INTRODUCTION. Advanced non-invasive diagnostic techniques will challenge the current of practice for the 21st Century Flight surgeon. Cerebral and cardiovascular disease, even in the incipient stages, will be readily detectable at the time of the periodic physical examination. The same will be true for other potentially disqualifying conditions. Brief, highly sensitive and specific cognitive and psychomotor office-based testing will be accomplished at the time of examination, including the assessment of the sensory system. In the 21st century pilot population, the use of addictive substances will be virtually unknown, the result of education and screening (and rehabilitation programs when necessary). The self-destructive, suicidal addictions (including nicotine, alcohol, amphetamines, and others) will be understood as incompatible with those who elect to undertake the privilege of flight. The 21st century approach will be that of individual assessment, emphasizing (1) Freedom from an impairing disease, (2) Capacity to perform as demonstrated by objective flight and high fidelity simulator assessment, and (3) Motivation to fly. CONCLUSION. As a result of advances in medicine, aircraft design and airspace characteristics, various medical standards of the "Golden Age" 20th century will be dropped. These include uncorrected distant vision, color vision, pure tone audiology (the spoken voice test substituted), upper date-of-birth limits, limits on persons requiring exogenous insulin (insulin pumps will be available), and certain other conditions. The main disqualifying conditions will be in the psychiatric and attitudinal realms.

ACCELERATION PHYSIOLOGY AND COUNTERMEASURES. B.N. Kurtz*, KRUG Life Sciences, San Antonio, TX 78279-0644.

Methods to enhance man's survivability in the sustained high or low G environments continue to be at the forefront of aerospace research. Several acceleration protection research efforts are being actively pursued in programs with high visibility. A new reentry G suit for NASA which features uniform pressure (UP) and the lower extremities promises to increase G-protection during shuttle reentry without the discomfort of an abdominal bladder (AB). This suit concept should also be adaptable for the National Aerospace Plane's (NASP) reentry G-protection requirements. It is hypothesized that these low G levels encountered in these environments do not significantly increase hemorrhage and thus the requirement for an AB is negated but the need to prevent blood pooling in hypervolumetric crewmembers is critical. The same G-protection principle used in these suits, i.e., lower body uniform pressure, is also the basis for a new advanced technology anti-g suit (ATAGS) soon to be flight-tested by the USAF. The AB is an absolute necessity in ATAGS since it is to be worn in fighter-type aircraft with high g onset rates which cause a rapid increase in heart-to-eye distance, decreased egress blood pressure and subsequent G-induced loss of consciousness (G-LOC). The USAF is now in the process of fielding COMBAT EDGE, an ensemble which uses positive pressure for G protection (PBG) in combination with the current anti-G suit. PBG offers relief to tactical aircraft from the fatigue effects of acceleration in air-to-air combat. Preliminary studies have demonstrated that PBG is even more effective when used with ATAGS.

THERMAL STRESS IN AEROSPACE MEDICINE: HOT ISSUES, COLD FACTORS. Harry C. Holloway, Uniformed Services University of the Health Sciences.

The initial explorations of the planetary systems beyond the moon are likely to be undertaken in the first four decades of the 21st century. Preparing for the social, psychological, and psychiatric problems to be faced must be initiated now if we are to adequately establish the risks which these matters pose. The counter measures to deal with those risks. Previous experience tells us that understanding these problems would include analysis of complex physiologic, toxicologic, sociologic, and psychologic variables that may interact within complex technological systems. This paper will emphasize the nature of the work that must be undertaken in the next two decades.


OVERVIEW. Spacehab Life Sciences 1 was the first Space Laboratory dedicated to life sciences research. It was launched into orbit in early June 1991 aboard the space shuttle Columbia. The data from this flight have greatly expanded our knowledge of the effects of microgravity on human physiology as reported. The data collected in-flight, not just pre and post. Principal goals of that mission were the measurement of rapid and semichronic (8 days) changes in the cardiovascular and respiratory systems during flight and then to measure the rate of readaptation following return to Earth. Results from the four teams involved in that work will be presented in this paper. In addition to the cardiovascular-cardiopulmonary research extensive metabolic studies were conducted on the payload crew. These studies encompassed fluid, electrolyte and energy balance, renal function, histology and muscularkeletal changes. Finally, the crew participated in several neurovestibular studies. Overall, the mission was an excellent step in further understanding the effects of microgravity on the human response to the space environment.

INTRODUCTION. Prolonged exposure to microgravity has long been suspected to cause serious cardiovascular deconditioning, but has not been adequately documented with objective measurements (Farhi et al., Respir. Physiol., 28:141-159, 1976) determined. Subjects were studied in both the erect and supine positions, over the average of 4-5 successive measurements. Results. Significant (P < .05) changes were found in the erect subjects, both at rest and exercise, on the day of reentry: at rest, heart rate increased to 133% of preflight values, while cardiac output dropped to 75%. Blood pressure was maintained. Calculated stroke volume decreased to 36%, while total peripheral resistance increased to 146%. These changes were also evident during exercise, although work did not cause further deterioration. Conclusions. 1) The subjects seemed able to vasconstrict sufficiently to maintain blood pressure in the face of the decreased cardiac output; 2) many of the trends, which cannot be proven now because of the limited number of subjects, may become statistically significant after the number of subjects is increased by repeating the studies on the SLS mission.

CARDIOVASCULAR ADAPTATION TO 0-G RESULTS FROM SPACELAB LIFE SCIENCES ON. R.A. Coffey*, H.C. Rockey*, L.D. Lane, R.P. Levine, D.E. Watsonbaugh, G.C. Blondy, University of Texas Southeastern Medical Center, Dallas, Texas 75235-9034.

Experiment 294 on the SLS-1 mission (3-6 June 91) examined the crew's adaptation to microgravity with a complex set of measurements (including during exercise) including cardiac output, cardiac output, blood pressure (arterial and mean), body temperature, heart rate (ECG), blood pressure (sphygmomanometer), end expiratory carbon dioxide, tidal volume, and expired minute volume, which were determined while the crew was at rest and during exercise on the day of re-entry. The results indicated that the crew was capable of maintaining their cardiovascular function despite the microgravity conditions. However, some changes were observed, particularly in blood pressure and heart rate, which may be indicative of the crew's adaptation to the microgravity environment. Further studies are needed to fully understand the effects of microgravity on cardiovascular function during space missions.

LUNG FUNCTION TESTS ON SLS-1 CREWMEMBERS. Harold J. B. Guy*, G.K. Prakasam and J.A. Weat, Univ. of California, San Diego 92102-0931.

INTRODUCTION. A headward fluid shift and reduction of topographic gradients should alter lung function at 0-G. METHOD. We tested resting lung function on the SLS-1 crew repeated before, during (4 payload crew: days 2, 4, 5, 9, 3 orbiter crew: days 2, 6, and after flight. RESULTS AND CONCLUSIONS. CO diffusing capacities (D50) were not affected by exposure, but the arterial and alveolar levels were elevated and almost constant throughout the mission (125% pre-flight standing control), and were higher than the control values. Membrane diffusing capacities of carbon dioxide (D2CO) and carbon monoxide (D2CO) were also reduced. Interstitial pulmonary edema at 0-G, at least at rest. Cardiac stroke volumes (SV2) were reduced. These results suggest that lung function is altered by space travel.

ECONOMIC AND ADMINISTRATIVE CHARACTERISTICS OF THE CLINICALLY BASED HYPERBARIC MEDICINE PROGRAM. Dick Clarke. Richland Memorial Hospital, Columbia, South Carolina.

No longer limited to regional referral centers, hyperbaric medicine facilities are now in place across the continuum of health care institutions. The increasing acceptance of hyperbaric medicine as a useful adjunctive therapeutic modality in cancer and other selected medical conditions has been accompanied by a growing emphasis on clinical trials; the changing attitude recognizes that HBO is adjunctive care in most cases. The American Board of Preventive Medicine has accepted HBO as a subspecialty of medicine. Equipment used includes large chambers with multiple locks, compressors, a control panel, water deluge system for fire safety, and mask breathing system, as well as smaller, transportable, portable acrylic single-lock "monoplace" chambers filled with 100% oxygen. The equipment includes a large steel, air-filled, 6-atmosphere "multiplace" chamber with water deluge system for fire safety, and mask breathing system. The equipment is designed for use in emergency departments, and can be transported to the site of the emergency.


Hyperbaric oxygen therapy is becoming a mature medical entity. As an adjunctive therapy for a variety of conditions and the primary indication for a few, HBO as a field is experiencing healthy growth. Once over-promoted and poorly substantiated, HBO is slowly beginning to establish a much-needed base of controlled clinical trials; the changing attitude recognizes that HBO is adjunctive care in most cases. The American Board of Preventive Medicine has accepted HBO as a subspecialty of medicine. Equipment includes large chambers with multiple locks, compressors, a control panel, water deluge system for fire safety, and mask breathing system, as well as smaller, transportable, portable acrylic single-lock "monoplace" chambers filled with 100% oxygen. A new hybrid single-atended patient type is equipped with air instead of O2, allows the higher pressures, and has a small lock for an attendant. Hyperbarics is increasing in DOD installations, with a major new Naval facility planned to supplement existing USAF and Army installations. Major HBO preparations were made—but fortunately were not needed—for Deert Storm. HBO is primary care for gas lesion diseases (decompression sickness and embolism) and certain CO poisonings, and is well accepted in gynecology. New emphasis focuses on wound care, including convincing results in the use of HBO to reduce the need for leg amputations in low oxygen HBO can reduce by more than half the need for subsequent amputations. The use of HBO as adjunctive therapy for osteoradionecrosis, especially of the mandible, is acceptable. Thermal burns heal faster and at considerably less cost when HBO is used adjunctively.