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Development of biological aspects in space flights

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ABSTRACT

The basic problems in space biology and space medicine included: possible noxious effects of cosmic factors on organisms and their prevention and life preservation during space flight, (e.g. air regeneration; selection and training of astronauts). First of all, the choice of the corresponding support system of the astronaut is defined by duration of space flight. In this paper presented the development of space medicine and biology in space flight safety and the future aspects.

KEYWORDS

Space biology;
Space medicine;
Safety of space flight;
Space elevator.

INTRODUCTION

Theoretical researches in the field of space equipment and designing of aircraft strongly stimulated the development of many sciences, including new branch of knowledge - space biology[1]. The basic problems in space biology and space medicine included: possible noxious effects of cosmic factors on organisms and their prevention and life preservation during space flight, (e.g. air regeneration; selection and training of astronauts). First of all, the choice of the corresponding support system of the astronaut is defined by duration of space flight. Space flights are inevitably connected with number of factors impact on a human body. The factors caused by dynamics of flight (acceleration, vibration, noise, zero gravity). The factors characterizing a space as habitat (high degree of a sparseness of the atmosphere, ultra-violet and infrared beams, radio and the microwave radiations, ionizing radiation, etc.). The factors connected with long stay of the crew in cabins limited on volume of spacecrafts (isolation as a part of small collectives, the artificial gas environment, the changed biological rhythm, etc.).

Without scientific justification of possibility of space flight of the person and ensuring its safety it was impossible to speak seriously about flight of the person in a near-earth space, and furthermore about interplanetary travel[2]. We can only artificially create room of the spacecrafts which gives to the human chance to live and work in space flight. But in attempt to solve this problem it is necessary to answer number of difficult questions. With the development of outer space technologies, the safety of space flights becomes main priority of astronautics[3, 4].

FULL PAPER

HISTORY OF THE DEVELOPMENT OF RESEARCH FOR SPACE FLIGHT SAFETY

Space! How to perceive it? In many research laboratory to test various hypotheses or unfavorable environment of people are developed. Space outside the earth's atmosphere, perhaps, is not hostile, but it requires special training to meet with him. The first human flight proved his ability to be and to conduct scientific research in space. Thus, carried out in the XX century breakthrough human space marked not only a high level of theoretical and practical achievements of mankind, but it seems that marked a new era in the development of human civilization - a man appeared in a radically new environment. Indeed, flying in outer space manned spacecraft - a tiny island life in the desolate environment. His appearance has been possible only due to the successful solution of not only technical, but also a number of related problems associated with the life and work of a man in an unusual space flight. To deal with the solution of this problem, it is necessary to rely on a solid foundation of knowledge that underlay the problem. At the initial stage of the practical ways of finding space exploration have been associated with the creation and launch of automated vehicles into orbit and to other planets, the first manned flight into space, and a long flight to space stations, of landing a man on the moon. Theoretical studies in the field of space technology and engineering-driven aircrafts dramatically stimulated the development of many sciences, including a new branch of knowledge - space biology[5]. It became apparent that the range of problems associated with long-term space flight includes a plurality of individual problems of biology, physiology, hygiene, psychology, and, if anything, the moral and ethical issues. Specific objectives are part of the complex medical problems that are subject to various purposes (problems of medical examination, selection and training of crews, life support, medical monitoring, prevention, treatment, rehabilitation, and others.). At the junction with adjacent areas of science and engineering problems are born medical support development, ergonomics, engineering psychology, valuation parameters and habitat conditions of activity, forecasting changes in the organism and the environment, management, and many others. Finally, the system approach should provide a common problem, characteristic of space in general, and for all kinds of scientific and practical activities, which it unites safety of manned space flight. Specified format film (seven pages) does not allow to fully cover the topic, but the fundamental problems can identify.

Practical astronautics both historically and structurally formed and initially developed as a branch of aviation[6]. Most of the first space rocket designers, including Sergei Korolev, came in the space program of the aircraft. The first group of cosmonauts was formed exclusively of military pilots and preparing for space flight in aviation techniques. For this reason, space exploration has many laws governing the development of aviation and the example of aviation can be traced to the laws of space development. Recently deceased, Academician Boris Chertok Yevseyevich (March 1912 - December 2011), an iconic figure in the cohort of the "fathers of space", recalled that radio equipment and aircraft, and then in the space program brought him "Elita". In this regard, it is not to mention the activities of violent fiction romantic framing a new era of human history. This science-fiction writers with their space novels, utopias, such as Alexei Tolstoy "Elita", Ivan Efremov "Andromeda", Ray Bredberi "The Martian Chronicles", Arthur C. Clarke "Fountains of Paradise", Stanislaw Lem "Solaris", the Strugatsky brothers "Hard to Be God". Many of them are fantastic utopia proved prophetic. For example, according to the predictions of Ivan Antonovich Efremov was discovered the largest diamond mine in the world in Yakutia. "Hyperboloid of Engineer Garin" Count Alexei Tolstoy anticipated appearance of lasers, and along with a bunch of Nobel Prizes. And in line with fantastic novel "Fountains of Paradise" by Arthur C. Clarke is currently developed and adopted to implement the project the most economical way to transport people and cargo into space - the project "space elevator". We think that the implementation of the philosophical and moral issues raised in the works of these utopians, is yet to come. Long before the birth of practical astronautics at the turn of the XIX and XX centuries school-

teacher "Kaluga romantic" Konstantin Tsiolkovsky laid the foundations of theoretical astronautics, offered a scientific strategy and tactics of human space exploration, and formulated the basic differences of space from the other sciences[7].

For example, the representation of the mechanisms of long-term effects of weightlessness on the human body. It is also necessary to mention the pioneering work on the effects of gravity on living organisms Russian biologist Stanislav Fedorovich Stein[8]. The essential difference between the work of Stein from his predecessors, and many modern scholars, is that Stein did not limit their experimental study, only one species of experimental animals. In accordance with evolutionary ideas, consider the possibility of species characteristics and response of the animals to various environmental factors, Stein conducted research on animals at different stages of evolution.

In 1896, Nikolai Zhukovsky theoretically restored the trajectory of the last flight in a glider aeronaut Otto Lilienthal and gave a scientific analysis of the causes of the disaster. These results were published in the article "On the death of balloonist Ott Lilienthal"[9]. Perhaps this is the first publication of safety. If we follow the dynamics of the post-war civil aviation priorities, it will look as follows[3].

- (1950-1970): the safety of the flight, the flight speed, range, performance efficiency, comfort, noise near the airport;
- (1970-1990): flight safety, performance efficiency, noise near the airport, comfort, flight speed, flight range; -
- (1990-2010): flight safety, the environment, indicators of efficiency, comfort, flight speed, flight range.

As you can see, with the development of aviation priorities are reversed all but one of which occupies the first position - flight safety. With the advent of manned spaceflight space flight safety is also a top priority of space.

Safety studies as the properties of any aircraft is to determine the area of the limiting values of the parameters and modes of aircraft flight, in which it performs the specified function[7]. In aviation, the Flight Safety Foundation has developed a guide to reduce the risk of accidents in the most difficult flight conditions: the approach and landing. 33th Assembly of ICAO (International Civil Aviation Organization) recognized it as one of the most important elements of the Global Aviation Safety Plan[8, 10, 11]. Mode of entry into the atmosphere, the approach and landing are also the most complex modes of flight of the spacecraft.

A notable step in the field of safety was the creation in 1970, the national organization - the National Committee of the USSR on the safety of aircraft and spacecraft, which coordinated the work of all concerned departments of the country. The main objectives of the aircraft and spacecraft were: implementation of relations with international and national foreign organizations, academic institutions and companies directly involved in solving actual problems of safety of aircraft and manned spacecraft. At first, the activity of spacecraft was expressed in a rigorous selection of future cosmonauts on health and psychomotor reactions, in search of such methods cosmonaut training that would enable them to fend off

Poster for the silent film

"Elita" ray bredberi "The Martian Chronicles"

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Andromeda galaxy - the constellation of the northern hemisphere (left). In the three-star Andromeda 2nd magnitude and spiral galaxy visible to the naked eye already known from the X century (in the center of the star chart with the Atlas 1690). According to Greek mythology, Andromeda was the daughter of the Ethiopian king Cepheus and Queen Cassiopeia. Was given to the father as a sacrifice to the sea monster, ravage the country, but is rescued by Perseus (right). After the death turned into a constellation.

the most likely contingencies and to survive in a possible emergency landing as on land and on the water. Improving the space-rocket systems and ground support equipment, complexity of space activities has led to the fact that under the aircraft and spacecraft, along with sections of the aviation segment was created and space section headed by Georgy Beregovoi.

Taking into account the planned long-term space flights, the National Committee published the first monograph - *Veregova G.T., Tishchenko A.A., Shibanov G.P., Yarpolov V.I. Safety of space flights. - M.: Engineering. 1977. -343 p.* Experience of the National Committee was used in the organization of a dozen years ago, the Interstate Aviation Committee.

Referring to the basic problems, ensuring the lives of people in the spacecraft. The first selection of the appropriate life-support systems astronaut determined by the duration spaceflight[11]. Space missions are inevitably associated with the impact on the human body a number of factors, which are conditionally be divided into three main groups[12]. These are the factors due to flight dynamics (acceleration, vibration, noise, weightlessness). Factors that characterize the space as a habitat (high vacuum atmosphere, ultraviolet and infrared rays, radio and microwave radiation, ionizing radiation, etc.). Factors associated with prolonged stays in limited volume spacecraft cabin (insulation in small groups, artificial gas atmosphere, altering the biological rhythm, etc.). Given the significant risk and complexity of space flight, great importance is attached to animal experiments.

Without scientific substantiation of the possibility of human space flight and its security can not be seriously talking about the flight of man in near-Earth space, and even more so on interplanetary travel. Only artificially created in the living areas of the spacecraft environment gives the person a chance to live and work in space flight. But when you try to solve this problem it is necessary to answer a number of difficult issues. What in particular, this medium should be? With what completeness, it should ensure the diversity of physical and intellectual needs of man? What criteria should be the basis for optimizing the relationship of the organism with an artificial habitat? After a number of criteria, in addition to the physiological-hygienic, can be classified as psychological, ergonomic and even philosophical and moral.

Konstantin Tsiolkovsky space exploration called the pursuit of light and space. Of course, the machines give a lot of information, and without them it is difficult to imagine the process of space exploration, but mastered can be considered that part of the space, which, as an infantryman[13].

ADVANCE OF SPACE MEDICINE AND BIOLOGY RESEARCH IN THE FUTURE

– Fundamental and applied research of biology in

space are as floow[14]:

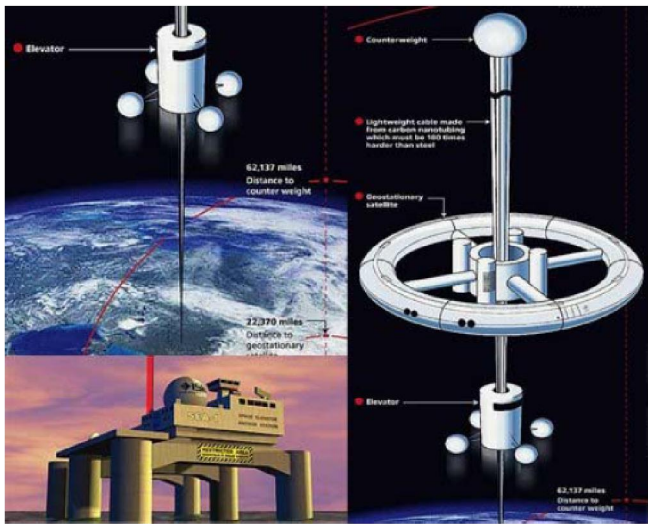
- Nature of living in space from molecules to organism in whole. Mechanisms of adaptation and readaptation.
- Specifics of ontogenic and phylogenic development of living system in microgravity.
- Biorythms in space.
- Gravity, radiation and magnetic field are the ambient factors for life on Earth, their role in structure and function of different living systems.
- Combined biological effects of main space flight factors.
- Ways of forming and distribution of life in Universe.
- Potential biological damage inhibited by flights beyond the Earth radiation belts and magnetosphere.
- Experimental modeling of pathology and trauma in space. Means and methods of treatment.
- Biological effects of artificial gravity and prolonged living in low gravity.
- Pharmacodynamics and pharmacokinetics of drugs in Space. Biotechnology Research.
- Biodosimetry methods for radiation safety control in space flights.
- Perspective methods and means of prophylaxis for manned flights beyond the Earth.

Modern design of space elevator

The main strategy of space sciences at next step are: to continue the fundamental and applied physiological and biological research abroad international space station (ISS); space transporation systems and unmanned spacecrafts including research on international basis, to accumulate the new biomedical data related to the extra prolonged orbital manned flights and future flights of crews to the Moon and Mars; to provide the medico-engineering and ergonomic support of new manned space systems development; to improve system for the medical support of human in space.

The main area of fundamental and applied biomedical research are studying the mechanisms of physiological adaptation to the specific factors of space flight and space enviroment, development and testing of new means and methods for propylaxis of unfavorable changes in organism and protection against adverse effects of space radiation, researching for lowering of potential medical risks in current orbital and future manned flights to the Moon and Mars with the use of contemporary technology and new achievements in general science.

We also need to improve research in ground based simulated experiments. Example, water immersion experiments for study of physiological effects of microgravity, head-down anti-orthostatic hypokinesia experiments for study of physiological effects of micro gravity, short radius centrifuge experiments for stydy of artificial gravity biomedical



Space elevator

effects, long-duration experiment in fully hermetical medico-engineering complex to study biomedical effects of some simulated peculiarities of manned mission to Mars and radiation experiment with monkeys.

CONCLUSIONS

Space medicine and biology research are important for national activity in space, but it requires to continue fundamental and applied research in manned and automatic space missions. Certain theoretical and experimental basis for medical support of manned missions to Moon and Mars is developed. New scientific technologies will be used for more active study of biomedical problems of interplanetary manned missions. The reported study was partially supported by the Russian Foundation for Basic Research (Research project No. 14-07-00564-à).

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