PROD. TYPE: COM
PP: 1-3 (col.fig.: nil)
AA 2724 MODC+
ED: C Shekar L
PAGN: Mahesh V – SCAN: DOSS
ARTICLE IN PRESS
Available online at www.sciencedirect.com
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Acta Astronautica ▮▮▮ (▮▮▮▮) ▮▮▮–▮▮▮
ACTA ASTRONAUTICA
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Historical aspects of human presence in Space

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Abstract

Purpose: This paper presents the development of human presence in Space from its beginnings. Study hypotheses were based on historical findings on scientific, medical, cultural, and political aspects of manned Space flight due to the different attitudes of Space minded nations and organizations. Impacts of aerospace medicine on the advances of biomedical sciences will be touched upon, as well as the historical development of aviation and Space medical achievements which are described briefly and visions for future developments are given.

Methods: An overview was gained by literature-study, archives research and oral history taking.

Results: Aviation Medicine evolved parallel to Man's ability to fly. War-triggered advancements in aviation brought mankind to the edge of space-equivalent conditions within a few decades of the first motor-flight, which took place in the USA in 1903 [V. Harsch, Aerospace medicine in Germany: from the very beginnings, Aviation and Space Environment Medicine 71 (2000) 447–450].

Forerunners and precursors of aerospace medicine can be found in the fields of high mountain physiology and aviation medicine. In Germany, in 1901, the meteorologists Arthur Berson and Reinhard Suering reached a height of 10,500 m with their balloon "Preussen" in 1901 [V. Harsch, Aerospace medicine in Germany: from the very beginnings, Aviation and Space Environment Medicine 71 (2000) 447–450]. For further ascents to the stratosphere the aviation-physiologists, Nathan Zuntz (Berlin) and his colleague Hermann von Schroetter (Vienna), in 1905 not only suggested the use of face-fitting breathing-masks, but also the employment of a hermetically sealed cabin [H.C. Gunga, K.A. Kirsch, Nathan Zuntz (1847–1920)—A German pioneer in high altitude physiology and aviation medicine, Aviation and Space Environment Medicine 66 (1995) 168–176]. Auguste Piccard successfully applied this principle in cooperation with Paul Kipfer in 1931, when they reached a height of 15,781 m [A. Piccard, Über den Wolken, unter den Wellen (Above the clouds, below the waves). Brockhaus, Wiesbaden, 1954].

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1. Introduction

Rocket- and jet-powered airplanes became operational in WWII and demonstrated the need for further developments of aerospace medical and technical solutions, e.g. ejection-seats, pressure-cabins, pressure- and anti-g-suits, demand-regulators with pressure-breathing and peep-application etc. [1].

After the end of WWII the advanced state of German aviation medicine was recorded at the AAF Aero Medical Center in Heidelberg, where the physiologist Otto Gauer and the astrophysicist Heinz Haber had already discussed the developments in the field of aerospace physiology, when they discussed the visionary topic of "Man under Gravity-Free Conditions". Both of them were part of a group of German specialists, invited to work in the US [2–6].

In 1948, a meeting of specialists under the visionary subject "*Aeromedical Problems of Space Travel*" took

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0094-5765/$ - see front matter © 2006 Published by Elsevier Ltd.
doi:10.1016/j.actaastro.2006.09.020

Please cite this article as: V. Harsch, Historical aspects of human presence in Space, Acta Astronautica (2006), doi: 10.1016/j.actaastro.2006.09.020

place in San Antonio, Texas. Thereafter, aviation physiologist Hubertus Strughold was made the first director of the Department for Space Medicine at the USAF School of Aviation Medicine along with German colleagues Konrad Buettner (bioclimatologist), Fritz Haber (engineer) and Heinz Haber (astrophysicist), as well as Hans Georg Clamann and Siegfried Gerathewohl. The existence of this institution was the result of the realization that jet and rocket aircraft were taking men into a region so far above the ground that it was physiologically indistinguishable from Space (Space Equivalent Conditions) [5,7].

Modern research in the fields of physics, engineering, astronomy, and medicine had advanced to the point where the discussion of manned rocket flights was less speculative. A symposium on these problems was held in Chicago, Illinois, on March 3rd, 1950 with the following program [5,7,8]:

- Harry G. Armstrong: Space medicine in the United States Air Force;
- Wernher von Braun: multi-stage rockets and artificial satellites;
- Hubertus Strughold: physiological considerations on the possibility of life under extraterrestrial conditions;
- Heinz Haber: astronomy and Space medicine;
- Paul A. Campbell: orientation in Space;
- Konrad Buettner: Bioclimatology of Manned Rocket Flight.

Andrew C. Ivy, Professor of Physiology at the Chicago University of Illinois, stated that the explosive development in aviation medicine and technology since the 1920s would undergo a similar development in aerospace sciences during the following decades. In 1949 Strughold and his colleagues "estimated that the main medical problems for space flight could be formulated and the majority of the questions fully answered within 10–15 years. Hardware could be developed within 15–20 years. The first manned space flights thus would become feasible between 1964 and 1969." [5].

In 1951 Major Ballinger headed this experiments with mice and apes up to 180 km with a two stage rocket (V2 and Aerobee). Since 1952 the USAF has had a field laboratory for space biological studies at Hollowman AFB, New Mexico, where John Paul Stapp studied the effects of very short and high-g-forces by means of his rocket-powered sled. Harald von Beckh performed 0-G-Flight-Experiments, David G. Simons flew his "Man-High"-Balloon up to 100,000 ft. while the Russians orbited the Sputnik. Many articles of SAM were published before



Fig. 1. H. Strughold (left) and L. B. Johnson (right) welcome Airman Farell in front of the "Space Cabin Simulator" at USAF School of Aviation Medicine "back on earth" (16th February 1958).

October 4th 1957, the date of the launch of Sputnik and included topics like: decompression, microgravity, astrobiology, circadian rhythms, radiation effects, human factors, life support systems and last but not least selection criteria and training of personnel for space flight. In 1958 Airman Farell was welcomed "back" on Earth from a simulated Flight to the Moon in the "Space Cabin Simulator" by the later President Lyndon B. Johnson and Hubertus Strughold [5] (Fig. 1).

In 1961, the Russian Cosmonaut Yuri Gagarin orbited the earth in Vostok-1 and only 8 years later two astronauts walked on the moon. The Apollo Program was one of the greatest feats of exploration and engineering development ever accomplished. The goal of landing men on the moon and returning them safely to earth was proclaimed by US-President Kennedy in the early 1960s. It became necessary to identify the means to ensure man's health and functional capability in a hostile environment. Tremendous developmental advances in full pressure suit and oxygen system technologies were made. Additionally, a very complex and powerful launch and transportation system was required. The technology of chemical rocket propulsion already began during the times of Ziolkowsky, Goddard, Oberth and others. In addition, the mission required substantial

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advances in rocket guidance and navigation technology, as well as in computer technology. The birth of manned space stations (Skylab, Salyut, Mir, Internatioal Space Station ISS), and the multi-use Space Shuttles and Buran, began under the scope of future space exploration.

The Space Age, which was entered with the successful application of Newtons actio-reactio law for propulsion by means of rocket propulsion, has opened new horizons to the human mind, similar to the new horizons opened by the invention of the microscope and telescope. Space projects are expensive but they offer tremendous opportunities for scientific and economical exploitation, e.g. navigations, communications and metereological satellites, but also in the application of telemedicine. Anyway, the Physicist and Nobel-Prize Holder Max Born stated in his time: Space Travel is a Victory of Human Intelligence, but a Failure of its Senses.

Significant knowledge could be acquired in human physiology notably in circulatory regulation processes, in the neurosensory pathways and reflex mechanisms of the human body. Additionally, instrumentation developed under the special constraints of space flight are providing clinics with new and precise diagnostic tools. The space environment, with weightlessness in particular as a new tool, and the unique experimental conditions made available to the ever-growing scientific community, must not be seen as an isolated effort, but rather as an extension of on-going research programmes.

2. Conclusions

Aerospace Medicine contributes to the resolution of fundamental questions in the several fields of research, which bring new impulses to medicine. The effects of microgravity, radiation, isolation, time scheduled operations etc. on astronauts and cosmonauts for periods from several days up to 15 months have been studied. In future, the development of a new crew vehicle, and a return to the moon and further are projects to happen within the next generation's lifespan. And next?! Let's go to Mars! We do need a new global vision for space exploration in the spirit of the Russian Rocketry-Pioneer Konstantin Ziolkowsky, who predicted *Human Presence in Space* in the early 20th century: "The Earth is the cradle of mankind, but one cannot live in the cradle forever."

Astronautico Subvenimus!

3. Uncited references

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