

# Hubertus Strughold: The “Father of Space Medicine”

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Dr. Hubertus Strughold (1898–1986) is known as the “Father of Space Medicine.” He first coined the term “space medicine” in 1948 and was the first and only Professor of Space Medicine at the U.S. Air Force School of Aerospace Medicine. He was a co-founder of the Space Medicine Branch of the Aerospace Medical Association in 1950. In 1963, the Space Medicine Branch initiated the “Hubertus Strughold Award,” which is given each year for the greatest achievement in space medicine.

**Keywords:** History of space medicine, Hubertus Strughold Award, aerospace medicine, Project Paperclip.

HUBERTUS STRUGHOLD was born on June 15, 1898, in Westtuennen, Westfalia, Germany. He studied medicine and natural sciences at the Universities of Muenster, Goettingen, Munich, and Wuerzburg. He received his M.D. and Ph.D. from the University of Muenster and the University of Wuerzburg, finishing in 1927 (8).

After receiving his degrees, Dr. Strughold served first as a research assistant to Professor Max von Frey in Wuerzburg and then to Professor Paul Hoffmann in Freiburg. Strughold was then named an Associate Professor of Physiology at the Physiological Institute in Wuerzburg in 1928. He gave one of the first lectures to be presented on the subject of Aviation Medicine (on what he called the vertical frontier) in 1928 at the University of Wuerzburg. As a Rockefeller Foundation Fellow (1928–1929), he specialized in aviation medicine and physiology at the Western Reserve University in Cleveland and then at the University of Chicago (Fig. 1). He gained international stature as a Professor of Physiology (specializing in aviation medicine) beginning in 1933 at Wuerzburg and later in Berlin. He was instrumental in establishing the German *Journal of Aviation Medicine* (*Zietschrift fur Luftfarhtmedizin*) in 1936 (9). In 1937, he became an honorary member of the Aero Medical Association in the United States (8).

Strughold was then appointed the Director of the Berlin Aeromedical Research Institute of the German Air Ministry in 1935. Although he was a civil servant, he was under the direct supervision of the German Air Force (Luftwaffe) (8). At the Institute, he developed an intimate knowledge of the medical aspects of high-speed, high-altitude flight and introduced the altitude

chamber concept of “time of useful consciousness” (11,18).

After World War II, Dr. Strughold became Professor of Physiology and Director of the Physiological Institute of the University of Heidelberg and Chief Scientist of the U.S. Army Air Force Aero Medical Center. It was here that many of the early concepts of space medicine were conceived (4). During this time, Strughold was the editor of a USAAF book, entitled *German Aviation Medicine in World War II* (3), which was a summary of knowledge from the German aerospace medical community. This was authored by 56 aviation medical specialists and greatly advanced aerospace medicine at a time of rapidly evolving technology that was allowing flights at much higher altitudes and speeds. The first article ever published on space medicine was written in this book: “Man under Gravity Free Conditions” by Heinz Haber and O. Gauer (7).

In 1947, he accepted an invitation as a part of Operation Paperclip to join the staff of the USAF School of Aviation Medicine (USAFSAM) at Randolph Field, TX (which moved to Brooks AFB, TX, in 1959). Col. Harry Armstrong (later Surgeon General), Brig. Gen. Malcolm Grow, Col. Otis Benson, Dr. Paul Campbell, as well as others, were directly involved in recruiting German physicians and scientists for aerospace medicine research in the U.S. Several other prominent German aeromedical specialists, including Hans-Georg Clamann, Konrad Buettner, Ulrich Luft, Siegfried J. Gerathwohl, and the brothers Fritz and Heinz Haber, were also assigned as research physicians to the Air Force School of Aviation Medicine as a part of Operation Paperclip (6,8).

On February 9, 1949, the commandant of the School of Aviation Medicine, Col. Harry G. Armstrong, organized the first Department of Space Medicine in the world. Dr. Hubertus Strughold subsequently became the first and only Professor of Space Medicine. Under his leadership, the school became a major center for

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Fig. 1. Dr. Strughold in Cleveland, OH (1929).

basic and clinical investigations into the physiological and behavioral effects of spaceflight and the space environment (8).

In November 1948 at Randolph Field, Dr. Armstrong organized a panel discussion on the "Aeromedical Problems of Space Travel." This featured papers by Strughold and Heinz Haber as well as commentary by six well-known scientists from universities and the military (1). This symposium marked the beginning of formal, academic inquiry into the medical hazards of extra-atmospheric flight. Strughold resolved the contradiction inherent in the title of the symposium by emphatically using the term "space medicine" for the first time. People interested in the physiology and psychology of extra-atmospheric flight had in the past devised a number of terms to describe their field of investigation: biomedicine, space biology, astrobiology, bioastronautics, aerospace medicine. However, the most appropriate term seems to be the one introduced by Dr. Strughold, "space medicine." Dr. Strughold predicted that the main medical problems of spaceflight could be formulated and the majority of the questions fully answered within 10 to 15 yr. Hardware could be developed within 15 to 20 yr. The first manned spaceflights thus would become feasible between 1964 and 1969. In March of 1950, another symposium, "The Biological Aspects of Manned Space Flight" (10), featured

Dr. Strughold as one of the main presenters, discussing the "Physiological Considerations on the Possibility of Life in Extraterrestrial Conditions." This conference led to discussions to form a permanent space medicine organization.

On May 31, 1950, Dr. Strughold and 17 other aerospace medical experts founded the Space Medicine Branch of the Aerospace Medical Association which had its first public meeting on May 17, 1951. Dr. Strughold was one of its first officers. He later served as Secretary-Treasurer, Vice-President and, in 1959, as the President of that organization.

In November 1951, at San Antonio, the School of Aviation Medicine and the privately financed Lovelace Foundation for Medical Research at Albuquerque, NM, sponsored a symposium discreetly entitled "Physics and Medicine of the Upper Atmosphere." It was still not acceptable to speak plainly of manned spaceflight within the Air Force. A good portion of the material presented by the 44 speakers at the 1951 symposium, however, covered the nature of space, the mechanics of spaceflight, and the medical difficulties of sending a man beyond the breathable atmosphere (24). Two other symposia were later organized by Dr. Strughold and conducted in 1960 (5) and 1965 (2).

It was at this 1951 meeting that Dr. Strughold expounded on his most notable contribution—the concept of "aeropause," a region of "space-equivalent conditions" or "atmospheric space equivalence." The term "aerospace" originated from this concept and came into use following this meeting. Strughold pointed out that while many astronomers, astrophysicists, and meteorologists set the boundary between the atmosphere and space at 100 to 600 mi from Earth, the biological conditions of space begin much lower, at about 50,000 ft. Strughold contended that the distinction between space and atmosphere was artificial and misleading, at least as far as human biology was concerned. For this reason, he argued that manned spaceflight was a natural extension of aeronautical flight, and space medicine was a logical extension of aviation medicine. Biomedical investigations into the human factors of spaceflight, he concluded, must be an extension of the knowledge already gained from aviation medicine.

In 1951, Dr. Strughold was the primary author, along with Heinz Haber, Konrad Buettner, and Fritz Haber, of a seminal paper in the *Journal of Aviation Medicine* (the forerunner of *Aviation, Space, and Environmental Medicine*). This paper, entitled "Where Does Space Begin? Functional Concept of the Boundaries between the Atmosphere and Space," proposed a dramatic thesis concerning the human potential for space exploration (21). Dr. Strughold again addressed the central problem of where space began and proposed that space was present in small gradations as altitude levels increased rather than existing in the remote regions of the atmosphere (13).

In 1952, Fritz Haber, also of the Air Force School of Aviation Medicine, designed a sealed chamber to be used for space medicine research. At the urging of Hubertus Strughold (9), the Air Force funded its construction and the cabin was completed in 1954.



Fig. 2. Dr. Hubertus Strughold (1963).

Strughold named it the "Space Cabin Simulator" (16). It provided 100 cubic feet of space, just enough for an aircraft seat and an instrument panel. It had life support systems for closed loop cabin atmosphere maintenance and urine distillation pure enough to drink. Cabin pressure was maintained constantly at a level equivalent to an altitude of 18,000 to 25,000 ft (8).

The space cabin simulator received its first national publicity in March 1956, when Airman D. F. Smith spent 24 hours in the chamber at San Antonio, performing a number of tasks for psychological monitoring and wearing biological instrumentation. In 1958, Airman Donald F. Farrell spent 7 days in the chamber (8). There were no unexpected physiological data, but daily logs by Farrell showed deterioration from good spirits to "the seemingly abrupt onset of frank hostility." Farrell's mental condition "reached the point of becoming the single conceivable reason for a premature termination of the flight." It was noted that Farrell's proficiency at tasks assigned to him also deteriorated severely as the experiment progressed. It was stated, "The psychological problems presented by the exposure of man to an isolated, uncomfortable void seem to be more formidable than the physiological problems."

Strughold had a long career at the School of Aviation Medicine and authored over 180 papers in the field of aerospace medicine. Among the fundamental studies

initiated under his leadership were those in acceleration, noise and vibration, atmospheric control, and nutrition. He contributed enormously to such space-travel problems as weightlessness (15,17), visual disturbances (22), and disruption of normal time cycles (20). He subsequently also played an important role in developing the pressure suits worn by early American astronauts. He was particularly interested in the aspects of the space medical problems related to Mars (12,14,19,23). At a time when the majority of the scientific community believed that rudimentary vegetation similar to lichen existed on Mars and caused seasonal darkening of the planet, Dr. Strughold stated that the odds were very small that this was possible (9).

The Hubertus Strughold Award was instituted beginning in 1963 (Fig. 2) by the Space Medicine Branch of the Aerospace Medical Association. It is presented each year for dedication and outstanding contributions in advancing the frontiers of space medicine and for sustained contributions to further the goals of the Space Medicine Branch (now the Space Medicine Association). There have been 44 recipients of this award representing the past and present pioneers in space medicine.

A U.S. citizen for 30 yr, Strughold's many honors included an Americanism Award from the Daughters of the American Revolution and the "Federal Civil Servant of the Year" Award in 1958. He was elected a Fellow of the Aerospace Medical Association (AsMA) in 1958 and received the Lyster Award (AsMA), Bauer Award (AsMA), Hermann Oberth Medal for Research in Space Flight (German Rocket Society), Melbourne W. Boynton Award (American Astronautical Society), and the Louis W. Hill Award (American Institute of Aeronautics and Astronautics). Dr. Strughold's contributions and achievements in the field of space medicine completely merit the title that he is still known by today: the "Father of Space Medicine."

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## EDITOR'S NOTE

Hubertus Strughold is widely recognized for his pioneering work at the School of Aerospace Medicine in San Antonio, TX, during the years when the USAF had its own space program, the Manned Orbiting Laboratory; his background and accomplishments in Space Medicine are described in the accompanying article. However, controversy has arisen in recent years over his activities in his native Germany during WW II.

Although Strughold remained a civilian, his work was funded and overseen by the German Air Force. Nevertheless, he refused to join the Nazi Party and was renowned for his personal bravery in serving as a subject of experiments in rapid decompression to high altitude. On the other hand, there is documentary evidence that he was present at meetings where cruel human experiments were discussed. It should be noted that, although Strughold was questioned by Allied authorities during the post-war investigation of Nazi war crimes, he was never charged with wrongdoing.

In recent years, a number of institutions have concluded that there is a cloud over Strughold's reputation and have withdrawn honors previously granted to him. Perhaps most significant to our community, the USAF removed his name from the former Strughold Library at Brooks AFB. Some individuals feel that these remedial actions are justified, while others regard them as caving in to unsubstantiated accusations.

The Space Medicine Association, a constituent organization of the Aerospace Medical Association, annually presents to one of its members a major award named after Strughold. Some members of the Aerospace Medical Association believe that the name of the award should be changed, while the SMA Executive Committee feels that, absent any evidence that Strughold was directly involved in the Nazi medical atrocities, the name should be retained. Each side in this debate strongly defends its position, but both also admit that the evidence is inconclusive. With Strughold's death in 1986 and the continuing unavailability of key primary documents, it seems unlikely that either side will change the minds of the other any time soon.

A group of respected members of the SMA have written a paper giving a detailed description of the controversy and defending Strughold as an honorable scientist who was caught in difficult circumstances and tarred by association. The manuscript was submitted for publication in this journal but, after consulting the Editorial Board, we judge that this historical-political controversy lies outside the scope of a science journal. Following our decision not to publish that paper, the authors informed us that they intend to submit the manuscript to another journal. Should the paper be published, we invite the authors to write a Letter to the Editor citing the reference for consideration by our readers.