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SPACE MEDICINE BRANCH REPORT

The German SL-mission D-2: another project of international cooperation in the space life sciences

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1992 has been a very productive year for the space life sciences, with five major flight opportunities. It began with NASA's "IML-1" mission in January, followed by the German-Russian mission "Mir '92" in March. In the same time frame, the French flew "Antares" with Sojus to Mir, while European Space Agency's (ESA) "EURECA" was launched with the Shuttle. The last event of this series was the Japanese payload on SL-J in September. These missions are characterized by the participation of astronauts from several European countries and Japan, and strong international cooperation in science. These joint projects will continue in 1993, with the German SL-D-2 mission, which was postponed from 1988 to February 1993 because of the tragic Challenger accident.

As a preparatory mission for the Space Station era, D-2 will give Germany and her partners another opportunity to learn about the operation of large international and interdisciplinary payloads. Like mission D-1 flown in 1983, D-2 has been prepared under German management and responsibility. Payload training and control has been performed by the German Aerospace Research Establishment, DLR, and 210 hours of payload operation will be shared in two shifts by two payload specialists from DLR and two mission specialists from NASA.

The second mission objective for D-2, to continue research in microgravity, will be accomplished through 92 experiments, of which 43% are contributed by non-German investigators from 11 different nations, including the U.S. and Japan. With 41 experiments, the life sciences are predominant in the payload, followed by 39 experiments in material sciences and fluid physics, and some technology studies (automation, robotics and telescience), Earth observation, atmospheric physics, and astronomy.

The life sciences payload is structured as follows: studies on humans; investigations of cells (bacteria, mesenchyma, lymphocytes, etc.); research on gravisensitivity in animals and plants; dosimetry and biological effects of radiation; and of bioprocessing-cell culturing, electrofusion, and hybridoma production.

The primary hardware on D-2 for studying humans is the Anthrorack. This ESA-built research facility was developed for integrated analysis of body systems to better understand adaptive responses to microgravity, in particular as they occur as a consequence of headward fluid shift and reduced loading. Emphasis is placed on the respiratory, cardiovascular, and renal systems and the parameters in blood and urine involved in fluid and electrolyte regulation. Presently, the basic physiological mechanisms, such as those resulting simultaneously in body fluid reduction and in a persisting facial edema, are not well understood. Nor do we understand the mechanisms for other consequences of microgravity, such as cardiovascular deconditioning or reduction of physical work capacity.

Anthrorack primarily consists of two subsystems that monitor respiratory and cardiovascular function. The key instrument for measurement of lung circulation and ventilation is a quadruple mass spectrometer; for cardiac imaging and determination of arterial and venous blood flow, an ultrasound system is available. These two instruments are complemented by additional equipment for specific measurements. Leg fluid distribution, tissue thickness, and tissue compliance are measured with ultrasound techniques, and fluid content and perfusion along the body axis with electrical impedance. Intraocular pressure is monitored by self-tonometry. Central venous pressure is measured with a catheter before and during launch and during the early adaptation to microgravity. And, finally, a neck chamber provided by NASA is used to study baroreceptor-cardiac reflex responses.

Monitoring physiological functions at rest is only one aspect of studying adaptation. To learn more about possible changes in the regulatory capacity of the human body, it is necessary to analyze functional systems under loading and with stimulation. For such studies, a bicycle ergometer and a lower body negative pressure device are used. In addition, body fluid distribution and cardiovascular reactions are examined when microgravity-induced fluid volume reduction is reversed through intravenous infusion of physiological saline. These studies will provide data for the development of measures counteracting the effects of microgravity.

One reason why knowledge about the physiology of microgravity is still limited is the small number of subjects studied in space with equipment and controlled conditions comparable to that of a terrestrial research laboratory. International cooperation could help to overcome this shortcoming, if measurements were taken in a way that allowed data obtained from different missions to be pooled. Some investigators from D-2 and NASA's dedicated life sciences mission SLS-1 have initiated such measures. Standardization of some experiment protocols has been agreed upon, and a joint head-down-tilt simulation study was performed. Space medicine will benefit if other researchers will follow this procedure.

Space Medicine Branch Seeks Archival Materials

The Space Medicine Branch has become the latest group to arrange with Wright State University's Special Collections section of the Fordham Health Sciences Library to be the official repository for all the Branch's papers, books, minutes, journals, and other materials of historical importance to the Branch. A few items have been already handed over to the Special Collections Librarian, Mary Ann Hoffman. Anyone having materials or items of significance to the Branch and wishing to donate those artifacts to the Space Medicine Branch archives are asked to contact either Mrs. Hoffman or the Branch secretary/treasurer, Robin Dodge, M.D. Initial inquiries may be made to either party at:

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FAA proposes flight simulator training centers

The FAA has issued a Notice of Proposed Rulemaking which would provide for the establishment and certification of independent simulator flight training centers. It would make training available to a wider range of pilots and provide for the flexibility to develop training tailored to specific airports and conditions in each center's region.

It is envisioned that the users of the simulator centers would include private pilots who are seeking advanced ratings, commuter pilots who want to advance to larger aircraft, and pilots for the larger airlines who want to qualify to fly additional types of aircraft. The centers could also be used to test and flight-check pilot skills.

The benefits resulting from increased safety, as a result of pilots being able to practice dangerous emergency procedures in simulators, rather than in flight, is estimated at $20 million a year. In addition, use of simulators would reduce the level of air traffic and cut noise and air pollution.