Space Medicine Research at Martin-Denver

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The research program of the Space Medicine Section at Martin-Denver began in October 1957, the day before Sputnik I. The program includes the design and development of simulators and trainers applicable in the selection and training of the space man, and laboratory research projects designed specifically to promote the development of the closed, self-sustaining ecological system. The laboratory itself was activated in October 1958, and is already too small. Expansion of facilities is now in progress.

The staff of the Space Medicine Section consists of scientists active in the areas of physiology, microbiology, psychology, agronomy and plant pathology, sanitary engineering, electronics and bio-engineering design. The staff serves as consultants to preliminary design engineers, but in addition conducts an active research program in the areas just mentioned.

The following brief descriptions are representative of the laboratory projects now under investigation.

Physiology - There are still many unknown factors in the physiology of manned space operations. One of these unknowns is the effect of sign and magnitude of ionized air on the physiology of the living organism. The effect of ionized air on man enclosed in a sealed cabin during space

operations may be significant. If air ionization is significant, then methods of control of air ionization with regard to sign and magnitude must be developed. Experiments aimed at assessing the importance of air ionization are now in progress, under the direction of Dr. Robert H. Edgerley, Head Physiologist. Assisting Dr. Edgerley are Dr. M. M. Hein and Mr. Norman LeVora.

Another project in physiology is the development of a new and versatile low-pressure research chamber which can be utilized for physiological research alone or in conjunction with the testing of photosynthetic gas exchangers as they are developed. (see below)

Microbiology - The feasibility of the use of microscopic algae in a photosynthetic gas exchange system in the closed ecology has been demonstrated. To make such a system practical and operational, considerable research on the refinements of algal culture is required. These refinements and the eventual design of operational gas exchange systems are now under active investigation and are the objectives of this portion of the program. The results will then be integrated with the other parts of the program in the development of the balanced, self-sustaining closed ecological system required for long-term manned satellite and lunar operations.

The microbiological research is under the direction of Dr. Robert D. Gafford, Research Biologist well known in the field of photosynthetic gas exchange systems. Gas exchange systems are under development for use in a gravity field and in the zero-gravity environment. An experimental model of a gas exchange system for zero-gravity use is now being tested, as well as more conventional types.

A paper on the testing of this zero-gravity exchanger will be presented at the Annual Meeting of the Aero Medical Association in Los Angeles, California, April 27-29, 1959.

Psychology - In subsequent manned space flight, the man himself will be in control of his ship. In order to acquire the necessary skills in the new control problems of space operations, trainers which simulate such problems are a requirement.

Martin-Denver has designed a Reaction Control Simulator which can simulate very accurately the problems associated with pilot training in the use of reaction controls for attitude orientation of his space vehicle. The simulator also has value in the human engineering of the space cabin, in the design and test of control and display systems, and in psycho-physiological research. Thus, Martin-Denver's simulator can be used to establish optimum design criteria in the engineering of future space cabins, rather than be used merely as a checkout and training device for an already designed system.

A paper on this Reaction Control Simulator will also be presented at the Aero Medical Association Meeting in April.

Food Production - In establishing the self-sustaining ecology at the permanent lunar base, it will be necessary to set up food-producing facilities within the closed ecology. Martin-Denver is engaged now in hydroponic food production research which is oriented specifically toward lunar basing problems. Nutriments for these fruit-, vegetable-, and grain-producing plants are derived from human and kitchen wastes. The problem of developing suitable waste-processing methods for complete re-utilization of all waste materials is under attack, using several approaches. The challenge of food production in the sealed ecology

offers new and exciting problems to the agronomist interested in hydroponics.

Dr. Hugh Pote, with Mr. Ed Romano, is working the problems of food production in closed ecologies.

Bio-Engineering Design - One of the most important aspects of Space Medicine research is the design and construction of specialized equipment and instrumentation required in each of the areas mentioned. The design of out-of-the-ordinary equipment particular to biological research or application in space technology is the fort of Mr. Dan Richardson, our Bio-Engineering Design Specialist. Mr. Herbert Schafer, Electronics Engineer Design Specialist, is concerned with the problems of instrumentation for simulators, and for biological research.

Many of the support facilities of Martin-Denver are being utilized to further the Space Medicine research program. These include the instrumentation development laboratory, the precision machine shops, model shop, materials laboratory and many others. The many kinds of engineering talent available in the Company makes for an ideal environment and rapid progress in Space Medicine research at Martin-Denver.