oparin).

Altogether, the session pointed out that space biology, formed at the junction of a number of scientific disciplines, embraces an ever large number of problems. Their scope is not exhausted by the above considerations. Reports were heard at the session which were devoted to works of scientists on adynamia and artificial hibernation, engineering psychology, gravitation and blood supply to the brain, physiological study of speech (for the purpose of developing a system of perceiving it automatically), the effect of space flights on hereditary structures, etc. All of these theoretical and experimental efforts are brilliant testimony to the advances in space biology in our country.

In a short historical period (five years) a great deal has been accomplished. From the first artificial satellite to a group space flight — this has been the path of Soviet science during those years.

The advances of Soviet astronautics including Soviet space biology create confidence in the fact that our country, putting into practice the outline of the Program of the Party will also in the future retain first place in the peaceful conquest of space.

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