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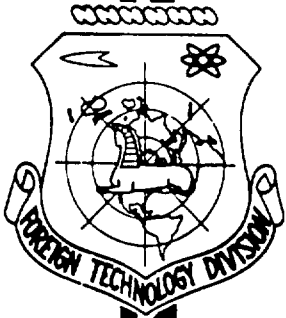
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TRANSLATION

ABOUT THE ONES WHO REMAIN ON EARTH

By
O. Gazenko

FOREIGN TECHNOLOGY DIVISION



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ABOUT THE ONES WHO REMAIN ON EARTH

BY: O. Gazenko

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ABOUT THE ONES WHO REMAIN ON EARTH

By

O. Gazenko

This is a report about actions of cosmic medicine - a science, which only a decade ago, was not in existence, there was generally then, no cosmic biology, nor cosmic telemetering and a multitude of other branches of science, which now are already associated in everyones mind with the concept "Adoption of the Cosmos."

Cosmic medicine came into being and began developing on the basis of many scientific disciplines. But its basic foundation became aviation medicine, also a young science, the history of which does not reach far back than 50 years. Having been formed during this half of a century into an independent discipline, aviation medicine was enriched by natural investigation methods, it accumulated an extremely large experimental material and what is of no lesser importance, it created its special approach to the execution of experimental operations, its famous traditions.

The main thing is, that it distinguished and distinguishes investigations in this field - a tendency toward specific strictness and accuracy of obtained scientific data, a tendency toward fundamental basicity and authenticity of conclusions. Doctors-experimentors have well understood, that each one of their recommendations, each instrument developed with their aid, each contrivance, sample of equipment, intended for the protection of the pilot, in case of emergency is responsible for human life.

The perception of greater responsibility for their operations, an atmosphere, experiencing a high sense of duty, have naturally gone into modern cosmic medicine. What was naturally born in the first stages of development of aviation medicine, has become the basic principle of operation of cosmic doctors.

Among the founder of aviation, medicine special mention goes to Professor V. V. Strel'tsov. Vladimir Vladimirovich, obtained outstanding education, at the physiolog-

ical faculty, managed by Ivan Petrovich Pavlov. His immediate teacher was one of the outstanding physiologists of our country - Leon Abramovich Orbeli, who showed greater interest in applied physiology and has done very much for the establishment of aviation and naval medicine.

V. V. Strelstsov, has himself, flown for many years, he knew aviation and its needs very well. Remarkable is the fact that he was among the first ones in our country who jumped with a parachute, and his parachute is marked with one of the initial numbers.

In him, has fortunately combined an outstanding scientific training, with deep understanding of the most important needs of aviation practice. The greatly interested experimenter, he was the first one to volunteer and entered a primitive reduced pressure chamber (baro chamber), from which pumps evacuated all the air. The first hazardous experiments, in the barometric chamber, were carried out by V. V. Strel'tsov personally, he studied the effect of rarefied atmosphere on the human organism.

Almost thirty years ago, he headed in Moscow, the first research center, which began working especially on problems of aviation medicine. Strel'tsov, together with his co-workers, have done very much in training for record flights, the first Soviet stratostats, as well as the famous transcontinental avia flights, allowing to establish many international records.

Vladimir Vladimirovich Strel'tsov, is perhaps one of the first ones who perceived the value of investigating overloads originating during evolutions of aircraft and especially when executing figures of higher pilotage (acrobatics). He was the beginner and most stubborn propagandist of physical training of fliers, raising the resistance of the organism to the effect of overloads. V. V. Strel'tsov, organized and headed the first in our country faculty of aviation medicine, which has become for many years, the center of training aviation physiologists and doctors.

This gifted man has clearly reflected the characteristic traits of a leading doctor and scientific-experimentator - a person who himself, volunteered for the most complex and difficult experiments, who never considered it possible to submit someone else to risk and dangers. Only when Vladimir Vladimirovich, was certain that the forthcoming experiment, is safe, did he begin experimenting on a much broader scale. The test persons as a rule, were volunteers - doctors and students. Being deeply interested in this field of science, they volunteered and gladly participated in the experiments, helping them to penetrate into hitherto uninvestigated problems, in revealing the hidden secrets of nature. For them, the example and initiative, given by the efforts of V. V. Strel'tsov were an inspiration, for which young scientists have long formed.

Very much for aviation medicine, was also contributed by Aleksey Pavlovich Apollonov.

Aircraft still did not fly too high, but such scientists as Apollonov, was already intrigued and alarmed by the rising altitude boundaries. It was clear, that not today-tomorrow constructors will design new aircraft, and pilots require doctor's permission for conquering new heights. Then will come new and new....And aviation doctors began storming higher altitudes in labs long before the first aircraft went up into the air.

Thanks to these investigations, it was established, that at an altitude of about 10 to 12 km, even breathing with pure oxygen may provide the organism with the necessary amount of this gas, for maintaining vital activities. It was found that in such a case, oxygen for breathing must be applied at a certain excess (above atmospheric) pressure. In other words, the oxygen must be forced into the lungs under pressure. It was found, that the physiology of breathing is changed substantially. The fact is, under ordinary conditions, the inhaling appears to be an active act and exhalation, a passive one (on account of collapse of the chest). When

breathing under increased pressure, everything is upside down: the oxygen penetrates forcibly into the lungs, the chest expands, inhalation is passive. In order to exhale the air, it is necessary to strain the entire respiratory musculature, and exhalation becomes an active act. Doctors-physiologists, were confronted with the problem of investigating this breathing method universally, to find permissible limits of intrapulmonary pressure, because excessive pressure could disrupt the functions of the organism, disrupt the activities of the heart and even inflict mechanical injury to the lungs.

A. P. Apollonov, was one of the first ones who began investigating this complex and highly important problem for aviation medicine - effect of increased intrapulmonary pressure on the human being.

In order to gain a clear picture on what is happening, with the human being, at such an extraordinary type of breathing, A. P. Apollonov, has thought of and with his own hands, constructed a curious device. It is necessary to point out, that he was a precision worker, skilled experimenter, who not only thought of things, but he himself constructed practically all his experimental installations and instruments, needed by him to carry on the investigations.

One of the first samples of avia oxygen instruments and masks, were prepared by him at the lab from available materials.

The mentioned installation for studying respiration under higher pressure, represented a quite larger barrel made from a metal pipe part. Aleksey Pavlovich, made in it an opening for the head, provided this opening with a rubber diaphragm, enabling to seal to the chamber, from which air was pumped by a vacuum pump.

The author of this contraption climbed into the barrel, and his head remained outside. With the aid of a rubber diaphragm the body, was found to be sealed in the metal vessel, from the air was vacated to definite limits. In this way, the experimenter attained the desired effect, and approach to the problem, so to say,

and on the other hand, creating a rarefaction in the barrel and reducing the air pressure against the body, he at the same time, raised the relative air pressure in his lungs. Varying the rarefaction magnitude, he could relatively change the air pressure in the lungs, in comparison with the pressure which the air exerted against the surface of his body.

The experiments by A. P. Apollonov, investigations of aviation doctors, served as an incentive for further investigating this problem and development of equipment, providing pilots with oxygen when flying at higher altitudes. At present time, high altitudes aircraft, are provided with higher pressure instruments, the structural principle of which was conceived in the above mentioned, investigations of avia physiologists.

Recalling the first steps of aviation medicine, we must feel a feeling of thankfulness to its pioneers, who by experimenting on their own bodies, on self made installations began studying many extremely difficult problems, the solving of which was their main purpose - to attain flight safety.

Historically, this was so, that the problem of high altitude physiology, and especially the struggle with the negative effect of rarefied atmosphere, were the first and most actual problems of aviation medicine.

A solution of these problems, was attained in barometric chamber experiments, the founder of which, as already said, was V. V. Strel'tsov, directly when flying aerostats (A. A. Pereskokov and others), and on the aircraft. Of no lesser importance were the results of experimental investigations in high mountains. Here mentioned, should be made about the investigations of academician I. P. Rezinkov, student and assistant to I. P. Pavlov, and other investigators, such as G. Ye. Vladimirov, who at the time of the mount El'brus expedition, into the domain of snows and rarefied atmosphere, made very important and interesting observations, the results of which are presently utilized in constructing the feeding systems of

pilots and cosmonauts, when studying certain problems, connected with digestion, metabolism in the extraordinary conditions of existence of the human organism.

Flights into cosmos - are flights under conditions of extreme degrees of rarefaction. The walls of a hermetically sealed cabin, isolate the cosmonauts from airless (vacuum), space. The problem of meteoric danger, was discussed many times at greater length. It is assumed, that the probability of encountering a meteoric body by a cosmic ship is low. But it does exist. It can easily be understood, that if a meteor would pierce the wall of the cabin, the entire cabin air will escape rapidly through the hole made by the meteor. This may occur so rapidly, like an explosion, that it is spoken about and "explosive" depressurization (decompression).

For the unprotected human being, such a situation is absolutely fatal. Into space, the air escapes not only from the cabin. Small amounts of oxygen, which exist in the air ways, liquid media and in the tissues of our organism, will try to liberate themselves, and escape into the surrounding medium. This phenomenon resembles somewhat the fact of what is taking place with fish, when dragged out to the surface of the sea, from greater depths. These unfortunate creatures, as a result of the expansion of the gases, dissolved in their bodies, blow up to critical dimensions. Something like it, takes place with ground creatures, which live as if on the bottom of an air ocean, when they are lifted into rarefied atmospheric layers. Instantaneously, the blood as if boils up. There is nothing surprising in it: it is known that at an altitude of about 19 km, water begins boiling at a temperature of only 37°C, in other words, boiling takes place at body temperature of a human being. Such boiling is sure death. Consequently, the cosmonaut must be provided with a special suit, helmet, which assume the function of protecting the human being against the fatal effects of extreme degrees of rarefaction, in case of cosmic ship cabin decompression.

It is perfectly natural, that problems, connected with the construction of such

equipment, were solved by engineers in cooperation with doctors. Aviation doctors, when testing the effectiveness of high altitude equipment, did this with themselves acting as guinea pigs.

These experiments were carried out in a barometric chamber: conditions of sudden cabin decompression, were reproduced.

According to the statements of the tested persons, at the moment of pressure drop, the human being feels a shock. The air is forced out from the lungs. The mouth quivers, the face becomes distorted. Because the air in the lungs expands suddenly, the human being, verbally from the sharp shock, may for a certain time lose their perception of the surroundings (that is why, all rescue (life saving) systems, as a rule, are intended for automatic connection). The experimenter turns the valve and oxygen under pressure, begins flowing into the helmet of the test person. One of the problems of these experiments, was the selection of oxygen pressure values, which would cause no harm to the human being.

Of no lesser importance was the determination of time reserve, that is the time from the moment of emergency to loss of consciousness, by the human being. During this fraction of time, the rescue systems should be connected and begin functioning.

In order to create reliable systems and be convinced that they will not fail in flight and in case of decompression, protect the life of the pilot or cosmonaut, it was necessary to undergo certain risks in experimentation. It is therefore, no wonder that the first experiments were made with the doctors themselves, in role of test persons.

A no less difficult problem, connected with protecting the human being against the effect of high temperature of the medium. When the flight is executed in dense atmospheric layers, the skin of the aircraft or cosmic ship, becomes heated due to friction with air particles. In emergency cases, the air temperature in the cabin of the flying apparatus, may rise considerably. It is only natural, that the protective means, which are available to pilots of aircraft, or cosmic ships, must be

intended for most extreme unfavorable conditions.

Reliability and effectiveness of means, protecting a human being against overheating, were checked in special experiments, which are carried out in so-called thermal chambers - installations enabling to raise the temperature of the air, to necessary maxima, creating thereat, the necessary humidity, surround the tested person, with red hot metal screens.

Developing means for protecting humans against high temperature, enthusiasts of aviation and cosmic medicine, carried out a multitude of experiments on themselves, in the thermal chamber, the thermal shields of which have breathed fire. They investigated the reactions of the organism to overheating, they tested suits, capable of protecting a human being against intensive heat, they determined the time, within which a human can resist such difficult conditions and continue working. These were very burdensome and difficult tests. In spite of the fact, that in one of such experiments, the human was dressed in a suit, offering maximum reflection of thermal rays, the temperature of his body approached 39° . He felt as if in a difficult (serious) feverish state. Special instruments registered the deviations of the functional state of the organism, approaching the dangerous limit.

Detailed investigations were also made in hot deserts - in these generally quite unbearable and perfidious regions of the Earth. Known are facts, that people accidentally lost in the desert, perished soon and within a few days, the desert dried them up. It was no longer easy to develop safety measures for the case, when the aircraft or cosmic ship has to make a landing in the desert. Pilots, engineers and doctors, by their selfdenying efforts, sought a solution for these and many other difficult and very important problems of aviation and cosmic medicine.

It can be said, that the mentioned experiments, appear to be a classic form of medical investigations. They originated from humanistic reasons, which are the functions of medicine as a science, and of soviet medicine in particular.

The work of an experimenter, conducting investigations with participation of other people, is perhaps no less complex, than experiments on himself. From a leading experimenter, such job requires enormous emotional strain, which is apparently, comparable with the thing which a doctor experiences, when operating on a seriously ill patient.

Each time, he begins a new test, the researcher understands well, that he approaches a certain critical boundary, beyond which he is not permitted to go. He must not miss a moment, when the human being, who entrusted his life in his hands, approaches the dangerous boundary.

Ordinarily, everything is solved with brief instances. On the encephalograph screen-instrument, registering the currents of brain action, slow waves do appear, indicating a change in state of central nervous system, indicating the development of preunconsciousness condition. The researchers understands clearly, that it is necessary to cut off the experiment immediately, because within several seconds come fainting, disruptions of organismal functions, may take place, which are quite serious for the health of the tested person.

Each such experiment, is extremely responsible, it requires from the doctor-experimenter maximum attention, cold bloodedness, heroism, enormous will power. At the contemporary state of development of science, such experiments cannot be avoided. It is necessary to develop, test, check the effectiveness of various means protecting the human being against various unfavorable factors, namely in conditions of their real effect. In contrast to an actual emergency situation, when the human being is left to himself, in lab tests, he is constantly and attentively watched and followed by the eyes of the doctors-experimentors and by sensitive instruments. Any deviations are immediately registered, and the tested persons are not subjected to critical actions of the unfavorable factors, because these investigations, appear to be safe for their participants.

It is natural, that experiments with the participation of people, are conducted only then, when there is confidence, that they are not dangerous, although a certain risk, apparently, does remain. The safety of such investigations, is attained first of all, by the fact that the very first experiments were carried out on animals. This is the first phase, by nature, of all investigations, in the field of aviation and cosmic medicine, when we speak about flight safety problems. To solve various problems, are used various animals. It is not by incident, that literature on aviation and cosmic medicine, when we speak about flight safety problems. To solve various problems, are used various animals. It is not by incident, that literature on aviation and cosmic medicine, carries an extraordinary wide list of representatives of the animal world, among which, in addition to small lab animals - mice, rats, guinea pigs and rabbits - an honorable place is taken up by dogs and monkeys. But this does not exhaust the list and one can see on its also insects, birds and mollusks, such as it would appear, unexpected experimental animals, like a bear, swine or giraffe. There is nothing surprising in it. A giraffe for example, is a very interesting and suitable object for studying the regulation of blood circulation, when terrestrial gravitation forces, effect its body. It is known, that a rapid change over from lying to standing position, sometimes causes dizziness. This is due to change in blood circulation in the brain, originating at rapid change of body position, in space. In case of a giraffe, thanks to the very long neck, the brain is farther away from the heart. The head of this animal covers a greater distance from the ground to tree branches, situated high up in the air. An improved regulation of blood circulation, assuring in these conditions a normal level of blood supply, to the animal's brain, represents great interest and is constructive from the viewpoint of developing methods of protecting a human being against blood circulation, disorders under the effect of overloads.

Scientists paid attention to the fact that the skin of swine, is very close in

its structure to human skin. That is why in some experiments, intended for studying skin damages or the development of any kind of protective means, against possible damages under flying conditions, does participate this, so far from scientific, animal.

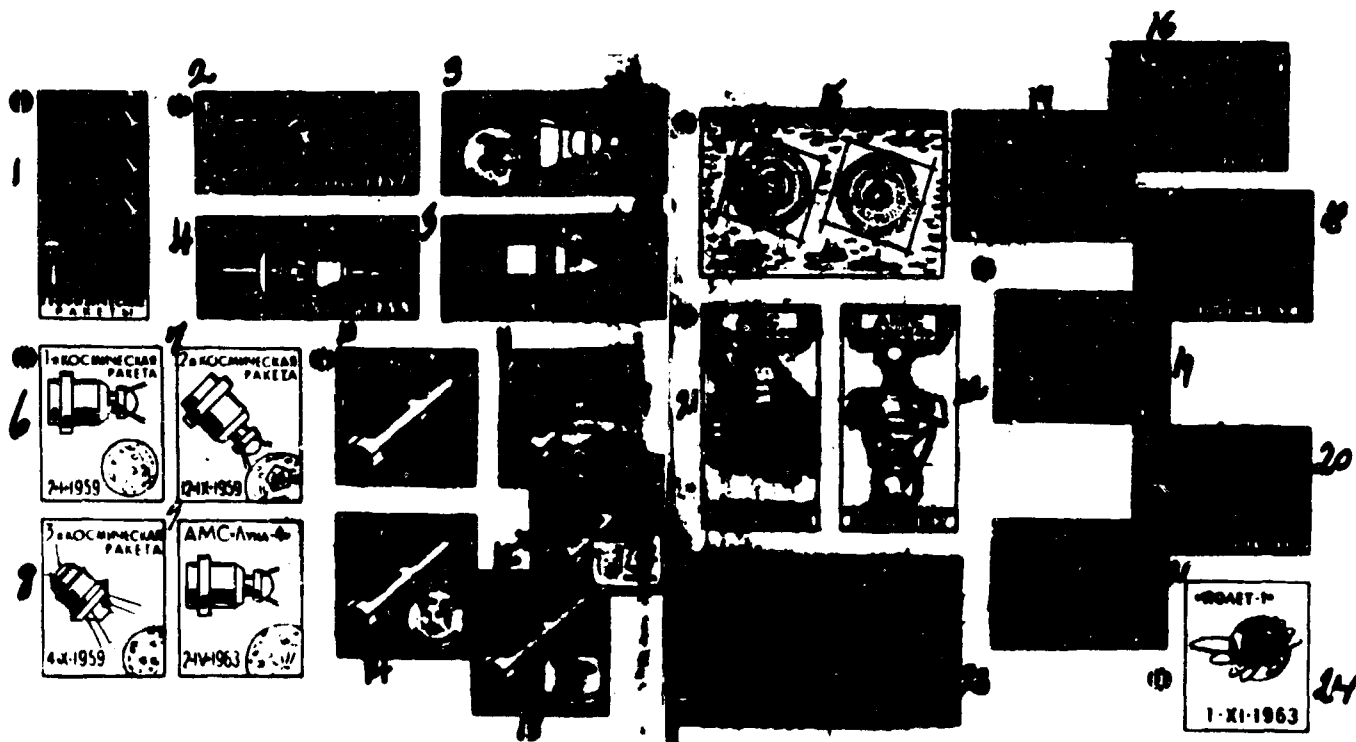
And in bears, in contrast to many other animals, almost as on a person, is formed the cervical section of the spine. That is why when investigating damages to the osseous apparatus, during catapulting, such exotic animals, like bear, have found lab application.

All this: experiments on animals, investigations with the participation of people - has prepared the necessary conditions for the heroic flight of the famous conquerors of the cosmos. That is why, paying the due tribute to the cosmonauts - heroic sons of our nation, we should forget the great contribution into these remarkable feats given by greater groups of laborers, engineers, technicians, scientists, who created outstanding aircraft, and then cosmic ships, and also about the self-denying work of modest medical lab technicians, specialists of aviation and cosmic medicine.

The last decade is marked by a sharp expansion of spatial boundaries of scientific and practical activities of the human being. From launching of rockets, to an altitude of several tens of kilometers, to entry into distant cosmos, to the Moon and neighboring planets - over hundreds of millions of kilometers is the step, made on the way of adopting cosmic space. In the realization of this step, greater merits go to Soviet scientists, who assured our native science, with the priority in developing cosmic investigations.

What discoveries has humanity gained by studying cosmic space, during those years?

The launchings of man-made earth satellites enabled to accurately establish the shape of the Earth (our planet), to detect the ellipticity of the equator. Satellites



Results of the great decade. Investigation of the cosmos.

- 1) Geophysics rockets; first man made earth satellite, October 4, 1957; Second Man-made earth satellite, November 3, 1957; 4) third man-made earth satellite, May 15, 1958; 5) Heavy man-made earth satellite, Feb. 4, 1961;
- 6) first cosmic rocket, 2-1, 1959; 7) Second cosmic rocket, 12-IX-1959;
- 8) Third cosmic rocket, 4-X-1959; 9-AMS-Luna-4, 2-IV-1963. 10) First cosmic ship, 15-V-1960; 11) Second cosmic ship (Byelka-Strelka dogs), 19-VIII-1960; 12-third cosmic ship (Pchelka-Muskha dogs) 1-XII-1960; 13-fourth cosmic ship (chernushka dog) 9-III-1961; 14-fifth cosmic ship (Zvezdochka dog) 25-III-1961.
- 15-Ballistic rockets 1-VII-1960; 16-VOSTOK 1, 12-IV-1961; 17-VOSTOK-2, 6-VIII-1961; 18-VOSTOK-311-VIII-1962; 19-VOSTOK-4, 12-VIII-1962; 20-VOSTOK-5, 14-VI-1963; 21-VOSTOK-6, 16-VI-1963; 21-AMS to Venus, 12-II-1961; 22-AMS Mars 1, 1-XI-1962; 23-Satellites of series Kosmos 1-XXI.6-III-1962 -12.XI.1963 24-POLET 1, 1-XI-1963.

Letters AMS = automatic interplanetary station.

have become a means of investigating the deep bowels of the Earth, mass distribution within the planet, accurate measurement of distances on its surface.

Flights of man-made earth satellites were first to offer the possibility of observing the meteorological phenomenon, over greater distances at once. Satellites have become an important instrument, in studying weather and climate on planetary scale.

Reliably established, was the extent of the upper atmosphere in space, its composition, change in its characteristics, in dependence upon latitude, upon time of the year and diurnal periods. A relation was established between these changes and the cycle of solar activity. The discovered hydrogen geocorona, of the planet, extends over 20 thousand kilometers from the Earth.

Explained was the nature of short wave solar radiation, its changes in time. It was established that it does affect the state of the upper atmosphere of the Earth. The micrometeoroid cloud, surrounding our planet was discovered. Radiation belts were discovered, which envelop the Earth, by several concentric rings.

The nature of reduction in earth's magnetic field intensity, was established in proportion to its getting away from its surface, data were obtained on interplanetary magnetic field. The possibility appeared for directly investigating streams of solar plasma, interplanetary gas, primary cosmic rays.

Explained were the characteristics of the magnetic field of Moon and Venus. It was established how the opposite side of the Moon looks. Data were obtained on the surface temperature of the Venus, about the composition of its atmosphere, the nature of its rotations and a number of other data.

A direct study began of the entire solar system as a whole, interplanetary matter and cosmic rays, at greater distances from the Earth. "Mars-1" detected a hitherto unknown meteoric stream, the orbit of which does not intersect with the terrestrial orbit.

The possibility of establishing ultra remote ultrashort wave radio communication, over distances of tens of millions of kilometers, was established experimentally.

Investigated were meteoric and radiation dangers, in cosmic space around the Earth. It was proven practically, that a human being can live for a long period of time and be active (work), in specific conditions of cosmic flight.

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