Meeting of the Space Medicine Association

DENVER, COLORADO—MAY 17, 1951

ON MAY 31, 1950, at the Palmer House in Chicago, Illinois, during the annual session of the Aero Medical Association, an informal meeting was called by Paul A. Campbell, M.D., and Andrew C. Ivy, M.D., in which the need was recognized for an organization devoted entirely to Space Medicine. A temporary subcommittee was named to prepare the necessary petition for Branch Membership of the Aero Medical Association, and those elected were as follows:

Dr. Andrew C. Ivy, Chairman
Dr. John P. Marbarger, Secretary
Colonel R. J. Benford
Captain Ashton Graybiel

The first meeting of the established organization "Space Medicine Association of the Aero Medical Association" took place at the annual meeting of the Aero Medical Association at the Shirley-Savoy Hotel at Denver, Colorado, on May 17, 1951, with Colonel Paul A. Campbell acting as chairman. The following names were shown on the attendance register:

Harry G. Armstrong, E. J. Baldes, E. R. Ballinger (guest), Friedrich E. Beischer, Otis O. Benson, Jr., R. J. Benford, Howard W. Blakeslee (guest), Paul A. Campbell, Leon D. Carson, P. H. Evans (guest), Herbert F. Fenwick, Don Flickinger (guest), A. Pharo Gagge, Charles F. Gell, Ashton Graybiel, Victor Guillemin, Jr., Fritz Haber, Fred A. Hitchcock, M. M. Kalez, Wilbur E. Kellum, G. J. Kidera, Charles F. Lombard, John P. Marbarger, J. B. Poppen, Herman P. Roth, Herman J. Schaefer, Benjamin J. Strickland, Jr., Hubertus Strughold, Kenneth S. Scott, Arnold D. Tuttle, Clayton S. White, Frederich S. Wolf, W. V. Whitehaven (guest).

Colonel Paul A. Campbell, USAF (MC), Director of Research, USAF School of Aviation Medicine, was elected Chairman, Space Medicine Association Branch of the Aero Medical Association for the year 1951-1952.

Dr. John P. Marbarger, retiring secretary, gave the annual report and was extended the appreciation of the Association for his exemplary services in this capacity.

Dr. Hubertus Strughold, Head of the Department of Space Medicine, USAF School of Aviation Medicine, was then elected Secretary and Bibliographer for the year 1951-1952.

Captain Ashton Graybiel, USN (MC) School of Aviation Medicine, was elected Chairman of the Membership Committee with authority vested to appoint two assistants.

Dr. Andrew C. Ivy, Vice President, University of Illinois, was elected Chairman of the Program Committee for the next annual meeting, with authority vested to appoint two assistants.

Funds were raised and provided to the Secretary for use in administrative expenses for the year 1951-1952.

At the conclusion of the business meeting of the Space Medicine Association Branch of the Aero Medical Association, Colonel Campbell introduced the speakers, Dr. Hubertus Strughold and Dr. Fritz Haber.

DR. HUBERTUS STRUGHOLD, after having given a brief review of the development of Space Medicine during the past two years, gave a summary of

paper entitled "Space as a Functional Concept" which was prepared recently by H. Strughold, H. Haber, K. Buettner, and F. Haber, of the Department of Space Medicine. Dr. Strughold's summary was as follows:

One usually thinks of Space as a topographically defined system; in other words, the borders of Space in relation to the earth are identified with the limits of the atmosphere, i.e., 300 to 500 miles above the earth's surface. The borders of space are also identified with that zone where the terrestrial field of gravitation is so reduced as to be insignificant. This topographical concept of Space is misleading when used in discussions of problems related to manned Rocket flight. These problems must be treated on the basis of the functions which the atmosphere has for men and craft. These functions introduce us to a new concept of Space which is more adequate to the peculiarities of manned Rocket flight than is the topographical interpretation of Space. First, Dr. Strughold pointed out, we must consider the atmospheric function of supplying breathing air. The time of useful consciousness decreases with increased altitude, from several minutes at 20,000 to 24,000 feet to a minimum of 10 to 15 seconds at 40,000 to 50,000 feet. At this point a decisive limit is reached; at still higher altitudes this time span remains constant. In case of a spaceship cruising outside the atmosphere being destroyed completely by the impact of a meteorite, the same minimum value of about 13 seconds is expected. From the viewpoint of respiration, this would mean that the borders of Space are found at an altitude of about 10 miles. It is at this height that the atmosphere's function of supplying oxygen, vanishes. It is interesting to keep in mind that at this height in our internal atmosphere, i.e., in our alveolar air, oxygen pressure is zero just as it is zero in interstellar space.

Another problem, Dr. Strughold mentions, is that of "synthetic air." Because of the low air density above the level of about 10 miles, breathing air for the ship's crew can no longer be derived from the ambient atmosphere. In these zones of the atmosphere a ship would depend as much on "synthetic air" as in actual space.

This same line of thought can be applied to the filter function of the atmosphere. This function includes filtering of solar radiation, cosmic radiation and meteorites.

The blue fraction of visible light is scattered by the air molecules in the lower zones of the atmosphere up to the 60,000 foot level. For this reason we have the beautiful blue sky to enjoy. However, above this height the blue turns gradually into the darkness of Space. Stars are visible at these heights during daytime. The optical appearance of the sky becomes "space-like."

Viewed from outside to the earth, the filter function of the atmosphere starts to become effective for ultraviolet at 80,000 feet and for heavy primaries at about 120,000 feet. Above these levels we are exposed to these factors in full force; we are actually in space in relation to these factors.

The majority of meteorites ranging between fine meteoric dust and particles of one gram or more are incinerated within the zone from 250,000 to 500,000 feet. Above this upper level

the same meteoric conditions exist as in interstellar space.

These examples may be sufficient to demonstrate that the various space factors gradually come into play with increasing altitude, not along a sharp topographical line but rather within a very broad zone—depending on the function of the atmosphere. It is better, under this aspect, to speak of functional boundaries between atmosphere and space. This functional concept of space brings us problems of Space Medicine very near to the earth and into the reality of today. This is especially true of the gravity-free state. This problem belongs to the complex of the atmospheric function of supplying mechanical support for the craft.

DR. FRITZ HABER: Weight has been considered a constant in the course of history and in daily life. However, due to the progress of aviation and rocketry, this is no longer true. In Aviation Medicine it is a well-known fact that a pilot performing a pull-out is three times, or even six times, as heavy as under normal conditions. In rockets coasting outside the atmosphere there is no weight at all. Thus it seems to be worthwhile to discuss the phenomenon of weight.

The daily life weight is a consequence of the attractional forces of the earth. It is measured by scales. However, everyone knows that he has to stand still on a scale if he wants to obtain the exact value of his weight. A body to be weighted must not be accelerated or otherwise the forces of inertia created by acceleration interfere with the attractional forces of the earth. To make this clear, one can think of trying to determine the weight of a body outside the gravitational field of the earth. As long as the scale and the body are not accelerated, the scale reads zero. If scale and body are accelerated with 1 g the scale would show the "normal" weight of the body. This weight is directed against the direction of the acceleration. There seems to be two kinds of weight. One weight produced by the attractional forces, and another one produced by acceleration. However, physics provide no means to discriminate between the two kinds of weight, so both can be called "weight." They can be added or subtracted in any fashion.

In a human centrifuge for instance, due to centrifugal acceleration, considerable weight is added to the normal weight. By acceleration of 1 g directed downward, weight is subtracted from the normal weight resulting in weightlessness.

These considerations give evidence that weight is not topographical in nature. One can produce weight far out in space and outside any gravitational field, but on the other hand it is possible to eliminate weight within the gravitational field of the earth. Thus the borderline of space is not sharply defined as far as the phenomenon of weight is concerned.

Following Dr. Haber's dissertation Dr. Herman J. Schaefer was requested by the Chairman to make a few remarks.

DR. HERMAN J. SCHAEFER: I would like to make a few remarks in answer to one of the questions which Dr. Haber mentioned in his introductory speech. I have reference to the ques-

tion "How can we derive a correct definition for the term 'Free Space.'" Quite generally we could state that free space begins in the zone at which all criteria—the distribution of matter, the strength of the different fields, and the intensities of the different types of radiation—are no longer noticeably influenced by the earth or any other celestial body. It might be of interest to lend a few thoughts to this problem from the standpoint of cosmic radiation.

In my paper in the main session I have limited the discussion of cosmic radiation to the altitude range in which present aviation is interested. But let us look at it here in the Space Medicine Section from a somewhat wider scope.

We must determine at what distance from the earth the full and undistorted intensity of cosmic radiation is present; or if we want to formulate it in terms of space medicine; at what distance from the earth a space ship and its crew is exposed to the full intensity of primary cosmic radiation. That distance, then, would give us the limit at which free space begins.

In my paper I showed a graph which demonstrated that the intensities of all components of the primary cosmic radiation—the protons, alpha particles, and heavy nuclei—level off to a constant value at an altitude between 100,000 and 120,000 feet. Beyond this altitude no influence of interaction processes of the primary particles with the atoms of the gas blanket of the earth is longer discernible. However, it would be wrong to conclude that this means at the same time that the state of free space is already reached.

It is well known—I presented the relevant curves last year at the meeting in Chicago—that besides the collisions with atoms of the gas blanket, another important factor strongly influences the intensity of the earth. This field exerts a deflection influence on the primaries. This influence is strongest at the equatorial plane and decreases toward the poles. Due to this phenomenon the primary intensity at the top of the atmosphere is about three to four times greater at the polar caps than in the equatorial belt. Now, this difference in intensity extends over thousands of miles into space corresponding to the large extension of the geomagnetic field into space. Thus, if we base the definition for the region in which free space begins on the premise that the influence of the geomagnetic field on the cosmic ray intensity is negligibly small, we obtain a distance which probably is comparable to the radius of the moon's orbit. Therefore, for space travel, the problem of a possible health hazard from cosmic radiation necessitates additional inquiries far beyond the range of anything which we have studied thus far.

Following Dr. Schaefer's presentation, a few remarks were made by Major General Harry G. Armstrong and Brig. General Otis O. Benson, Jr.; due to time limitation, the meeting then adjourned.

NOTE: The next meeting of the Space Medicine Association of the Aero Medical Association will be held in conjunction with the Annual Meeting of the Aero Medical Association at the Statler Hotel in Washington, D. C., March 17-19, 1952.