



Aerospace Medicine
and Biology
A Continuing
Bibliography
with Indexes

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AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 310)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in April 1988 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*.



Scientific and Technical Information Division 1988
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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 305 reports, articles and other documents announced during April 1988 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1988 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED

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ON MICROFICHE

ACCESSION NUMBER → **N88-10483*** # Texas Univ., Houston. Health Science Center. ← CORPORATE SOURCE

TITLE → **PREVENTION OF DISUSE OSTEOPOROSIS: EFFECT OF SODIUM FLUORIDE DURING FIVE WEEKS OF BED REST Final Report** ← PUBLICATION DATE

AUTHOR → **VICTOR S. SCHNEIDER** Oct. 1987 64 p ← AVAILABILITY SOURCE

REPORT NUMBERS → **(NASA-CR-172018; NAS 1.26:172018)** Avail: NTIS HC A04/MF ← PRICE CODE

COSATI CODE → **A01 CSCL 06E**

An attempt was made to modify factors which promote disuse osteoporosis and thereby prevent it from occurring. Since fluoride is currently used to enhance bone formation in the treatment of low turnover osteoporosis, it was hypothesized that if the fluoride ion was available over a long period of time that it would slow the demonstrated loss of calcium by inhibiting bone resorption and enhancing bone formation. This study was used to determine whether oral medication with sodium F will modify or prevent 5 weeks of bed rest induced disuse osteoporosis, to determine the longitudinal effects of 5 weeks of bed rest on PTH, CT and calcitriol, to measure muscle volume changes and metabolic activity by magnetic resonance imaging and magnetic resonance spectroscopy during prolonged bed rest, to measure changes in peak muscle strength and fatigability, and to measure bone turnover in bone biopsies. Subjects were studied during 1 week of equilibration, 4 weeks of control ambulation, 5 weeks of bed rest, and 1 week of reambulation. E.R.

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

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ACCESSION NUMBER → **A88-12321*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TITLE → **CONTINUOUS MONITORING OF BLOOD VOLUME CHANGES IN HUMANS**

AUTHORS → **H. HINGHOFER-SZALKAY and J. E. GREENLEAF** (NASA, Ames Research Center, Moffett Field, CA; Graz, Universitaet, Austria) ← AUTHOR'S AFFILIATION

JOURNAL TITLE → **Journal of Applied Physiology** (ISSN 0161-7567), vol. 63, Sept. 1987, p. 1003-1007. Research supported by the Oesterreichische Akademie der Wissenschaften. refs ← PUBLICATION DATE

(Contract NASA TASK 199-21-12-07)

Use of on-line high-precision mass densitometry for the continuous monitoring of blood volume changes in humans was demonstrated by recording short-term blood volume alterations produced by changes in body position. The mass density of antecubital venous blood was measured continuously for 80 min per session with 0.1 g/l precision at a flow rate of 1.5 ml/min. Additional discrete plasma density and hematocrit measurements gave linear relations between all possible combinations of blood density, plasma density, and hematocrit. Transient filtration phenomena were revealed that are not amenable to discontinuous measurement. I.S.

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 310)

MAY 1988

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LIFE SCIENCES (GENERAL)

A88-20853

TWO FACTORS CRITICAL IN THE PRESSURE RESPONSE OF THE IMPACTED HEAD

GUY S. NUSHOLTZ, PATRICIA S. KAIKER, and WENDY S. GOULD (Michigan, University, Ann Arbor) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1157-1164. Research supported by the Motor Vehicle Manufacturers Association and DOT. refs

Mechanisms of impact head trauma were investigated by studying the response of the head to blunt impact in the posterior-to-anterior direction in anesthetized *Macaca mulatta* animals. The animals were instrumented as described in the studies of Nusholtz et al. (1979). A nine-accelerometer array was rigidly affixed to the skull, and epidural pressure transducers were used to document pressure changes. Injury was assessed by pathological examination. The test results indicated that negative-pressure peaks occurring during an impact equal to or greater than 1 atm do not produce injury, implying that cavitation is not a mechanism of head injury. When the impact produces significant tension, the thermodynamic response (fluid vaporization) of the cerebrospinal system is an important consideration. In addition, the initial head-neck position is a critical factor associated with the cerebrospinal system's response to head impact, and is a predictor of the pressure and injury response. I.S.

A88-20857

CARBAMATE-INDUCED PERFORMANCE AND THERMO-REGULATORY DECREMENTS RESTORED WITH DIAZEPAM AND ATROPINE

CANDACE B. MATTHEW, ROGER HUBBARD, W., RALPH P. FRANCESCONI, and GLENN J. THOMAS (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1183-1187. refs

The effect of carbamate physostygmine (PH), a drug with potential activity as an anticholinesterase, on thermoregulation and physical performance was studied in rats exercised on a treadmill, together with the effects of an atropine (an anticholinergic drug) and diazepam (an anticonvulsant drug) on the PH-induced decrements in performance and thermoregulation. After drug administration, rats were run to exhaustion. The administration of PH was found to reduce (by 60 percent) endurance capacity, as measured by run time (RT), and to significantly increase heating rate (HR) relative to control values, whereas atropine and diazepam without PH improved RT and HR over control levels. Administration of atropine or diazepam along with PH was found to restore both RT and HR values to control levels. I.S.

A88-20861

LOCOMOTOR BEHAVIOR IN MICE FOLLOWING EXPOSURE TO FISSION-NEUTRON IRRADIATION AND TRAUMA

MICHAEL R. LANDAUER, G. DAVID LEDNEY, and HIRSCH D. DAVIS (DNA, Armed Forces Radiobiology Research Institute, Bethesda, MD) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1205-1210. DNA-supported research. refs

Locomotor activity, body weights, and food and water consumption were monitored in female mice for 35 d following a sublethal wound (W), burn (B), exposure to 3 Gray fission neutron radiation (R), or combination of these injuries: radiation-wound (RW) and radiation-burn (RB). Activity in groups W and RW was depressed immediately after injury, with recovery to control levels after 5 and 14 d, respectively. Mice that received radiation alone showed a biphasic response with decrements in activity on days 0-4 and 9-11. Groups B and RB exhibited depressed activity levels that differed significantly from control levels until day 17. Food intake was reduced for about 6 d in groups R, W, RW, and RB, but returned to control levels by the end of the experiment. Animals in group B did not show significant reduction in food intake or body weight. Water consumption was reduced for 5-6 d in groups R and RB and was increased in groups W, RW, and B. The data suggest that behavioral responses to fission-neutron radiation are exacerbated by tissue trauma. Author

A88-20862

THE INFLUENCE OF HIGH AND LOW PRESSURE ON PHAGOCYTOSIS OF ESCHERICHIA COLI BY HUMAN NEUTROPHILS IN VITRO

EGIL LINGAAS and TORE MIDTVEDT (Rikshospitalet, Bakteriologiske Institut, Oslo, Norway) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1211-1214. refs

The effect of pressure on the phagocytic function of human neutrophils was investigated by exposing human polymorphonuclear neutrophils to high (4 atm) and low (0.4 atm) pressures in vitro before and during the phagocytosis of radiolabeled *E. coli*. Preexposure of neutrophils to high pressure before phagocytosis did not influence uptake. When phagocytosis took place at 4 atm, the uptake of opsonized (by active serum or IgG) bacteria was significantly depressed. On the other hand, the uptake of nonopsonized *E. coli*, or uptake of *E. coli* opsonized by heat-inactivated serum or in presence of albumin was not affected by high pressure, suggesting a role of membrane receptors in uptake mechanism. Hypobaric pressure did not alter the uptake of *E. coli* opsonized by active serum or IgG. I.S.

A88-21099* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TECHNOLOGY BASE FOR MICROGRAVITY HORTICULTURE

R. L. SAUER (NASA, Johnson Space Center, Houston, TX), J. W. MAGNUSON, R. R. SCRUBY, and H. W. SCHELD (PhytoResource Research, Inc., College Station, TX) *SAE, Intersociety Conference on Environmental Systems*, 17th, Seattle, WA, July 13-15, 1987. 10 p. refs

(Contract NAS9-16671)
(SAE PAPER 871436)

Advanced microgravity plant biology research and life support system development for the spacecraft environment are critically

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hampered by the lack of a technology base. This inadequacy stems primarily from the fact that microgravity results in a lack of convective currents and phase separation as compared to the one gravity environment. A program plan is being initiated to develop this technology base. This program will provide an iterative flight development effort that will be closely integrated with both basic science investigations and advanced life support system development efforts incorporating biological processes. The critical considerations include optimum illumination methods, root aeration, root and shoot support, and heat rejection and gas exchange in the plant canopy. Author

A88-21101

DESIGN OF A PLANT GROWTH UNIT FOR CELSS FLIGHT EXPERIMENTS

S. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) and M. OLESON (Boeing Aerospace Co., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 5 p. (SAE PAPER 871438)

The design of a plant growth chamber for controlled ecological life support system flight experiments is proposed. The chamber consists of: (1) a cuvette, (2) an illumination control system, (3) a nutrient monitor/control system, and (4) an embedded microprocessor. The functions of these components are described. Methods for providing the proper balance of light intensity and power are examined. The need to keep the nutrient monitor/control system well aerated and to control the gaseous composition of its atmosphere are discussed. I.F.

A88-21122* Management and Technical Services Co., Houston, Tex.

LIFE SCIENCES BIOMEDICAL RESEARCH PLANNING FOR SPACE STATION

GARY R. PRIMEAUX (RCA Government Services; Management and Technical Services Co., Houston, TX), ROGER MICHAUD, LADONNA MILLER, JIM SEARCY, and BERNISTINE DICKEY (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs (SAE PAPER 871464)

The Biomedical Research Project (BmRP), a major component of the NASA Life Sciences Space Station Program, incorporates a laboratory for the study of the effects of microgravity on the human body, and the development of techniques capable of modifying or counteracting these effects. Attention is presently given to a representative scenario of BmRP investigations and associated engineering analyses, together with an account of the evolutionary process by which the scenarios and the Space Station design requirements they entail are identified. Attention is given to a tether-implemented 'variable gravity centrifuge'. O.C.

A88-21143* Montana State Univ., Bozeman.

CONSEQUENCES OF BACTERIAL RESISTANCE TO DISINFECTION BY IODINE IN POTABLE WATER

GORDON A. MCFETERS and BARRY H. PYLE (Montana State University, Bozeman) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 16 p. refs

(Contract NAS9-17346)
(SAE PAPER 871489)

This study was done to quantify the sensitivity of bacteria to iodine under controlled laboratory conditions. When exposed to 1 mg/l I₂ for 1 min, bacteria isolated from the Shuttle were more resistant than a *P. aeruginosa* isolated from a povidone-iodine solution. Cultures grown in rich media were more sensitive than those grown in low nutrient solutions. The *P. aeruginosa* and a *P. cepacia* isolated from the Shuttle were resuspended in PBW after exposure to iodine. Iodinated cells recovered better than uniodinated controls. Pseudomonads in biofilms developed on coupons of stainless steel were more resistant to iodine than cells suspended in buffered water. Although resistant bacteria may

colonize spacecraft water systems, multiple treatment barriers should provide adequate control of these contaminants. Author

A88-21146* State Univ. of New York, Binghamton.

TREATMENT BED MICROBIOLOGICAL CONTROL

GILBERT E. JANAUER, TIMOTHY W. FITZPATRICK, MICHAEL B. KRIL, GEORGIA A. WILBER (New York, State University, Binghamton), and RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 18 p. refs

(Contract NAS9-11604)
(SAE PAPER 871492)

The effects of microbial fouling on treatment bed (TB) performance are being studied. Fouling of activated carbon (AC) and ion exchange resins (IEX) by live and devitalized bacteria can cause decreased capacity for selected sorbates with AC and IEX TB. More data are needed on organic species removal in the trace region of solute sorption isotherms. TB colonization was prevented by nonclassical chemical disinfectant compositions (quaternary ammonium resins) applied in suitable configurations. Recently, the protection of carbon beds via direct disinfectant impregnation has shown promise. Effects (of impregnation) upon bed sorption/removal characteristics are to be studied with representative contaminants. The potential need to remove solutes added or produced during water disinfection and/or TB microbiological control must be investigated. Author

A88-21164

DESIGN AND DEVELOPMENT OF THE LIFE SUPPORT SUBSYSTEM OF A LABORATORY MODEL OF THE BOTANY FACILITY

W. P. FOTH and H. LOESER (MBB-ERNO Raumfahrttechnik GmbH, Bremen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 13 p. ESA-supported research. (SAE PAPER 871519)

For botanical experiments of long duration (e.g., Eureka Botany Facility) the life support subsystem has to provide the composition of the atmosphere as far as the CO₂ and O₂ partial pressure and total pressure are concerned. Furthermore, the air humidity and the soil moisture has to be controlled. In order to allow the potential experimenters to gain practical experience in growing plant samples in such an environment and to learn how selected plants react to various operational conditions, a laboratory model has been designed and tested. Author

A88-21281

THE MOLECULES OF VISUAL EXCITATION

LUBERT STRYER (Stanford University, CA) Scientific American (ISSN 0036-8733), vol. 257, July 1987, p. 42-50.

An account is given of the molecular chemistry that furnishes a basis for visual excitation. A rod cell can be excited by a single photon; the cascade of molecular reactions presently discussed amplifies this minute quantity of information into a signal that is of use to the nervous system. The rhodopsin molecule, embedded in the membrane of the disk, receives light and initiates the excitatory cascade. Attention is given to the roles of the two components of rhodopsin, retinal and opsin. The excitatory cascade forms part of a cycle that is mediated by transducin, which relieves the inhibition of inactive phosphodiesterase. It is noted that hormone action strikingly parallels that of vision. O.C.

A88-21570

SCIENTIFIC OBJECTIVES AND FUNCTIONAL REQUIREMENTS OF LIFE SCIENCES IN THE SPACE STATION

FLEMMING BONDE-PETERSEN (Rigshospitalet, Copenhagen, Denmark) (Columbus II; Proceedings of the Second Workshop, Hanover, Federal Republic of Germany, June 9-11, 1986) Space Technology - Industrial and Commercial Applications (ISSN 0277-4488), vol. 7, no. 1-2, 1987, p. 157-160.

The types of biomedical experiments planned for the International Space Station are listed and briefly characterized,

indicating the operational capabilities and equipment they require. Primary objectives include descriptive and applied human physiology and medicine, animal physiology, plant physiology, cellular physiology, radiation biology and exobiology, and bioprocessing. Consideration is given to the relatively noncritical microgravity specifications for life-science experiments (typically 0.001 g or less), the crew-intervention requirements, the arrangement of experimental equipment in the Pressurized Module, and the integration of a large centrifuge module in the core Space Station. T.K.

A88-22926
NONLINEAR DYNAMICS OF CARDIAC EXCITATION AND IMPULSE PROPAGATION

DANTE R. CHIALVO and JOSE JALIFE (New York, State University, Syracuse) *Nature* (ISSN 0028-0836), vol. 330, Dec. 24, 1987, p. 749-752. NIH-supported research. refs

It is reported here that the general response patterns of nonoscillatory cardiac conducting tissues, when driven rhythmically by repetitive stimuli from their surroundings, are similar to those of other deterministic systems showing chaotic dynamics. Such patterns include phase locking, period-doubling bifurcation, and irregular activity. Electrophysiological techniques and analytical arguments are used to explain this unforeseen behavior and to provide some key information about its mechanisms. The study of these dynamics is of general application to the understanding of disordered phenomena in excitable media, and may provide new insight about the origin of fatal cardiac arrhythmias. C.D.

A88-22928
STRUCTURE AND MOBILITY OF ELECTRON GAIN AND LOSS CENTRES IN PROTEINS

GEORGE D. D. JONES, JEREMY S. LEA, MARTYN C. R. SYMONS, and FATAI A. TAIWO (Leicester, University, England) *Nature* (ISSN 0028-0836), vol. 330, Dec. 24, 1987, p. 772, 773. refs

It is shown that a major radical species formed by electron loss in a range of proteins is the backbone amido radical, $\cdot\text{N}(\text{CO})$, characterized by hyperfine coupling to one N-14 nucleus. These centers are efficiently trapped in proteins at low temperatures. In contrast, the expected backbone electron-capture centers, $\cdot\text{NH}(\text{CO})$, are not readily trapped and electron transfer occurs until the ejected electron is trapped by some electrophilic center. C.D.

A88-22929
ELECTRON TRANSFER FROM PROTEIN TO DNA IN IRRADIATED CHROMATIN

PAUL M. CULLIS, GEORGE D. D. JONES, MARTYN C. R. SYMONS, and JEREMY S. LEA (Leicester, University, England) *Nature* (ISSN 0028-0836), vol. 330, Dec. 24, 1987, p. 773, 774. refs

Evidence is reported that when DNA is complexed to proteins as it is in the nuclei of eukaryotes, electron transfer from the histone to DNA is facile. This leads to a significant increase in the yield of electron-gain centers in DNA as judged from their electron spin resonance spectra. In contrast, 'holes' generated in the proteins are trapped and do not lead to any detectable increase in the yields of $\text{G}(\text{dot}^+)$. C.D.

A88-22956
SEEDING SPACE

BETH DICKEY *Space World* (ISSN 0038-6332), vol. X-4-280, April 1987, p. 15-19.

It is believed that life support, not suitable vehicles, will be the biggest obstacle to travel beyond earth orbit. With the goal of establishing a kind of 'island earth' that is ecologically self-sufficient, NASA's Closed Ecological Life Support System (CELSS) has been proposed. CELSS would supply humans with clean water, fresh air, and an adequate diet without outside help or resupply missions. A major challenge is turning garbage and human waste into consumable nutrients; another question is how to make the system reliable when someone's life depends on it. Progress made in synthetic seed technology is described. K.K.

A88-23693
DIFFERENTIAL EFFECTS OF HYPOXIA ON SLEEP OF WARM- AND COLD-ACCLIMATED RATS

MARCUS J. POLLARD, DAVID MEGIRIAN, and JOHN H. SHERREY (Tasmania, University, Hobart, Australia) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2189-2194. Research supported by the Sudden Infant Death Syndrome Research Foundation of Australia, Tassmanian SID Society, and University of Tasmania; National Health and Medical Research Council of Australia. refs
 (Contract NHMRC-83/0310; NHMRC-83/0550; NHMRC-85/0329)

The effect of hypoxia, at the levels of 10, 12, 13, 15, or 18 percent of oxygen, on the sleep-waking pattern (SWP) and the maximum-minimum deep body temperature was investigated in warm-acclimated (WA) and cold-acclimated (CA) rats, using electrocorticograms and postural neck electromyograms to identify three main states of consciousness. It was found that the SWP of WA rats was more vulnerable to hypoxia than that of CA rats, and that the character of response differed. Whereas in WA rats there was an increasing disruption of SWP with decreasing O₂ levels, there was no such trend for CA rats. The effect of decreasing O₂ levels on WA rats was chiefly on the frequency of state changes (and less on epoch durations). In CA rats, this change in pattern was evident only at 10 percent O₂. Maximum and minimum body temperatures of WA and CA rats were not significantly affected by the lack of O₂. I.S.

A88-23694
MODERATE HYPOXIA - REACTIVITY OF PIAL ARTERIES AND LOCAL EFFECT OF THEOPHYLLINE

CHRISTLIEB HALLER and WOLFGANG KUSCHINSKY (Bonn, Universitaet, Federal Republic of Germany) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2208-2215. refs

The effect of moderate hypoxia on the reactivity of pial arteries to H(+), adenosine, and K(+) and the effect of local and systemic theophylline on the vascular adenosine receptors were investigated in cats under normoxic or hypoxic conditions. The arterial blood pressure was recorded from a catheter in a femoral artery, and arterial pH, P(CO₂), and P(O₂) were measured with microelectrodes. The pial arterial reactivity to each of the tested factors remained unchanged during hypoxia, compared with normoxic condition. Vasodilation induced by hypoxia could not be reduced by either perivascular microapplication of theophylline, nor by systemic theophylline given either before or during hypoxia. On the other hand, systemic theophylline was found to block dilations induced by the perivascular microapplication of adenosine during normoxia, indicating that systemic theophylline can block vascular adenosine receptors. However, since local theophylline had no effect on the hypoxic dilatation of pial arteries, adenosine may not be the major causative factor for the hypoxic hyperemia. I.S.

A88-23697
INCREASED CAROTID BODY HYPOXIC SENSITIVITY DURING ACCLIMATIZATION TO HYPOBARIC HYPOXIA

MARTIN VIZEK, CHERYL K. PICKETT, and JOHN V. WEIL (Colorado, University, Denver) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2403-2410. refs
 (Contract NIH-HL-14985)

The effect of acclimatization to hypobaric hypoxia on the ventilatory and neural responses to hypoxia was investigated in cats exposed to simulated altitude of 15,000 ft for 48 h (control cats remained at ambient altitude). After acclimatization, cats were anesthetized and intubated, and their ventilatory response and carotid sinus nerve activity were measured during progressively lowered oxygen pressure. Exposure to hypobaric hypoxia produced acclimatization, as manifested by a decrease in end-tidal P(CO₂), both in normoxia and hypoxia. This was associated with an increased hypoxic carotid body response despite a lower end-tidal P(CO₂), and an apparent increased dependency of ventilation on carotid body function. The results suggest that acclimatization to hypobaric hypoxia is associated with increased hypoxic

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ventilatory response accompanied by enhanced peripheral chemoreceptor responsiveness, which may contribute to the attendant rise in ventilation. I.S.

A88-23937

ENERGY MIGRATION DURING PHOTOSYNTHESIS [MIGRATSIIA ENERGIИ PRI FOTOSINTEZE]

A. I. BORISOV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *Biofizika* (ISSN 0006-3029), vol. 32, Nov.-Dec. 1987, p. 1046-1061. In Russian. refs

This paper considers the primary mechanisms of photosynthesis, i.e., the transfer of energy absorbed by the chlorophyll 'antenna' to photochemical reaction centers, at which the capture of this energy is accompanied by spatial separation of charges. The molecular mechanisms operating in the transfer of electron excitation in purple and in green bacteria are analyzed on the basis of available data on the photosynthetic units and the energy capture processes in these organisms. It is concluded that three mechanisms for intermolecular energy transfer operate during photosynthesis: the induction-resonance process, electron excitation, and exchange-resonance. I.S.

A88-23971

THE MECHANISMS OF THE MAGNETIC FIELD EFFECT ON BIOLOGICAL SYSTEMS [MEKHAHIZMY DEISTVIIA MAGNITNYKH POLEI NA BIOLOGICHESKIE SISTEMY]

A. N. KUZNETSOV (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) and V. K. VANAG (AMN SSSR, Institut Obshchei i Kommunal'noi Gigieny, Moscow, USSR) *Akademiia Nauk SSSR, Izvestiia, Serii Biologicheskaiia* (ISSN 0002-3329), Nov.-Dec. 1987, p. 814-827. In Russian. refs

The mechanisms responsible for the effect of a constant magnetic field (MF) on biological systems are examined on the basis of observations and theoretical considerations. It is estimated that, in order to influence biological systems by hydrodynamic effects in flowing biological fluids or by means of Lorentz forces, the MF should be significantly stronger than 10 T. Similarly, the MF should exceed 1-10 T to affect the orientation mechanism due to the magnetic anisotropy of biological structures. On the other hand, to affect the liquid-crystal state of biological membranes, a MF of only 0.1 T is required, while an MF as low as 1-10 mT is sufficient for changing rates of biological reactions by the mechanism of spin ban. If a specific receptor contains ferromagnetic inclusions, weak magnetic fields of about 1 mT may also influence the orientation mechanism. I.S.

A88-23972

THE SUCCESSION OF CHANGES IN INTRACELLULAR PROCESSES OF MICROORGANISMS AT SUPRAOPTIMAL TEMPERATURES [POSLEDOVATEL'NOST' PERESTROEK VNUTRIKLETOCHNYKH PROTSESSOV MIKROORGANIZMOV PRI SUPRAOPTIMAL'NYKH TEMPERATURAKH]

I. N. POZMOGOVA (AN SSSR, Institut Mikrobiologii, Moscow, USSR) *Akademiia Nauk SSSR, Izvestiia, Serii Biologicheskaiia* (ISSN 0002-3329), Nov.-Dec. 1987, p. 952-955. In Russian. refs

The nature and the succession of changes taking place in cellular processes of a microorganism incubated at supraoptimal temperatures, which lead to the inhibition of growth, are considered. It is shown that the excess thermal energy supplied to the cells at temperatures between the optimal and the maximal values affects primarily the process of DNA transcription, inducing transcription errors, the appearance of synonymous codons, and the activation of the 'heat-shock gene'. These events are followed by inhibitions of RNA synthesis and the expression of faulty m-RNA, and, finally, by the synthesis of characteristic 'heat-shock proteins', which differ from their normal counterparts by electrophoretic mobility. Protein alterations are manifested by metabolic changes characterized by the activation of enzymes regulating less effective energy paths. If the organism is transferred back to the optimal growth-temperature within one generation time period, the heat-induced alterations will be reversed. I.S.

A88-24285

EFFECTS OF MICROGRAVITY AND HYPERGRAVITY ON THE CELL - INVESTIGATIONS ON PARAMECIUM TETRAURELIA

G. RICHOLLEY, R. TIXADOR, J. TEMPLIER, G. GASSET, and H. PLANEL (Toulouse III, Universite, France) *Acta Astronautica* (ISSN 0094-5765), vol. 17, Jan. 1988, p. 147-150. refs

Previous space CYTOS experiments have shown that space flights resulted in an increase in growth of Paramecia cultures. Microgravity is the major factor responsible for this response: indeed the stimulatory effect disappeared in inflight cultures placed on a 1-g centrifuge aboard Spacelab. On the other hand, exposure to different levels of hypergravity on earth resulted in an opposite response; i.e., to a reduced cell growth rate. A possible mechanism for the action of microgravity on Paramecia is discussed. Author

A88-24503#

A RESPIRATORY MASK FOR MEASURING GAS EXCHANGE IN RATS - ANESTHETIZING AND RESTING

MASAYUKI NAKAYA and SACHIO IKAWA (Jikei University, Tokyo, Japan) *Japanese Journal of Aerospace and Environmental Medicine* (ISSN 0387-0723), vol. 24, Sept. 1987, p. 75-80. In Japanese, with abstract in English. refs

A respiratory mask was developed to permit the determination of respiration gas exchange in rats. The respiratory mask is simple and inexpensive to make. The mask was made from light plastic and retained by a neck strap with four rubber straps. The animals learned to accept the mask. Oxygen consumption (VO₂), heart rate (HR) and rectal temperature T(re) were measured in rats during anesthesia. After pentobarbital peritoneal injection (40 and 60 mg/kg body weight), VO₂, HR and T(re) decreased to minimal values. Resting VO₂ was measured in three tame rats. Resting VO₂ changed to stable, and values were obtained comparable to those of other investigators. The features of the mask make it useful for measuring metabolism during anesthesia and rest in rats. Author

A88-24550

REDUCED TEMPERATURE AFTERDROP IN RHESUS MONKEYS WITH RADIO FREQUENCY REWARMING

RICHARD G. OLSEN (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 59, Jan. 1988, p. 78-80. Navy-supported research. refs

Rhesus monkeys were anesthetized and rendered hypothermic by ice-water immersion. Rewarming by radio frequency (RF) energy at 13.56 MHz or by a surgical heating pad was initiated either immediately after removal from the ice water or after a delay of 20-26 min. Rectal temperature (Tre) was monitored during each experiment; RF energy, initially applied at a specific absorption rate of 10 W/kg, was able to raise Tre an average of 3 C in 20 min. For an equivalent period of rewarming with the heating pad, Tre had not yet recovered from the immersion-induced afterdrop. It is concluded that RF rewarming offers a special advantage when applied to the treatment of immersion hypothermia. Author

A88-24668

THE RESPONSE TO HEAT SHOCK OF PLANTS THAT ARE ADAPTED BY EVOLUTION TO EXISTENCE AT EXTREMELY HIGH TEMPERATURES [OTVET NA TEPLOVYI SHOK RASTENII, EVOLIUTSIONNO PRISPOBLENNYKH K SUSHCHESTVOVANIU PRI EKSTREMAL'NO VYSOKIKH TEMPERATURAKH]

S. V. LOPATO, V. P. MOMOT, and I. U. GLEBA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), vol. 297, no. 6, 1987, p. 1514-1516. In Russian. refs

N88-15353# Office of Naval Research, London (England).
REVIEW OF CYTOSKELETON RESEARCH IN CELL DIFFERENTIATION AND DEVELOPMENT
 CLAIRE E. ZOMZELY-NEURATH 10 Sep. 1987 13 p
 Proceedings of 1st International Symposium on the Cytoskeleton in Cell Differentiation and Development, Granada, Spain, 21-25 Apr. 1987
 (AD-A185832; ONRL-7-024-C) Avail: NTIS HC A03/MF A01 CSCL 06D

Papers given at this conference, held in April 1987 in Granada, Spain, are reviewed. The papers focused on the analysis of the assembly dynamics of microtubules, intermediate filaments, and action filaments to provide the structural basis of the role played by the cytoskeleton in differentiating a variety of cell systems, early embryogenesis, and to the biological and genetic aspects of cytoplasmic organization. GRA

N88-15354*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MICROGRAVITY PARTICLE RESEARCH ON THE SPACE STATION
 STEVEN W. SQUIRES, ed., CHRISTOPHER P. MCKAY, ed., and DEBORAH E. SCHWARTZ, ed. Dec. 1987 48 p Workshop held in Moffett Field, Calif., 22-24 Aug. 1985
 (NASA-CP-2496; A-87361; NAS 1.55:2496) Avail: NTIS HC A03/MF A01 CSCL 06B

Science questions that could be addressed by a Space Station Microgravity Particle Research Facility for studying small suspended particles were discussed. Characteristics of such a facility were determined. Disciplines covered include astrophysics and the solar nebula, planetary science, atmospheric science, exobiology and life science, and physics and chemistry.

N88-15360# International Trade Administration, Washington, D.C.
BIOTECHNOLOGY IN WESTERN EUROPE
 R. T. YUAN Apr. 1987 285 p
 (PB88-105887) Avail: NTIS HC A13/MF A01 CSCL 06B

A technical and industrial assessment was carried out in the major industrial nations of Western Europe and the Far East. Its objectives were: to determine the government policies in support of biotechnology, to identify the principal research laboratories and their activities, to identify the principal companies involved in biotechnology and their activities, and to study the various mechanisms for technology transfer from the research laboratories to the industrial sector. In order to carry out the mission, two senior scientists were selected for posting to the U.S. Embassies in London and Tokyo. They were chosen on the basis of scientific expertise, work experience overseas, language proficiency, and the appropriate cultural affinities. Their efforts were coordinated through the International Trade Administration in Wash., D.C.

Author

N88-15361*# Lockheed Engineering and Management Services Co., Inc., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST INDEX TO ISSUES 10-14
 LYDIA RAZRAN HOOKE Washington NASA Feb. 1988 100 p
 (Contract NASW-4292)
 (NASA-CR-3922(17); NAS 1.26:3922(17)) Avail: NTIS HC A05/MF A01 CSCL 06B

An index is provided for issues 10 through 14 of the USSR Space Life Sciences Digest. There are two sections. The first section lists bibliographic citations of abstracts contained in the Digest issues covered grouped by topic area categories. The second section provides a key word index for the same set of abstracts. Author

N88-15362# Arizona State Univ., Tempe. Dept. of Chemistry.
ARTIFICIAL PHOTOSYNTHESIS USING CHLOROPHYLL BASED CAROTENOID-QUINONE TRIADS Final Technical Progress Report
 D. GUST and T. A. MOORE Sep. 1987 9 p
 (Contract DE-FG02-84CH-10198)
 (DE88-001660; DOE/CH-10198/T1) Avail: NTIS HC A02/MF A01

Goal of this last year was the synthesis and study of a molecular tetrad consisting of a porphyrin or chlorophyll derivative covalently linked to both a carotenoid polyene and a rigid diquinone moiety. Photosynthesis converts light into chemical potential energy in the form of long-lived charge separation across a bilayer membrane. Recombination of the charge-separated state is prevented by the large distance between the final electron donor and acceptor. Reaction centers employ a series of electron transfer steps, each of which occurs over a short distance with high quantum yield. In photosynthetic bacteria, the charge separation sequence includes electron donation from a bacteriopheophytin to a quinone which then transfers an electron to a second quinone. The proposed carotenoid-porphyrin-diquinone (C-P-Q-Q) tetrad was designed to model this portion of the natural photosynthetic electron transport system, and to be the next step in the evolution of increasingly complex synthetic mimics of natural solar energy conversion. Such a tetrad has been prepared. Nanosecond laser flash photolysis and picosecond fluorescence decay studies were carried out. Electron transfer reactions in C-P dyads and C-P-Q triads were studied. DOE

N88-15363# European Space Agency, Paris (France).
PROCEEDINGS AND PROGRAM DRAFT IN GRAVITATIONAL BIOLOGY IN THE FEDERAL REPUBLIC OF GERMANY
 Jun. 1987 143 p Transl. into ENGLISH of Gravitationsbiologie in der Bundesrepublik Deutschland - Vortraege und ein Programmentwurf (Cologne, Fed. Republic of Germany, DFVLR), Oct. 1985 194 p Proceedings held in Cologne, Fed. Republic of Germany, 14-15 Jun. 1985 Original language document was announced as N86-29514
 (ESA-TT-988; DFVLR-MITT-85-16; ETN-88-91110) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The effects of weightlessness on animal organisms to better understand its effects on the human body during space flights are discussed. Investigations on vertebrate physiology, reproduction, genetics, neurobiology, and behavioral and motion physiology are proposed. ESA

N88-15364# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
THE ROLE OF THE DFVLR PROJECT MANAGEMENT LIFE SCIENCES IN THE SPACE PROGRAM OF THE FEDERAL REPUBLIC OF GERMANY
 FERDINAND DAHL *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 10-16 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmentwurf, DFVLR, Cologne (Federal Republic of Germany), Rept. DFVLR-Mitt-85-16, Oct. 1985 p 47-52 Original language document was announced as N86-29518

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The West German space program in cooperation with ESA and NASA is focused on the Spacelab 1 mission, on the Eureka mission, the Long Duration Exposure Facility, the International Microgravity Laboratory, Spacelab D2 mission, as well as on bioracks, European Radiation Assembly and Human Physiology Laboratory. Experiments are carried out in radiobiology, exobiology, physiology, botany, microbiology, rhythmic processes, and biotechnology. The DFVLR project management and the experiment/project selection procedure by the scientific advisory committees are presented. ESA

N88-15365# Stuttgart Univ. (West Germany).

A THEORETICAL CONCEPT FOR STATE CHANGES AND SHAPE CHANGES IN WEIGHTLESSNESS

RETO J. STRASSER *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 17-25 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne (Federal Republic of Germany), Rept. DFVLR-MITT-85-16, Oct. 1985 p 23-31 Original language document was announced as N86-29516

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

A theoretical concept for state and shape changes in weightlessness based on thermodynamics principles for open systems is developed. The influence of light, temperature, pressure, and gravity on the shape and state of a biological system, and therefore on the phenotype with steady genome are studied. Experiments are carried out on leaves, chloroplasts; neurospores and mammalian cell spheroids. An experimental module for cellular biology was built for automatic optical and electrode measurements. The data are recorded, stored, and processed at a ground station. Experiments in space stations are recommended to study the influence of gravity and geomagnetism on the shape and the biochemical processes of a biological system and to obtain data on the phylogenesis of more complicated organisms. ESA

N88-15366# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).

SOME REMARKS ON GRAVITATIONAL BIOLOGY

WOLFGANG BRIEGLEB *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 26-37 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 33-44 Original language document was announced as N86-29517

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

A functional system including direct/primary, indirect/secondary and various indirect/tertiary interactions between an organism and gravity was developed to study the genetic and phylogenetic consequences of gravity on animals living in water or on land. Gravitational fields influence the gravity receptors leading to humoral or neuronal responses according to cell or proprioceptor excitation. The immersed condition with no indirect gravity influence is compared with real weightlessness to analyze gravity direct influence on an isolated cell function or on a bunch of cells in egg ontogenesis and to analyze the effects of gravity on statocyst differentiation. In animals living on land, the antigravity structures and functions are influenced by gravity. The mutational effects of gravity leading to gene evolution through neuronal and functional morphological responses are presented. Hypergravity and weightlessness should be further studied. ESA

N88-15367# Konstanz Univ. (West Germany).

INVESTIGATIONS OF PARAMECIUM CELLS ANALYZED UNDER MICROGRAVITY CONDITIONS

HELMUT PLATTNER *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 38-41 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne (Federal Republic of Germany), Rept. DFVLR-MITT-85-16, Oct. 1985 p 9-20 Original language document was announced as N86-29515

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Paramecium tetraurelia cells were studied using light microscopy, video recording, amino-ethyl dextran as redocking trigger agent and electronic microscopy to analyze exocytosis movements, redocking cycles on the cellular membrane and

trichocyst building-up for 12 hr. The relationship between trichocyst ejection and motion behavior under microgravity conditions is studied using behavior mutants and secretion mutants to assess the negative or positive selection pressure of trichocyst presence or absence. ESA

N88-15368# Bonn Univ. (West Germany).

THE ORIGIN OF THE SPICULE SKELETON OF FRESH WATER SPONGES (SPONGILLIDES)

NORBERT WEISSENFELS *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 42-44 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 53-56 Original language document was announced as N86-29519

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Young fresh water sponges cultivated in the laboratory in constant temperature water and in ambient temperature were used to study the origin of the sponge spicule skeleton. The SiO₂ spicules are formed in scleroblasts. Aged spicules leave the scleroblasts and are transported by transport cells to their functional location where they adhere to the base plate through epongin which ensures their stability. The life cycle of the spongillides throughout the seasons is described. The influence of gravity on the development of young sponges should be studied. ESA

N88-15369# Cologne Univ. (West Germany).

LIMB REGENERATION IN AMPHIBIANS, A SUITABLE MODEL FOR INVESTIGATIONS OF THE EFFECTS OF WEIGHTLESSNESS AS REGARDS EVOLUTION AND MODIFICATIONS

HERMANN JOSEF ANTON *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 47-51 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 63-68 Original language document was announced as N86-29520

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Limb regeneration in urodeles, amphibians which have experienced a phylogenetic evolution to overcome the effects of gravity, was studied to analyze the long term effects of weightlessness depending on environmental conditions and on gene activation. The study gives data on evolution processes and phylogenesis under weightlessness, on calcium exchange, and physiological regeneration of the skeleton as a supporting and moving apparatus. ESA

N88-15370# Ruhr Univ., Bochum (West Germany).

INVESTIGATIONS OF THE REPRODUCTIVE PHYSIOLOGY OF THE RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON)

VOLKER BLUEM and RUEDIGER SCHULZ *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 52-55 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 69-73 Original language document was announced as N86-29521

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Morphological and endocrinal investigations on the reproductive physiology of the rainbow trout of either sex were performed to study hypothalamic production of gonadotropin releasing hormone (GnRH) using histological and histometrical analysis, to demonstrate the presence of gonadotrop hormone receptors (GTH-receptors) in testes and ovaries based on radioimmunological quantification and using the immunofluorescent technique. An in

vitro system for gonad tissues was developed to study steroid genesis in short-time cultures. The effects of puberty in rainbow trout on material exchange are studied. Ethiological studies were carried out to determine the influence of sexual and/or parental phases. The morphological control of gametogenesis in micro-g environment is recommended as well as in vivo and in vitro investigations of reproduction-dependent hormonal systems.

ESA

N88-15371# Essen Univ. (West Germany).
CHANGES IN THE MORPHOLOGICAL AND MOLECULAR BIOLOGICAL PROCESSES DURING EARLY EMBRYO DEVELOPMENT IN AMPHIBIANS UNDER MICRO-G CONDITIONS

HORST GRUNZ *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 56-60 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 75-80 Original language document was announced as N86-29522

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The effects of micro-g conditions on vegetative polarity (absence of change) in aging oocytes over 2 months were studied to determine the role of gene regulatory factors and the changes in nucleus-cytoplasm interactions. Cell affinity and induction should be investigated under micro-g conditions to study the processes of the reaggregation between ectoderm and endoderm and the changes in the standard structure so as to understand normal and pathological embryo development.

ESA

N88-15372# Justus Liebig-Universitaet, Giessen (West Germany).

XIPHOPHORUS: A SYSTEM TO RECOGNIZE RADIATION-INDUCED MUTATIONS AND TO STUDY THE EFFECTS OF ZERO-GRAVITY ENVIRONMENT ON EMBRYO DEVELOPMENT

CARL-RUDOLF SCHMIDT and FRITZ ANDERS *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 61-65 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 81-85 Original language document was announced as N86-29523

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The reproduction physiology of Xiphophorus is described. Laboratory mutants constitute a system of 60 stable and genetically determined species. Resulting from their crossbreeding melanomas appear due to a disordered oncogene. The Xiphophorus system is studied to determine the oncogene characteristics, regulation and transmission. Studies on Xiphophorus under weightlessness are recommended: influence of zero-g environment on skeleton and musculoskeletal structure; epigenetic and/or genetic effects of zero-g environment on embryogenesis in vivo and in vitro; and the effects of the combined action of cosmic radiation and weightlessness on embryos, sub-adult and adult animals of the mutation-sensitive Xiphophorus test species to investigate mutagenesis and teratogenesis.

ESA

N88-15373# Luebeck Univ. (West Germany).

HYPOXIC HYPOXIA AS A STIMULUS OF ERYTHROPOIESIS IN VIVO AND IN VITRO

WOLFGANG JELKMANN *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 70-75 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 95-100 Original language document was announced as N86-29524

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The action of weightlessness on red blood volume in astronaut's anemia and on erythropoiesis leading to increased hemolysis is studied. Several generations of mice and rats bred in weightlessness were studied to determine the effects of weightlessness on the erythropoietic tissues, in erythropoiesis and on calcification. Causes of astronaut's anemia are listed. The effects of weightlessness on the erythropoietic system ontogenesis were measured based on circulative blood and erythrocyte volumes, the functional integrity of the hematopoietic tissue and the capacity of the erythropoietic system to react to hypoxia.

ESA

N88-15374# Marburg Univ. (West Germany).

A LEARNING MODEL AS A BASIS FOR INVESTIGATIONS OF THE EFFECTS OF GRAVITY ON THE LEARNING PROCESSES AND MEMORY FORMULATION

CHRISTIANE BUCHHOLTZ *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 79-84 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 107-113 Original language document was announced as N86-29525

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The effects of gravity on learning strategy were studied using conditioned mice and a data acquisition computer system recording the daily performance of each mouse. The records are used to develop learning models. Increasing gravity causes changes in the functional relationship between data storage units. These changes depend on the calculation result of proprioceptive feedbacks, and on time dependent effects represented by transmission of data from a short term memory related to the biophysical phase to long term memory related to the biochemical phase.

ESA

N88-15375# Duesseldorf Univ. (West Germany).

LONG-TERM ADAPTATION OF THE OTOLITH ORGANS

ROLF ECKMILLER *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 85-90 Jun. 1987 Transl. into ENGLISH from Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 115-120 Original language document was announced as N86-29526

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Reduction in sensitivity of otolith organs in primates before a space mission and methods to reduce it were investigated to avoid space motion sickness. A procedure should be developed under neurophysiological control of the otolith afferences to influence the size and location of otoconia.

ESA

51 LIFE SCIENCES (GENERAL)

N88-15376# Ulm Univ. (West Germany).

FUNCTIONAL DEVELOPMENT OF GRAVITY RECEPTORS IN INSECTS AND AMPHIBIANS

EBERHARD HORN *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 91-98 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 121-128 Original language document was announced as N86-29527

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Insects using a proprioceptive system and amphibians using a statocyst were studied to analyze the functional development of a sensory system and its influence of the body muscle structure. The effects of micro-g through gravity receptors on the efficiency of the sensory system, on the adaptive mechanisms of the neuronal development under changing living conditions or under the animal pathological conditions, and on the hormonal environment are studied. The studies are based on eye reflex (*Xenopus*) and head reflex (*Gryllus*) and on equilibrium observations. ESA

N88-15377# Stuttgart Univ. (West Germany).

FUNCTION-DEPENDENT PLASTICITY IN THE NERVOUS SYSTEM

HINRICH RAHMANN and WOLFGANG PROBST *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 101-105 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 135-139 Original language document was announced as N86-29528

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The tectum opticum of fish midbrain is studied to demonstrate the involvement of gangliosides in the functional plastic changes in synaptic systems and in visual acuity. The structural synaptic plasticity after light variations involving synaptic vesicles and after temperature variations involving the nervous system are studied using differential quantitative light and electronic microscopes. The biochemical neuronal plasticity after temperature variations involves sialo-glycoconjugate bonds and gangliosides. The molecule basic properties are determined using the monolayer technique for physico-chemical *in vitro* experiments with various neuronal membrane lipids combined with calcium ions. Further investigations are recommended to study neuronal plasticity in reduced or in absence of gravity. ESA

N88-15378# Bonn Univ. (West Germany).

MORPHOLOGY AND DEVELOPMENT OF THE INNER EAR OF ANURANS

HANS SCHNEIDER and IRIS HERTWIG *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 106-109 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 141-146 Original language document was announced as N86-29529

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The Anuran inner ear consists of five sensory sections for orientation in space and perception of acoustic signals. Utriculus, sacculus and lagena are gravity receptors possessing otoliths. The ampullae of the semicircular canals are responsible for rotation sense. Papillia basilaris and papilla amphiborum allow respectively perception of high frequencies and low frequencies. The development of the labyrinth in amphibians begins after neurulation. The receptors consist of sensory cells and support cells. Experiments in simulated weightlessness show that the

development of sensory epithelia and otoliths do not depend on gravity and should be confirmed by experiments in space. ESA

N88-15379# Bielefeld Univ. (West Germany).

QUESTIONS ON THE EVOLUTION OF THE DEVELOPMENT PROGRAM OF THE VERTEBRATE INNER EAR UNDER LONG TERM ZERO-G CONDITIONS

BERND FRITZSCH *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 112-116 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 151-156 Original language document was announced as N86-29530

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

The long-term effects of weightlessness on the formation and function of the vestibular system are studied with particular focus on the persistence of motion defects of larva up to adult age, on the reproduction function, on the adaptation or selection of the offspring and hybrids resulting from successful reproduction under weightlessness, and on the sensory epithelium differentiation. The structural changes of the inner ear in adapted or selected offspring are studied using the electronic microscope and the afferent and efferent connections using tracer methods. High generation succession frequency and offspring number, applicable reproductive behavior and easy culture, and live food are the minimum requirements for program implementation. ESA

N88-15380# Kiel Univ. (West Germany).

LONG DURATION CONFINEMENT OF AQUATIC ORGANISMS IN WEIGHTLESSNESS (AQUASPACE)

RAINER FROESE *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 117-122 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 159-164 Original language document was announced as N86-29531

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

A confinement facility resulting from the study of the transition phase between water and air was developed to study aquatic organisms in weightlessness. The facility is a closed system filled with water and consists of a central supply unit, confinement tanks, a lock system, a computer system for food supply control and measurement processing, videocameras monitoring growth, reproduction and behavior of the aquatic organisms, and two chambers to remove the gases released in water through a diffusion membrane and to store oxygen in a gas mixture. The facility can be used to study the catabolism of the aquatic organisms in weightlessness and the effects of weightlessness and radiation on the reproduction biology. ESA

N88-15381# Ulm Univ. (West Germany).

PROGRAM DRAFT FOR A SPECIAL FIELD: GRAVITATIONAL BIOLOGY

EBERHARD HORN *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) p 127-142 Jun. 1987 Transl. into ENGLISH from *Gravitationsbiologie in der Bundesrepublik Deutschland-Vortraege und ein Programmwurf*, DFVLR, Cologne, Federal Republic of Germany, Rept. DFVLR-Mitt-85-16, Oct. 1985 p 173-189 Original language document was announced as N86-29532

Avail: NTIS HC A07/MF A01; original German version available from DFVLR, Cologne, Fed. Republic of Germany DM 50

Gravitational biology as a special field for fundamental research or organism biology in weightlessness is discussed. Cellular and molecular biology, genetics; reproduction and development biology; vegetative biology and matter exchange biology; neurobiology;

behavioral and motion physiology; population genetics, and evolution biology, and ecology and life preservation systems are suitable fields of research. The cooperation between the different field specialists and experts can contribute to the knowledge of body stabilization and plasticity and adaptivity in weightlessness. ESA

N88-15396# Joint Publications Research Service, Arlington, Va. **KARYOMETRIC EVALUATION OF NEURONAL REACTIONS OF RAT CEREBRAL CORTEX TO THE COMBINED EFFECT OF IONIZING RADIATION, LONGITUDINAL ACCELERATIONS AND VIBRATION**

V. P. FEDOROV and I. B. USHAKOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 56-60 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 39-42

Avail: NTIS HC A08/MF A01

Using karyometric procedures, the reactions of neuronal nuclei of the middle layers of the sensorimotor cortex of rats exposed to the combined effect of ionizing radiation and longitudinal acceleration or vertical vibration were investigated. It was found that the size of neuronal nuclei varied depending on the radiation dose and type of combination of radiation with other exposures.

Author

N88-15403# Joint Publications Research Service, Arlington, Va. **SPLEEN LYMPHOCYTE NUCLEIC ACIDS IN PREGNANT RATS FLOWN IN SPACE AND THEIR OFFSPRING**

G. S. KOMOLOVA, V. F. MAKEYEVA, I. A. YEGOROV, and L. V. SEROVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 98-101 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 66-69

Avail: NTIS HC A08/MF A01

The spaceflight effect on the synthesis of nucleic acids in spleen lymphocytes in pregnant rats and their offspring was investigated. In addition to the inhibition of the DNA replicative function previously detected in males, activation of RNA synthesis was seen in the pregnant females. Such changes did not develop in the synchronous mock up controls. The 30 day and 100 day old pups of the rats flown in space during the last third of their pregnancy showed no changes in the DNA replicative function. The 100 day old animals displayed only a slight, when compared to the vivarium controls, decline of RNA synthesis which was produced by concomitant factors rather than by microgravity per se. It is supposed that microgravity induced activation of RNA synthesis in spleen lymphocytes of pregnant rats is associated with the involvement of these cells in adaptive trophic processes that are to maintain plastic homeostasis of the fetus in an unusual environment.

Author

N88-15404# Joint Publications Research Service, Arlington, Va. **DISTINCTIVE CHANGES IN ARTERIAL PRESSURE AND BLOOD FLOW IN COMMON CAROTID ARTERY OF MONKEYS FLOWN ABOARD COSMOS-1514 BIOSATELLITE**

V. P. KROTOV, H. SANDLER, A. M. BADAQVA, J. HINES, V. S. MAGEDOV, and H. STONE *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 102-108 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 69-74

Avail: NTIS HC A08/MF A01

Preflight, the rhesus monkey, Bion, was implanted with sensors and transducers to measure blood pressure and linear flow velocity in the common carotid artery and to compare these parameters with central circulation. At the early flight stage blood pressure increased, blood flow decreased and resistance in the area grew. The last change can be regarded as a compensatory reaction that can provide rapid adaptation of regional circulation to changes

in systemic circulation. At later flight stages blood pressure showed distinct circadian oscillations and blood flow, a significant increase when compared to the ground based 36 hour control study. Regulatory mechanisms of the cardiovascular system changed to the greatest extent on flight day 2. This manifested as a decrease of the amplitude of circadian oscillations of the above circulation parameters. Signs of cardiovascular adaptation to the effects of microgravity were discerned on flight days 3 to 5. Author

N88-15411# Joint Publications Research Service, Arlington, Va. **THIRD SOVIET-FRENCH SYMPOSIUM ON SPACE CYTOLOGY**

I. B. KRASNOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 138-143 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 92-95 Symposium held in Reims, France, 4-11 May 1986

Avail: NTIS HC A08/MF A01

The Third Soviet-French Symposium on Space Cytology, which was organized within the framework of collaboration in the area of medicine and medical technology between the USSR Ministry of Health and French National Institute of Health and Medical Research, convened from 4 to 11 May, 1986 in France. Space cytology is a discipline that studies the effect of spaceflight factors such as weightlessness, high energy particles, etc., on the structure, function and metabolism of prokaryote and eukaryote cells of bacteria, plants, and animals. Some titles of meetings are: Nerve cells, Lymphocytes and cells in tissue cultures, Bone tissue, Erythrocytes, Analytical methods, and Biological models. E.R.

N88-15414# Joint Publications Research Service, Arlington, Va. **EXPERIMENTS WITH RATS FLOWN ABOARD COSMOS-1667 BIOSATELLITE (MAIN OBJECTIVES, CONDITIONS AND RESULTS)**

O. G. GAZENKO, YE. A. ILYIN, YE. A. SAVINA, L. V. SEROVA, A. S. KAPLANSKIY, V. S. OGANOV, I. A. POPOVA, K. V. SMIRNOV, and I. V. KONSTANTINOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 8-16 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 9-16

Avail: NTIS HC A08/MF A01

Morpho-biochemical investigation of the rats flown on the biosatellite Cosmos-1667 have shown that the 7 day spaceflight produces shifts in different systems, organs, and tissues which reflect adaptive processes to microgravity. Early signs of structural, functional, and metabolic rearrangement can be detected in the musculoskeletal apparatus, hemopoietic system, lymphoid organs, and neurohormonal systems, i.e., in the systems and organs that develop changes during long term flights. The rates of adaptation to microgravity are different not only in various systems and organs but also within the same tissues. Most shifts that emerge at an early stage of adaptation to microgravity progress with flight time but some of them develop to a full extent after the 7 day flight. The specific feature of the early stage of adaptation to microgravity is the lack of significant changes in tissues. The fact gives evidence that the mechanisms maintaining homeostasis at the organism level are not as yet disrupted during 7 days of flight. Author

N88-15415# Joint Publications Research Service, Arlington, Va. **BRAIN MORPHOGENESIS IN RATS DEVELOPING IN WEIGHTLESSNESS**

I. B. KRASNOV, S. N. OLENEV, I. I. BABICHENKO, and V. S. KESAREV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 17-24 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 16-22

Avail: NTIS HC A08/MF A01

Macroscopic and light microscopic examination of the brain of 18 day fetuses, and neonate 15, 30, and 100 day rats whose embryonic development from day 13 to day 18 occurred in

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spaceflight on Cosmos-1514 did not reveal any changes in the brain structures of the fetuses or pups of the three ages. However, the brain of the 18 day fetuses that developed in flight showed signs of insufficient tissue oxygenation, trends toward delayed cell migration in the cortex and delayed differentiation of neurosecretory cells of the hypothalamic supraoptic nuclei. The cell differentiation rate returned to normal during continued embryogenesis after flight at 1 G. Author

N88-15417# Joint Publications Research Service, Arlington, Va. **MORPHOMETRIC ANALYSIS OF RAT AORTA ENDOTHELIUM DURING LONG-TERM HYPOKINESIA**

A. N. GANSBURGSKIY *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 32-35 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 26-28

Avail: NTIS HC A08/MF A01

Twenty-four white rats were exposed to 30, 60, and 100 day hypokinesia. Using the stereological technique, film preparation of their aortic endothelium were examined for the mean areas of endothelial cells, nuclei, and cytoplasm. Also, the content of endothelial cells showing karyopyknosis, karyolysis, or binuclear structures was measured morphometrically. As compared to the matched control, the numbers of cells with karyopyknosis, karyolysis, and two nuclei increased significantly at every time interval studied. On hypokinesia day 30, the area of endothelial cell, nuclei, and cytoplasm was greater than that of the controls. On hypokinesia days 60 and 100, the cell size was within normal limits and the nuclear size was smaller. This led to a decrease of the nucleus-plasma ratios. Together with other factors responsible for hypercholesterinemia, the above changes in the endothelial layer may facilitate atherosclerotic lesions of the vascular wall during prolonged hypokinesia. Author

N88-15418# Joint Publications Research Service, Arlington, Va. **NUCLEIC ACID CONTENT OF SKELETAL MUSCLES DURING HYPOKINESIA AND IN THE RECOVERY PERIOD**

D. Z. SHIBKOVA and N. A. FOMIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 36-40 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 28-31

Avail: NTIS HC A08/MF A01

The concentration of nucleic acids in the gastrocnemius muscle of Wistar rats was measured during 60 day hypokinesia and 30 day recovery periods. The data obtained indicated that this hypokinesia model leads to an arrest of muscle growth and inhibition of the age-related accumulation of nucleic acids in the gastrocnemius muscle. The content of DNA and RNA genetic matrices largely depends on the muscle activity. Normalization of the motor function results in an activation of genetic mechanisms of biosynthesis regulation, acceleration of reparative processes, and recovery of muscular activity. Author

N88-15420# Joint Publications Research Service, Arlington, Va. **ACID-BASE EQUILIBRIUM AND SOME RAT BLOOD PARAMETERS FOLLOWING EXPOSURE TO HYPERBARIC OXYGENATION**

V. V. GLADILOV and N. A. MOYSEYENKO *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 56-61 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 41-45

Avail: NTIS HC A08/MF A01

Acid-base equilibrium, glycolytic parameters, electrophoretic mobility, and hemoglobin oxygen affinity in the blood of rats exposed to hyperbaric oxygenation were measured. The animals were kept at 2026 kPa for 15, 30, or 60 minutes. It was found that the short-term oxygenation led to changes in acid-base

equilibrium, then to biochemical changes in plasma and erythrocytes and, consequently, to a higher oxygen-binding ability of hemoglobin. The increased hemoglobin oxygen affinity was significantly stable and persisted for a certain period of time in the normal atmosphere. The experimental data demonstrated that most blood parameters taken under study varied in a different manner, depending on the time during which the animals were exposed to oxygen. Author

N88-15423# Joint Publications Research Service, Arlington, Va. **CHANGES IN FUNCTIONAL PARAMETERS OF ANIMALS DURING LONG-TERM INHALATION OF ACETIC ACID**

V. P. SAVINA and B. V. ANISIMOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 79-84 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 56-60

Avail: NTIS HC A08/MF A01

Laboratory animals inhaled acetic acid vapors at a concentration of 86 to 27 mg/cu m for 3 to 35 days. It was found that the dose of 36 mg/cu m inhaled for as long as 22 days constituted the minimal acting dose. The most sensitive parameters to be used in detecting the toxic effect of acetic acid were: treadmill run duration, open field activity, and ethylene, acetaldehyde and acetone concentrations in the exhaled air. Author

N88-15425# Joint Publications Research Service, Arlington, Va. **EFFECT OF PYROCETAM ON MOUSE RESISTANCE TO HYPOXIC HYPOXIA 2-3 MONTHS AFTER EXPOSURE TO X-RADIATION**

A. V. POPOV, A. A. BOCHENKOV, YU. YU. IVNITSKIY, and YU. V. VOLKOVSKIY *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 91-95 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 64-66

Avail: NTIS HC A08/MF A01

The resistance of mice to hypoxic hypoxia 3 months after their X-irradiation was evaluated with respect to such parameters as survival rate during the ascent to 11,000 m, life time at that altitude, and brain succinic dehydrogenase (SDH) and lactate dehydrogenase (LDH) activities at an altitude of 7000 m. Irradiated mice proved to be less resistant to hypoxic hypoxia. The SDH activity increased to a greater extent in nonirradiated than in irradiated animals. Pyracetam increased significantly the resistance of hypoxia of both irradiated and nonirradiated mice. The SDH activity was stimulated by hypoxia in a greater degree in the pyracetam-treated mice. The resistance to hypoxic hypoxia and SDH activation at an altitude of 7000 m were found to be closely related. The LDH activity remained essentially unchanged in any of the animal groups. Author

N88-15430# Joint Publications Research Service, Arlington, Va. **EFFECT OF STEROID HORMONES ON BIOGENIC AMINE LEVELS IN LUNGS DURING DEVELOPMENT OF PULMONARY HYPERTENSION IN RATS SUBMITTED TO CHRONIC HYPOBARIC HYPOXIA**

N. N. PRIBYLOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 114-117 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 76-78

Avail: NTIS HC A08/MF A01

At the present, it is known that the lungs are involved in biosynthesis of phospholipids, conversion of angiotensin 1 to angiotensin 2, metabolism of histamine, acetylcholine, kinins, prostaglandins, heparin, serotonin, catecholamines, and vasoactive polypeptides. Considering the close relationship between metabolism of steroid hormones and their effect on activity of biogenic amines, the task of testing the effect of steroid hormones on the levels of the most important vasopressor amines in lung

tissue, in the presence of chronic hypobaric hypoxia, was undertaken. Author

N88-16096# Joint Publications Research Service, Arlington, Va.
SPACE BIOLOGY AND MEDICINE

A. I. GRIGORYEV *In its* JPRS Report: Science and Technology. USSR: Space p 86-94 24 Nov. 1987 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 2, Mar. - Apr. 1987 p 34-39

Avail: NTIS HC A08/MF A01

Medical and biological research has always assumed an important role in the space program. The number of experiments has grown with the emergence of manned missions. The work performed in the Intercosmos program represents a qualitatively new phase in the development of a space medicine and biology. The development of space medicine and biology is traced and some future experiments suggested. E.R.

N88-16097# Joint Publications Research Service, Arlington, Va.
RESULTS OF RESEARCH WITH BIOLOGICAL SATELLITES
Abstract Only

G. LOMANOV *In its* JPRS Report: Science and Technology. USSR: Space p 95 24 Nov. 1987 Transl. into ENGLISH from Sotsialisticheskaya Industriya (Moscow, USSR), 18 Sep. 1987 p 4
Avail: NTIS HC A08/MF A01

Some of the important results of research which has been conducted with biological satellites over the last 15 years is reviewed. In particular, weightlessness has been found to produce no destructive effects on tissues, intracellular processes and the principal systems of an organism. This means that space missions lasting as long as a year can now be authorized. With the aid of biological satellites, radiation safety norms have been substantiated, radiation monitors for manned spacecraft have been tested, and studies of the locomotion system have been conducted. These studies have led to development of a system of measures and physical exercises for preventing atrophy of groups of muscles that are not exerted in zero gravity, as well as loss of calcium from bone tissue. Author

N88-16098# Joint Publications Research Service, Arlington, Va.
RESEARCH ON COTTON PLANTS GROWN IN SPACE

In its JPRS Report: Science and Technology. USSR: Space p 98 24 Nov. 1987 Transl. into ENGLISH from Pravda Vostoka (Tashkent, USSR), 22 Jul. 1987 p 3
Avail: NTIS HC A08/MF A01

Twenty cotton plant seedlings that had been planted in space were germinated. Some of these second generation plants were prepared to return to space. Two experiments for growing seeds in orbit proved unsuccessful. In the next experiment the cosmonauts breathed on the seedlings, and specially watered them, and the first green leaves appeared while the mission was in progress. Cotton thus became the third agricultural crop to sprout onboard a Soviet spaceship. Experiments are now continuing to determine the effects of zero gravity and other conditions of space flight affecting the cellular level and hereditary apparatus of the cotton plants. Interesting changes in fiber lengths are now being observed in one of the plants. E.R.

N88-16262# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Biochemie.

LIFE SCIENCES EXPERIMENTS ON STRATOSPHERIC BALLOONS AND SOUNDING ROCKETS

C. WIESE, B. BECHLER, F. K. GMUENDER, G. LORENZI, and A. COGOLI *In* ESA, Proceedings of the 8th ESA Symposium on European Rocket and Balloon Programs and Related Research p 371-376 Aug. 1987 Sponsored by the Swiss Federal Inst. of Technology Board

(Contract SNSF-3.382-0.82)

Avail: NTIS HC A21/MF A01

The results of an experiment with human erythroleukemic cells K-562 exposed to cosmic radiation on a stratospheric balloon flight are presented. The advantages offered by sounding rockets to short-term biological investigations in microgravity are discussed.

It is recommended that ESA and national agencies organize more opportunities for experiments in balloons and sounding rockets for investigators in life sciences, as a complement for studies performed in Spacelab, in free flyers, and in the Space Station. Results show that hemoglobin synthesis is reduced by microgravity and cosmic radiation. ESA

N88-16263# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

THE D-1 BIORACK RESULTS: A BASE FOR FURTHER SPACE BIOLOGICAL INVESTIGATIONS

D. A. M. MESLAND *In its* Proceedings of the 8th ESA Symposium on European Rocket and Balloon Programs and Related Research p 377-382 Aug. 1987

Avail: NTIS HC A21/MF A01

Scientific results obtained with the first flight of the ESA Biorack on Spacelab mission D1 are summarized. Effects of microgravity on bacteria, unicellular organisms, human lymphocytes, and insect development are found. It is proposed that microgravity causes very subtle deviations in cell architecture and transportation mechanisms, which by accumulation in active cells become manifest as a measurable change in cell properties. Experiments to test this hypothesis are outlined. Experiments concerning phenomena of the cell surface, including cell fusion, are proposed to be of particular importance for biological studies using sounding rockets. ESA

N88-16264# University Hospital, Copenhagen (Denmark). Inst. of Aerospace Medicine.

SCIENTIFIC OBJECTIVES AND FUNCTIONAL REQUIREMENTS OF LIFE SCIENCES IN THE SPACE STATION

F. BONDE-PETERSEN *In* ESA, Proceedings of the 8th ESA Symposium on European Rocket and Balloon Programs and Related Research p 383-385 Aug. 1987
Avail: NTIS HC A21/MF A01

The scientific objectives for research in the Space Station on human physiology and medicine; animal physiology; plant physiology; cellular physiology; radiation biology and exobiology; and bioprocessing are summarized. Requirements for crew intervention and microgravity level are indicated. A pressurized module layout is shown. ESA

N88-16266# Centre National d'Etudes Spatiales, Paris (France).
CONTRIBUTION OF STRATOSPHERIC BALLOON FLIGHTS IN SPACE BIOLOGY

K. BOST, R. TIXADOR, G. RICHAILLEY, M. DELPOUX, G. PERBEL, A. COGOLI, and C. NOGUES (Centre d'Enseignement et de Recherches de Medecine Aeronautique, Paris, France) *In* ESA, Proceedings of the 8th ESA Symposium on European Rocket and Balloon Programs and Related Research p 391-394 Aug. 1987

Avail: NTIS HC A21/MF A01

Results of biological research performed aboard satellites and/or stratospheric balloon flights are reported. Findings on bacteria cultivated with various concentrations of antibiotics; the proliferation and cell metabolism of Paramecia; the genetic effects of space in plants; cell proliferation, glucose consumption, and hemoglobin production in human cells; gravireaction of lentil seedlings; and lesional effects of cosmic rays in rat brains are presented. The advantages and disadvantages of balloon flights in space biological research in order to discriminate the respective parts of cosmic rays and weightlessness are discussed. ESA

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N88-16316# United Nations Industrial Development Organization, Vienna (Austria).

SAFETY GUIDELINES AND PROCEDURES FOR BIOSCIENCE-BASED INDUSTRY AND OTHER APPLIED MICROBIOLOGY

23 Apr. 1986 19 p Presented at informal UNIDO/WHO/UNEP Working Group on Biotechnology Safety, Vienna, Austria, 27-29 Jan. 1986

(PB87-140521; UNIDO-ID/WG.463/1) Avail: NTIS HC E02/MF E01 CSCL 06B

The United Nations Industrial Development Organization (UNIDO) publication on industrial safety for biotechnology research and development and applied microbiology covers the following topics: (1) project objectives; (2) risk and risk assessment, the IBRD guidelines, the World Health Organization classification system; and (3) conjectural risks associated with applied biotechnology. GRA

N88-16317*# Lockheed Engineering and Management Services Co., Inc., Washington, D.C.

USSR SPACE LIFE SCIENCES DIGEST, ISSUE 14

LYDIA RAZRAN HOOKE, RONALD TEETER, MIKE RADTKE, and JOSEPH ROWE (Library of Congress, Washington, D. C.) Washington, D.C. NASA Feb. 1988 110 p

(Contract NASW-4292)

(NASA-CR-3922(16); NAS 1.26:3922(16)) Avail: NTIS HC A06/MF A01 CSCL 06B

This is the fourteenth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 32 papers recently published in Russian language periodicals and bound collections and of three new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. Also included is a review of a recent Soviet conference on Space Biology and Aerospace Medicine. Current Soviet life sciences titles available in English are cited. The materials included in this issue have been identified as relevant to the following areas of aerospace medicine and space biology: adaptation, biological rhythms, body fluids, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, equipment and instrumentation, gastrointestinal systems, habitability and environment effects, human performance, immunology, life support systems, mathematical modeling, metabolism, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, radiobiology, and space biology and medicine. Author

N88-16318# Joint Publications Research Service, Arlington, Va. **USSR REPORT: LIFE SCIENCES. BIOMEDICAL AND BEHAVIORAL SCIENCES**

5 Dec. 1986 121 p Transl. into ENGLISH from various Russian articles

(JPRS-UBB-86-022) Avail: NTIS HC A06/MF A01

Articles from the open literature are summarized in the areas of aerospace medicine, agrotechnology, biochemistry, biophysics, biotechnology, environment, epidemiology, genetics, immunology, laser bioeffects, marine mammals, medicine, microbiology, military medicine, molecular biology, pharmacology and toxicology, physiology, public health, radiation biology, veterinary medicine, and psychiatric conferences.

N88-16319# Joint Publications Research Service, Arlington, Va. **POSSIBLE USE OF PLASMIDS FOR STUDY OF EFFECT OF SPACE FLIGHT FACTORS ON BIOLOGICAL OBJECTS**

S. N. ZALOGUYEV, A. F. MOROZ, L. I. GLATMAN, A. A. TEREKHOV, N. G. ANTSIFEROVA, V. L. POPOV, F. M. KIRILLOVA, L. N. KATS, M. P. BRAGINA, and V. M. SHILOV *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 1-9 5 Dec. 1986 Transl. into ENGLISH from Antibiotiki i Meditsinskaya Biotekhnologiya (Moscow, USSR), no. 5, May 1986 p 357-362 Avail: NTIS HC A06/MF A01

In order to ascertain the effects of space flight on bacterial resistance to antibiotics, the effect of space flight factors on the phenotype and certain molecular-genetic plasmid parameters in

E. coli strains whose growth and reproduction occurred in Earth orbit was studied. Plasmids were selected so that there would be representatives of various classes (R, Col, Hdl and others) that differed in molecular weight, degree of conjugation, and origin. An absence of any changes in the properties of the plasmid-coded strains and the strains of the flight experiment agrees well with the results of a study of the plasmid composition of strains that were obtained in an electrophoretic analysis of plasmid DNA. A comparison of the electrophoregrams shown in the diagram convincingly demonstrates the complete likeness of the plasmid profiles of flight and synchronous experimental strains that carry the same number of plasmids with unchanged molecular weights. In short, data indicate that the space flight factors active under the experimental conditions for a period of 24 hours did not have any effect on the examined properties of the tested strains and their plasmids. J.P.B.

N88-16320# Joint Publications Research Service, Arlington, Va. **ZERO GRAVITY AND LIVING ORGANISM Abstract Only**

In its USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 10 5 Dec. 1986 Transl. into ENGLISH from Tass (Moscow, USSR), 31 Jul. 1986

Avail: NTIS HC A06/MF A01

It is established that zero gravity can cause structural changes in cells. Such changes have been detected for the first time in tissues of tradescantia during the plant's lengthy stay on a space flight. Such changes had not been registered on Earth even when tissues were subjected to radiation, vibration or fluctuations in temperature. The results of the experiments were confirmed by numerous experiments on other experimental specimens. Zero gravity has an unfavorable effect not only on mitosis. It causes unpleasant blood surges to the head in cosmonauts and changes in the state of the cardiovascular system and metabolism. Soviet scientists have developed preventive measures against the unfavorable influence of zero gravity on living organisms. As a result, periods of man's stay in space have increased. Author

N88-16321# Joint Publications Research Service, Arlington, Va. **BIORHYTHMIC ASPECTS OF INTERCONTINENTAL ANTARCTIC ADAPTATION**

A. L. MAKSIMOV and T. B. CHERNOOK *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 72-78 5 Dec. 1986 Transl. into ENGLISH from Izvestiya Akademii Nauk Kirgizskoy SSR (Frunze, USSR), no. 2, Mar. - Apr. 1986 p 35-39 Avail: NTIS HC A06/MF A01

A comparative study of human circadian rhythm was carried out in order to clarify the question of whether a stable adaptation phase occurs in polar research workers after six months of wintering at an Antarctic high altitude polar station, as well as to evaluate the rearrangement in the biorhythmic structure. In the mid-winter polar night, considerable changes were noted in the biorhythmic indicators with respect to the periodic organization and pulse-amplitude characteristics. In the same period there was an inversion in pulse rate rhythm, ultradian circadian rhythms appeared, and a maximum in the rate of cardiac contractions coincided with a minimum sodium retention in saliva, attesting to the activation of the sympathoadrenal system during night rest. No 24- or 12-hour rhythms were revealed with respect to the temperature indicator and a considerable flattening of the diurnal curve of the body temperature occurred. Potassium and sodium excretion from saliva was characterized by a great value spread over 24 hours and the appearance of a 12-hour ultradian rhythm. In conclusion, no stable adaptation phase was found in the subjects, evidently as a result of extreme winter conditions. J.P.B.

N88-16322# Joint Publications Research Service, Arlington, Va.
NEUROCHEMICAL CHANGES IN HIBERNATION Abstract Only
 E. Z. EMIRBEKOV and S. P. LVOVA *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 79 5 Dec. 1986 Transl. into ENGLISH from Neyrokhimiya (Yerevan, USSR), no. 3, Jul. - Sep. 1984 p 306-317
 Avail: NTIS HC A06/MF A01

A brief literature review is presented on the data accumulated in the neurochemical literature on biochemical changes in the brain during hibernation. It has been shown, for example, that during hibernation many of the oxidative enzymes and flavin-dependent dehydrogenases evidence high levels of activity, whereas the phylogenetically newer elements, such as the cytochrome oxidases, are present with diminished activity. In conjunction with these observations, the cortex has been shown to be unusually susceptible to cyanides during hibernation. With hibernation, serotonin levels show elevation while catecholamines show concomitant depression, a process reversed on waking, with the actual changes suggesting profound alterations in the thermoregulatory center. However, despite the facts and figures that have been accumulated, these quantitative data are not yet sufficient to formulate an unequivocal concept of hibernation.

Author

N88-16323# Joint Publications Research Service, Arlington, Va.
EFFECTS OF EXTREME HYPOXIA ON PHOSPHOLIPID METABOLISM IN SUBCELLULAR STRUCTURES OF RAT BRAIN Abstract Only
 S. V. GASTEVA, T. YE. RAYZE, and L. M. SHARAGINA *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 80 5 Dec. 1986 Transl. into ENGLISH from Neyrokhimiya (Yerevan, USSR), no. 3, Jul. - Sep. 1984 p 284-287
 Avail: NTIS HC A06/MF A01

Wistar rats were employed in a study designed to ascertain the effects of moderate and extreme hypoxia on the status of phospholipid metabolism in the cerebral hemispheres. Maintenance of the animals in a pressure chamber at 266.90 gPa for 2 hours, with periodic reduction to 213.38 gPa, resulted in profound reduction in phospholipid turnover and 40 to 45 percent reduction of the phospholipid levels in the mitochondria and synaptosomes. The reduction in the concentration of the phospholipids in the myelin, cytosol and microsomes ranged from ca. 10 to 20 percent. Exposure to moderate hypoxia (266.60 gPa) led to a similar depression of the turnover rate, but with no decrease in the levels of the phospholipids. The data were interpreted to indicate that moderate hypoxia depressed phospholipid anabolism and catabolism to an equal extent, whereas extreme hypoxia led largely to inhibition of the biosynthesis of phospholipids in the cerebral hemispheres.

Author

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A88-20851* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
AEROBIC FITNESS IN WOMEN AND RESPONSES TO LOWER BODY NEGATIVE PRESSURE
 MARY ANNE BASSETT FREY, KAREN L. MATHES, and G. WYCKLIFFE HOFFLER (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1149-1152. refs

The role of tolerance to orthostatic stress in the maintenance of high aerobic fitness in women was investigated by examining the responses of heart rate, stroke volume, cardiac output, Heather index of contractility, arterial pressure, peripheral resistance,

change in calf circumference, and thoracic impedance of healthy female subjects to lower body negative pressure (LBNP) applied for 5 min at -50 mm Hg or until a subject became presyncopal. The testing protocol involved a stepwise reduction in pressure and consisted of two parts: an LBNP test in supine position followed by a treadmill test to peak aerobic capacity. Women were found to exhibit the same response pattern to LBNP as was previously reported by Convertino et al. (1984) for men. The results do not support the hypothesis that orthostatic tolerance in women is inversely related to aerobic fitness, as demonstrated by a finding that the peak aerobic capacity of subjects who became presyncopal did not differ from the peak of the tolerant subjects, and that hemodynamic responses to LBNPL were not a function of aerobic capacity. I.S.

A88-20852 **EFFECTS OF CAFFEINE ON SIMPLE REACTION TIME AND MOVEMENT TIME**

BERT H. JACOBSON and BETTY M. EDGLEY (Oklahoma State University, Stillwater) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1153-1156. refs

The effects of moderate (300 mg) and high (600 mg) caffeine on simple reaction time (RT) and movement time (MT) were investigated in young (average age 21 years and mean weight 72.8 kg) subjects. The pretest and posttest values for MT and RT were measured with a Dekan automatic performance analyzer; the MT and RT were defined as by Surburg (1977), in that RT was the elapsed time for the perception of stimuli to the subsequent initiation of muscular response, and MT included the elapsed time for the initiation of the muscle response until the prescribed action was completed. A bright light served as the visual cue for initiating the movement. Subjects who ingested 300 mg caffeine were found to register a significant improvement in both RT and MT from the pretest values. No considerable change occurred in the 600-mg group in either RT or MT. These results suggest that, although moderate doses of caffeine are directly related to beneficial changes in RT and MT, large doses apparently serve to diminish or inhibit these initial neuromuscular changes. I.S.

A88-20855* Universities Space Research Association, Houston, Tex.

LACK OF EFFECTS OF ASTEMIZOLE ON VESTIBULAR OCULAR REFLEX, MOTION SICKNESS, AND COGNITIVE PERFORMANCE IN MAN

RANDALL L. KOHL (Universities Space Research Association, Houston, TX), JERRY L. HOMICK (Space Biomedical Research Institute, Houston, TX), NITZA CINTRON (Technology, Inc., Houston, TX), and DICK S. CALKINS (NASA, Johnson Space Center, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1171-1174. refs

Astemizole was orally administered to 20 subjects in a randomized, double-blind design to assess the efficacy of this peripherally active antihistamine as an ant motion sickness drug possessing no central side-effects. Measures of vestibular ocular reflex (VOR) were made to evaluate the agent as a selective vestibular depressant. Following one week of orally administered astemizole (30 mg daily), a Staircase Profile Test, a VOR test, and a variety of tests of cognitive performance were administered. These tests revealed no statistically significant effects of astemizole. This leads to the conclusion that, although the drug probably reaches the peripheral vestibular apparatus in man by crossing the blood-vestibular barrier, a selective peripheral antihistamine (H1) action is inadequate to control motion sickness induced through cross-coupled accelerative semicircular canal stimulation in a rotating chair. Author

A88-20858

A DIFFERENT APPROACH TO WIND CHILL

W. C. KAUFMAN, W. G. LAATSCH, and C. R. RHYNER (Wisconsin, University, Green Bay) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1188-1191. refs

The response of humans to wind chill depends not only on physical conditions and physiological state but also on past experience, their perception of the environment, and on the extent of change of the weather conditions from the norm. In this paper, average daily temperature and wind speed for Chicago, Illinois, for the winter months and for Fargo, North Dakota, and Green Bay, Wisconsin, for the months of February were used to extract data for wind chill temperature (WCT) in these locations. The wind chill was presented as a frequency table and as it may relate to human perception of cold. Plots were obtained which showed perception of cold, as related to WCT, as flesh-freezing, dangerously cold, bitterly cold, very cold, and comfortable for the inhabitants of the three localities, and which makes it possible to compare the daily forecast to past weather. It is suggested that, for any given community, wind-temperature conditions as they may be perceived and how they relate to the norms of that community might add greater meaning to the numerical WCT. I.S.

A88-20859

THE INFLUENCE OF REGIONAL INSULATION ON THE INITIAL RESPONSES TO COLD IMMERSION

MICHAEL J. TIPTON and FRANK ST. C. GOLDEN (Institute of Naval Medicine, Gosport, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1192-1196. refs

Twelve healthy male subjects performed three 10-min head-out immersions in water at 10 C. The responses of the subjects to immersion were recorded under three conditions: (1) control condition (CC) - torso and limbs exposed; (2) torso protected/limbs exposed condition (TPC); and (3) limbs protected/torso exposed condition (LPC). Results showed that the LPC significantly reduced the heart rate (p less than 0.01), minute ventilation (p less than 0.05), and respiratory frequency (p less than 0.05) during the first minute of immersion compared to the CC. Subjects also found the LPC the most comfortable. The TPC significantly reduced minute ventilation (p less than 0.01) and respiratory frequency (p less than 0.01) on immersion compared to the CC, but did not significantly lower the heart rate response. A comparison of the LPC and TPC revealed no significant difference in minute ventilation and respiratory frequency recorded on immersion. The LPC, however, produced significantly lower heart rates on immersion (p less than 0.05) than the TPC. It was concluded that the limbs may be more important than the torso for the initiation of cardiac response to cold water immersion. Author

A88-20863* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MECHANISMS UNDERLYING THE ANTIMOTION SICKNESS EFFECTS OF PSYCHOSTIMULANTS

RANDALL L. KOHL and MICHAEL R. LEWIS (NASA, Johnson Space Center; Universities Space Research Association, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1215-1218. refs

Data related to the mechanism responsible for the antimotion sickness effects of psychostimulants such as amphetamine are examined. From the analysis of current literature and new evidence, the following three hypotheses are suggested: (1) selective enhancement of dopaminergic, but not noradrenergic, transmission is sufficient to account for amphetamine-induced resistance and, perhaps, for natural resistance to motion sickness; (2) the site of this enhanced dopaminergic transmission is probably within the basal ganglia; and (3) the neuropharmacology of the basal ganglia, but not of the brain-stem vestibular areas, can account for the therapeutic synergism of scopolamine and amphetamine. The therapeutic action of psychostimulants may be dissociable from some of their side effects, particularly cardiovascular effects related to peripheral norepinephrine release. I.S.

A88-21123

BONES AND STONES IN SPACE - INTEGRATING THE MEDICAL AND SCIENTIFIC QUESTIONS

CHRISTOPHER E. CANN (California, University, San Francisco) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs (SAE PAPER 871465)

Bone loss and muscle atrophy are two consequences of long-term spaceflight, and neither the underlying mechanisms nor effective countermeasures have yet been found. Experiments designed for Space Station and beyond incorporate a number of scientific objectives focused on two interrelated concepts, calcium homeostasis and bone homeostasis. The experiments to be done require a trade-off between ground based analysis of samples and development of instruments to do these studies in flight. The scientific community is currently in the process of defining which scientific objectives can be accomplished in flight and what instrumentation is required to do this. Author

A88-21144* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MEDICAL EFFECTS OF IODINE DISINFECTION PRODUCTS IN SPACECRAFT WATER

RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX), DANIEL S. JANIK (NASA, Johnson Space Center, Houston, TX; National Research Council, Washington, DC; Utah, University, Salt Lake City), and YVONNE R. THORSTENSON (NPI, Salt Lake City, UT) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 14 p. refs (SAE PAPER 871490)

Various iodination products (IDPs), including iodinated and iodine-induced new compounds, will be present in the iodine-disinfected water that is expected to be used by crews on the NASA Space Station and on long duration missions. The metabolic intermediaries created by such a process may be more important to crew health than the parent IDPs, and reclamation and recycling may be expected to produce additional products. These medical effects may be expressed in crews as hypersensitivity, allergic, acute toxic, and chronic toxic reactions, as well as modifications of immune system response. O.C.

A88-21170

THE MATHEMATICAL STRUCTURE OF THE HUMAN SLEEP-WAKE CYCLE

STEVEN H. STROGATZ (Harvard University, Cambridge, MA) Berlin and New York, Springer-Verlag (Lecture Notes in Biomathematics. Volume 69), 1986, 249 p. Research supported by Harvard University. refs

The problem of internal desynchronization in the human sleep-wake cycle is considered, reviewing the results of recent theoretical and experimental investigations. Numerical data are presented in extensive tables and graphs; data-reduction procedures are described; and techniques for evaluating the prediction accuracy of analytical and simulation models are presented and applied. T.K.

A88-21902

PROCEDURAL APPROACHES FOR DETECTING HYPERLIPEMIA IN FLIGHT PERSONNEL [METODICHESKIE PODKHODY K VYIAVLENIU GIPERLIPIDEMII U LETNOGO SOSTAVA]

S. A. BUGAROV, R. K. KISELEV, V. E. POTKIN, T. A. ORLOVA, V. I. PLAKHATNIUK et al. Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Sept. 1987, p. 48, 49. In Russian.

The definition of the state of hyperlipemia in a subject depends upon the norms set for the control levels of atherogenic plasma lipoproteins. A relationship is proposed for the determination of the coefficient of atherogenicity, which expresses the ratio between the contents of atherogenic and nonatherogenic lipoproteins, i.e., the ratio between the low-density and high-density cholesterol fractions. This relationship was used to analyze the status of lipid metabolism in 44 pilots in the 23-41 yr bracket, comparing the results with those of two conventional methods (comparisons of

individual cholesterol values with its upper limits or with the age-normalized 'proper' levels). Using the coefficient of atherogenicity, hyperlipemia was diagnosed in 21 subjects; only seven subjects were diagnosed hyperlipemic by all three methods used. I.S.

A88-21932

OPTIMAL REGULATION OF BLOOD CIRCULATION AND ERYTHROPOIESIS UNDER CHANGES OF MOTOR ACTIVITY [OPTIMAL'NAIA REGULIATSIIA KROVOBRASHCHENIIA I KROVETVORENIIA PRI IZMENENII DVIGATEL'NOI AKTIVNOSTI]

I. F. OBRAZTSOV, M. A. KHANIN, and I. B. BUKHAROV (Moskovskii Aviatsonnyi Tekhnologicheskii Institut, Moscow, USSR) *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), vol. 297, no. 1, 1987, p. 248-250. In Russian. refs

A mathematical model of the functional state of the blood circulation and erythropoiesis under changes of the motor activity (especially under hypodynamia) is presented with reference to conditions arising during prolonged stay in weightlessness. It is shown that functional shifts under hypodynamia (lowering of the hematocrit and the volume of circulating blood, and an increase in the blood minute volume) should be viewed as a normal physiological adaptation. Here, the blood circulation and erythropoiesis systems pass into a new functional state, corresponding to minimum energy expenditures. B.J.

A88-22871

SIMULATOR SICKNESS - SOME MEASUREMENT ISSUES

KEVIN C. ULIANO and ROBERT S. KENNEDY (Essex Corp., Orlando, FL) IN: *Simulators IV; Proceedings of the SCS Conference, Orlando, FL, Apr. 6-9, 1987*. San Diego, CA, Society for Computer Simulation, 1987, p. 102-104. refs

Simulator sickness is a special case of motion sickness that one can experience upon exposure to flight simulators. Identifying those who are susceptible to simulator sickness has proven difficult because different people with different backgrounds get ill for apparently different reasons - no reliable predictor has emerged due mainly to the fact that people manifest simulator sickness in different ways. Some physiological and paper-and-pencil criteria measures of simulator sickness have proven useful, and these measures are discussed along with a proposed avenue of research. Author

A88-22872

TRACING THE ETIOLOGY OF SIMULATOR SICKNESS

LAWRENCE J. HETTINGER, ROBERT S. KENNEDY, and KEVIN S. BERBAUM (Essex Corp., Orlando, FL) IN: *Simulators IV; Proceedings of the SCS Conference, Orlando, FL, Apr. 6-9, 1987*. San Diego, CA, Society for Computer Simulation, 1987, p. 105-108. refs

An increasing incidence of motion sickness-like symptoms in flight simulators, referred to as simulator sickness, has created an urgent need to identify the relevant causal factors. Of particular concern are reports of simulator sickness occurring with the use of devices which lack motion bases. In these instances, the attention of visual scientists and system designers is increasingly being focused on the optical characteristics of computer-generated imagery to determine whether disturbances of the visual components of the visual-vestibular system may be a contributing factor. This paper discusses several aspects of visual-vestibular perception which are thought to be involved in the etiology of simulator sickness; vection, the vestibulo-ocular reflex, optokinetic nystagmus, and the pseudo-Coriolis effect. Author

A88-23205#

DETERMINATION OF HUMAN ENDURANCE TO CATAPULT OVERLOAD WITHOUT THE EFFECT OF RESTRAINT SYSTEM
XIANGCHANG ZHUANG, FENG XIAO, and MINGSHAN LI (Institute of Space Medical-Engineering, Beijing, People's Republic of China) *Acta Aeronautica et Astronautica Sinica* (ISSN 1000-6893), vol. 8, Sept. 1987, p. A496-A502. In Chinese, with abstract in English. refs

The response of the human body to ejection is simulated theoretically, considering the body as a 1-DOF elastic structure and modeling its behavior by analogy to the current in an electrical oscillator with damping ratio 0.3 and natural frequency 10.5 Hz. The response of this circuit to square-wave, sine-wave, sawtooth, trapezoidal-wave, discrete-wave, and overlapping-wave inputs is then evaluated in terms of the input/output amplitude ratio, with the output amplitude corresponding to the ejection overload on the human body. The curve of endurance versus ejection overload is then plotted from data on the compressive-stress resistance of human vertebrae. T.K.

A88-23526

CARDIOVASCULAR RESPONSE TO THE TILT TABLE TEST AS A FUNCTION OF TYPE OF PHYSICAL TRAINING [REPOSE CARDIO-VASCULAIRE AU TEST DE LA TABLE BASCULANTE EN FONCTION DU TYPE D'ENTRAINEMENT PHYSIQUE]

CHARLES YANNICK GUEZENNEC (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France), MARC GIAOUI (Clinique Saint-Francois, Paris, France), and JEAN-MICHEL CLERE (Centre d'Essais en Vol, Bretigny-sur-Orge, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 102-109. In French. refs

In order to study the influence of type of training on orthostatic tolerance, tilt table testing was performed on two groups of six subjects each: (1) a group practicing aerobic training for endurance; and (2) a group practicing muscle-building. The results show a lower resting heart rate for the endurance trained group, a similar elevation for both groups under the effect of verticalization, and no change for downward tilting of the head. Muscle-building is not shown to result in a gain in orthostatic tolerance. R.R.

A88-23528

SPACE SICKNESS - CURRENT RESEARCH [LE MAL DE L'ESPACE - ASPECTS ACTUELS]

ALAIN LEGER (Service de Sante des Armees, Paris; Centre d'Essais en Vol, Bretigny-sur-Orge, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 114-119. In French. refs

Recent NASA epidemiological data on space sickness are reviewed, and causal mechanisms based on a reinterpretation of otolithic impulses are discussed. Due to the difficulty in producing ground-based simulations of the effects of microgravity on the vestibular system, in-flight data such as that obtained aboard Spacelab 1 are necessary to determine causal mechanisms of space sickness. It is suggested that detection and prevention of space sickness will involve a better understanding of the neurohumoral mechanisms responsible for the apparent neurovegetative symptoms of this condition. R.R.

A88-23529

BONE CHANGES IN MICROGRAVITY [MODIFICATIONS OSSEUSES EN MICROGRAVITE]

M. C. NOGUES (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 120-123. In French. refs

Bone demineralization in weightlessness and the long term evolution of such osteoporosis are considered. Calcium losses of 3.2-8.3 percent were found aboard the three-month flight of Gazenko 4 despite the use of prophylactic measures. The use of animals both in-flight and on the ground provides a means of studying the mechanisms responsible for the disorders noted in phosphocalcium metabolism. Results obtained on bone samples support the idea that cell decoupling remodels bones to adapt their structure to the applied forces. R.R.

A88-23530

EXPERIMENTAL MODELS IN SPACE PHYSIOLOGY (EXCLUDING MATHEMATICAL MODELS) [MODELES EXPERIMENTAUX EN PHYSIOLOGIE SPATIALE (MODELES MATHEMATIQUES EXCLUS)]

CLAUDE MILHAUD and DIDIER LAGARDE (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 124-129. In French. refs

Various ground-based methods of microgravity simulation for the study of the physiopathological effects of microgravity are evaluated, and the need for animal experimentation is emphasized. Due to their short durations, ground-based techniques for inducing microgravity have only limited application to the study of physiopathological effects. Other methods such as bed rest and liquid immersion simulate only small aspects of microgravity. It is noted that ground-based animal studies may suffer similar limitations to those performed on humans. The in-flight testing of rats and primates is also considered. R.R.

A88-23531

EXTRATERRESTRIAL RADIATION AND SPACE EXPLORATIONS. III [RAYONNEMENTS EXTRATERRESTRES ET EXPLORATIONS SPATIALES. III]

R. P. DELAHAYE (Inspection du Service de Sante pour l'Armee de l'Air, Paris, France) and P. J. METGES (Hopital d'Instruction des Armees Begin, Saint-Mande, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 133-137. In French. refs

Dosages of radiation experienced during manned space flights are discussed, and in-flight measurements are compared with predictions. Exposures for flights lasting less than 15 days (including Gemini, Mercury, Vostok, and Voskhod) are less than 200 millirads. It is noted that most of the 114 manned flights prior to 1986 occurred without significant exposure to radiation due to solar eruptions. Apollo 14 radiation dosages were the highest of all the Apollo flights, due, in part, to the crossing of the Van Allen belt. A dosage of 50 rem has been recorded for a recent 12-month Soviet flight, a value high enough to produce significant after-effects. R.R.

A88-23532

CONTINUOUS ELECTROCARDIOGRAPHIC MONITORING OF DIFFERENT PILOT CATEGORIES - COMPARISON OF OBSERVED HEART RATES [ENREGISTREMENT ELECTROCARDIOGRAPHIQUE CONTINU CHEZ DIFFERENTES CATEGORIES DE PILOTES - COMPARAISON DES FREQUENCES CARDIAQUES OBSERVEES]

A. SEIGNEURIC, G. LEGUAY, P. QUANDIEU, J. P. BURLATON, and J. P. GOURBAT (Hopital d'Instruction des Armees Dominique Larrey, Versailles; Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 138-140, 143-145. In French. refs

Results for 24 hours of continuous EKG monitoring of three groups of pilots are presented. In flight, transport pilots showed the lowest heart rates. Although little overall difference is found between the experienced and unexperienced combat pilots, the experienced pilots showed a higher maximum heart rate, and the unexperienced pilots showed higher minimum and median values. The relationship between heart rate and sinusal activity is explored, and it is suggested that the autonomic nervous system plays a critical role in adaptation of the sinus activity to flight. R.R.

A88-23533

EVALUATION OF AERONAUTICAL WORKLOAD. II [EVALUATION DE LA CHARGE DE TRAVAIL EN AERONAUTIQUE. II]

G. SANTUCCI (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 146-152. In French. refs

Various methods for the assessment of workload are examined with application to pilot safety. The SWAT method is based on the evaluation of parameters including the work time, the mental

effort, and the degree of nervous tension. The limitations of cardiovascular and respiratory indices for workload evaluation are pointed out. Indices of cerebral functioning are discussed such as the direct observation of encephalic activity and peripheral indicators including ocular movement, eyelid blinking, and pupil diameter. It is noted that the task of workload assessment is complicated by the difficulty of evaluating the degree of mental work. R.R.

A88-23534

CORRELATION BETWEEN CHOLESTEROL AND ITS COMPONENTS, AND THE AEROBIC CAPACITY AND WEIGHT OF YOUNG PILOTS IN THE BELGIAN AIR FORCE [CORRELATION ENTRE LE CHOLESTEROL ET SES COMPOSANTS ET LA CAPACITE AEROBIE ET LE POIDS DES JEUNES PILOTES DE LA FORCE AERIENNE BELGE]

G. PIRQUIN, P. VANDENBOSCH, and J. VASTESAEGER (Force Aerieenne, Centre Medical, Brussels, Belgium) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 153-156. In French. refs

A88-23535

EPILEPSY AND AERONAUTICS - RECENT RESEARCH [EPILEPSIE ET AERONAUTIQUE - QUELQUES ASPECTS ACTUELS]

G. SOLIGNAC (Centre Principal d'Expertise Medecale du Personnel Navigant, Paris, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 157-160. In French.

Means of determining a predisposition for epileptic fits amongst adults are discussed, with application to the selection of navigation personnel. Emphasis is placed on the use of EEG data to determine such indicators as the extent of cranial trauma. In some cases, pulsed light stimulation is found to induce the classical photoparoxysmal reactions in epileptics only after sleep deprivation. Aeronautical stresses which can induce epileptic fits include pulsed light stimulation encountered in flight (such as the rhythmic light variation caused by helicopter rotor blades), hyperventilation, and insomnia resulting from time zone changes. R.R.

A88-23695

HYPERHYDRATION WITH GLYCEROL SOLUTIONS

M. L. RIEDESEL, D. Y. ALLEN, G. T. PEAKE, and K. AL-QATTAN (New Mexico, University, Albuquerque) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2262-2268. Research supported by the University of New Mexico and USAF. refs

(Contract NIH-5-M01-RR-00997-10)

Glycerol was tested as an agent to promote hyperhydration of male and female subjects. Series I experiments involved ingesting 0.5, 1.0, or 1.5 g glycerol/kg body wt and, within 40 min, drinking 0.1 percent NaCl, 21.4 ml/kg. In series II, 1.0 g glycerol/kg body wt was ingested at time 0, and 25.7 ml/kg of 0.1 percent NaCl was ingested over a 3.5-h period. Experiments were of 4-h duration and included controls without glycerol as each subject served as his/her control. Blood samples were taken at 40- or 60-min intervals for hemoglobin (Hb), hematocrit (Hct), plasma osmolality, glycerol, and multiple blood chemistry analyses. Urine was collected at 60-min intervals. Glycerol ingestion increased plasma osmolality for 2 h and reduced the total 4-h urine volume. There were no significant changes in Hb or Hct as a result of the glycerol or excess fluid intake. This study demonstrates that glycerol plus excess fluid intake can produce hyperhydration for at least 4 h. Author

A88-23696

ROLE OF OXYGEN IN THE PRODUCTION OF HUMAN DECOMPRESSION SICKNESS

P. K. WEATHERSBY, B. L. HART, E. T. FLYNN, and W. F. WALKER (U.S. Navy, Naval Medical Research Institute, Bethesda, MD) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2380-2387. Navy-supported research. refs

The contribution of O₂ to the risk of decompression sickness (DCS) was assessed in a trial of 477 human exposures under

conditions of N₂-O₂ diving (at 10 to 40 percent of O₂, for 30-, 60-, and 240-min duration) with immediate return to the surface (i.e., no-decompression dives). Only 11 cases of DCS and 18 cases of marginal symptoms were recorded despite exceeding the presently accepted no-decompression limits by more than 20 percent. Analysis by maximum likelihood showed a shallow dose-response curve for increasing depth. It is concluded that O₂ has no influence on DCS risk. I.S.

A88-23698**CENTRAL VENOUS PRESSURE IN HUMANS DURING SHORT PERIODS OF WEIGHTLESSNESS**

PETER NORSK, NIELS FOLDAGER, FLEMMING BONDE-PETERSEN, BENNY ELMANN-LARSEN, and TORBEN STAEHR JOHANSEN (Rigshospitalet, Copenhagen; Royal Danish Air Force, Vaerloese, Denmark) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 63, Dec. 1987, p. 2433-2437. Research supported by the Danish Space Board. refs

Changes in the central venous pressure (CVP) caused by variations in Gz during a parabolic flight which resulted in 23 s of weightlessness (free fall) and either 60 or 120 s of +2 Gz were measured in 14 male subjects aboard a Gulfstream-3 jet. The CVP measurements (performed using central venous catheters and strain-gauge pressure transducers) were compared with values obtained in flight at 1 G with the subjects in the supine (+Gx) or upright sitting (+Gz) positions; CVP values for these positions were found to be about 5.0 and 2.6 mm Hg, respectively. During weightlessness, CVP was found to increase significantly (to about 6.8 mm Hg) as compared with the upright sitting in flight, whereas during +2 Gz, CVP was only 2.8 mm Hg. Heart rate (measured in six subjects) increased from about 70 beats/min at upright sitting to 79 beats/min during weightlessness and to 80 beats/min during +2 Gz. I.S.

A88-23970**THE EFFECT OF VESTIBULAR VEGETATIVE DISTURBANCES DURING HYPOKINESIA ON REGIONAL HEMODYNAMICS [VLIIANIE VESTIBULOVEGETATIVNYKH RASSTROISTV V USLOVIAKH GIPOKINEZII NA REGIONARNIUI GEMODINAMIKU]**

E. V. LAPAEV, V. S. BEDNENKO, O. A. VOROB'EV, I. N. ARTAMONOV, and V. V. ZARITSKII (Akademiia Nauk SSSR, Iztvestia, Seria Biologicheskaiia (ISSN 0002-3329), Nov.-Dec. 1987, p. 805-813. In Russian. refs

This paper investigates the effect of simultaneous exposure to antiorthostatic hypokinesia (ANOH), Coriolis acceleration (CA), and optokinetic stimulation on the dynamics of blood flow rate in the major vessels of the head region; the contents of blood and liquid media in lung tissues; and the sizes of the right cardiac ventricle, liver, kidneys, and spleen. Electrocardiograms and echograms were obtained for twelve healthy human subjects lying on a stand specially designed (Lapaev et al., 1984) for vestibulomotor studies, which made it possible to expose the supinely positioned subjects to the effects of the ANOH, CA, and optokinetic stimuli. The simultaneous exposure of the subjects to the three vestibular stimuli was found to cause a decrease of blood flow to the head, a decrease of the blood contents in the right ventricle and liver (measured by the decreased sizes of these organs), and small increases in the fluid contents of lung and spleen. I.S.

A88-24073**SLEEPINESS IN SHIFTWORK - A REVIEW WITH EMPHASIS ON CONTINUOUS MONITORING OF EEG AND EOG**

TORBJORN AKERSTEDT (National Institute of Psychosocial Factors and Health; Karolinska Institutet, Stockholm, Sweden), LARS TORSVALL (National Institute of Psychosocial Factors and Health, Stockholm, Sweden), and MATS GILLBERG (Forsvarets Forskningsanstalt, Stockholm, Sweden) *Chronobiology International* (ISSN 0742-0528), vol. 4, no. 2, 1987, p. 129-140. refs

Many forms of shiftwork disrupt the normal relation between rest/activity and the circadian regulation of bodily functions. Among the most obvious effects of this disruption is disturbed sleep and

increased sleepiness. Here, the effect of shiftwork on sleepiness is discussed. Much of the data in this area consist of self-ratings, but emphasis will be on some recent approaches that have made use of EEG methods to provide continuous monitoring of fluctuations of sleepiness in freely moving subjects. Author

A88-24074**CIRCADIAN RHYTHM IN THE MEMBRANE OF CIRCULATING HUMAN BLOOD CELLS: MICROVISCOSITY AND NUMBER OF BENZODIAZEPINE BINDING SITES - A SEARCH FOR REGULATION BY PLASMA IONS, NUCLEOSIDES, PROTEINS OR HORMONES**

FRANCIS LEVI (CNRS; Fondation Adolphe de Rothschild, Paris, France), JESUS BENAVIDES, DOMINIQUE QUARTERONET, THIERRY CANTON (Rhone-Poulenc Sante, Gennevilliers, France), YVAN TOUITOU (Paris VI, Universite, France) et al. *Chronobiology International* (ISSN 0742-0528), vol. 4, no. 2, 1987, p. 235-243. refs

A88-24075**LIGHT AND MELATONIN AS ZEITGEBERS IN MAN**

JOSEPHINE ARENDT (Surrey, University, Guildford, England) and JAMES BROADWAY (British Antarctic Survey, Cambridge, England) *Chronobiology International* (ISSN 0742-0528), vol. 4, no. 2, 1987, p. 273-282. refs

The interrelation between two zeitgebers, bright light and the melatonin secretion, is discussed. It is shown that bright light, suitably applied to give an artificial long-photoperiod in winter, will provoke a phase shift in the melatonin secretion rhythm to a position characteristic of summer, indicating that light is not only a circadian zeitgeber, but also a strong circannual zeitgeber. It is also demonstrated that, in man, the 'darkness hormone' melatonin is also a zeitgeber. Given chronically in small doses in the late afternoon, melatonin exhibited effects indicating its ability to entrain the fatigue-alertness rhythm. Using a carefully timed protocol of administration, melatonin was shown to alleviate the jet-lag effects of disturbed sleep following eastward flight over eight time zones. I.S.

A88-24234**RED CELL AGGREGATION IN CARDIOVASCULAR DISEASES AND CRUCIAL ROLE OF INVERSION PHENOMENON**

LEOPOLD DINTENFASS (Sydney, University; Rachel Foster Hospital, Australia) *Angiology* (ISSN 0003-3197), vol. 36, May 1985, p. 315-326. refs

The red cell aggregation rate and the morphology of aggregates were studied in normal humans and in patients with cardiovascular diseases, using an analogue of capillary system constructed by using in vitro flow of blood from the heart in a slit-capillary photoviscometer described by Dintenfass et al. (1981). It was found that, in patients with myocardial infarction and with macrobubulinemia, not only the rate of red cell aggregation and the morphology of aggregates, but the size of aggregates differed drastically from the controls (from few cells only in controls to aggregates containing 20,000 or more cells). Normal donors exhibited aggregates formed basically of rouleaux, whereas patients with cardiovascular diseases exhibited the formation of sludge-like aggregates. A possible role of the sludge-like aggregates in the arterial spasm or in capillary occlusion is discussed from the viewpoint of the 'inversion phenomenon', described by Dintenfass (1967, 1968) as a dramatic increase in the viscosity of blood and in the resistance to flow below a certain critical capillary radius. I.S.

A88-24502#**RELATIONSHIP BETWEEN NUMBER AND VOLUME OF DYSBARIC BUBBLES CONCERNED WITH DECOMPRESSION SICKNESS**

YOSHIHIRO MANO (Tokyo Medical and Dental University, Japan), YUKIO MATSUI (Saga Medical School, Japan), and AKIO HYUGAJI (Mitsui Tohatsu Chemical, Inc., Div. of Analysis, Kanagawa, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 24, Sept. 1987, p. 63-74. refs

The relationship between the number and volume of air bubbles appearing after decompression was experimentally evaluated using agarose gel as a model for bubble formation. The density of the gel and the mean volume of bubbles formed in the gel were determined after exposure to pressures ranging from 1 to 5 kg/sq cm. Linear regression analysis was used to obtain an expression relating the mean volume and number of bubbles. The result should contribute to understanding the mechanism of bubble formation in decompression sickness (DCS) and to the prevention of DCS.

C.D.

A88-24504#**EFFECT OF FLUID REPLACEMENT ON RESPONSES OF ANGIOTENSIN II AND ALDOSTERONE TO A PHYSICAL ACTIVITY IN HEAT**

MASATO SUZUKI, MASATOSHI SHIOTA, and SACHIO IKAWA (Jikei University, Tokyo, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 24, Sept. 1987, p. 81-93. In Japanese, with abstract in English. refs

A study was carried out on five healthy, non-heat-acclimated male volunteers with a mean age of 29.2 years to investigate their angiotensin II (pAng II) and aldosterone (pAld) responses to physical exercise in a hot environment and to assess the effect of commercial sports beverage replacement during the recovery period on diastolic blood pressure (DBP) and water-electrolyte balance. Significant decreases in percent plasma volume and DBP and significant increases in serum Na(+) concentration and osmolality were observed when the subjects consumed no fluid, and a significant elevation of pAng II and pAld concentration was maintained until 120 min after exercise without fluid replacement. The DBP recovered to the initial level by 30 min after sports beverage replacement, and a slight increase in DBP was maintained thereafter.

C.D.

A88-24535**G-INDUCED LOSS OF CONSCIOUSNESS - DEFINITION, HISTORY, CURRENT STATUS**

RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 2-5. refs

The history of the occurrence of the G-induced loss of consciousness (G-LOC), its recognition as an operational hazard, and the measures used to prevent its onset are discussed. G-LOC is defined as 'a state of altered perception wherein the awareness of reality is absent as a result of a sudden critical reduction of cerebral blood circulation caused by increased G-force'. While the invention of the pneumatic anti-G suit reduced initial concern about G-LOC, a 1984 survey of pilots of high-performance aircraft has shown G-LOC to be the probable cause of aircraft mishaps for a number of years. In this paper, special consideration is given to the physiological phenomena connected with G-LOC and to various approaches used presently to reduce the occurrence of G-LOC and to reduce its hazard.

I.S.

A88-24536**A NEW LOOK AT THE LOSS OF CONSCIOUSNESS EXPERIENCE WITHIN THE U.S. NAVAL FORCES**

DAVID C. JOHANSON and HAROLD T. PHEENY (U.S. Navy, Naval Air Systems Command, Washington, DC) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 6-8. refs

Two surveys on the incidence of G-induced loss of consciousness (G-LOC) in U.S. Navy aircraft have been completed. Questionnaires returned (981) indicated an incidence rate of 12.2

percent in the first survey. A slightly higher incidence rate was found in the second survey based on the 2459 questionnaires returned. Results indicated that G-LOC is a significant problem in naval aviation in older as well as newer generation aircraft. Age, height, and weight of respondents did not appear to be related to incidence of G-LOC. Results indicated a need for improvement in the anti-G protective system and its use. Different forms of physical fitness training may differentially influence G-tolerance. Author

A88-24537**CONVERGING RESEARCH ON +GZ-INDUCED LOSS OF CONSCIOUSNESS**

JAMES E. WHINNERY (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 9-11. refs

The G-induced loss of consciousness (G-LOC) hazard can be reduced either by preventing its occurrence or shortening the period of incapacitation. The latter requires an understanding of this period of incapacitation. Two types of G-LOC occur: Type I is short duration and without convulsive type movements; and Type II is longer and with convulsions. Psychological suppression (denial) by pilots that G-LOC had occurred appears to be an important problem in reporting surveys and flying safety. Auditory and visual types of sensory stimuli to reduce the period of incapacitation are discussed. Recognition by the pilot that G-LOC has occurred appears to decrease incapacitation times and should be considered part of G training. Methods of developing an aircraft recovery system after G-LOC has occurred in pilots is considered a viable approach and is examined. Converging on the G-LOC problem by both reducing its incidence, as well as its duration, appears to offer an additional dimension in the approach towards solving this important operational problem.

Author

A88-24543* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

LEG VASCULAR RESPONSIVENESS DURING ACUTE ORTHOSTASIS FOLLOWING SIMULATED WEIGHTLESSNESS

CYNTHIA A. BLAMICK, DANIELLE GOLDWATER, and VICTOR A. CONVERTINO (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL; NASA, Ames Research Center, Moffett Field, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 40-43. refs (Contract NCA2-OR-745-911)

The effect of weightlessness on vascular response to orthostatic stress was investigated in human subjects by measuring changes in the arterial pulse volume (APV) of the legs during exposure to lower body negative pressure (LBPN) applied before and after 10 days of continuous 6-deg head-down bed rest. Heart rate, mean arterial blood pressure (MAP), and impedance rheographic indices of APV were measured during rest and at 1 min of -30 mm Hg LBPN. Bed rest was found not to alter the responses of MAP to LBPN. Resting APV was decreased after bed rest; however, APV was reduced upon transfer from rest to 1-min LBPN by the same relative magnitude before and after bedrest. It is concluded that peripheral arterial vasoconstriction, as indicated by reduction in APV during LBPN, is not affected by bedrest. The results suggest that there was no apparent alteration in responsiveness of the leg vasculature following simulated weightlessness, and that the control mechanisms of peripheral resistance do not contribute significantly to reduced orthostatic tolerance following spaceflight.

I.S.

A88-24546**OPTIMUM SAMPLING TIMES FOR MAXIMUM BLOOD LACTATE LEVELS AFTER EXPOSURES TO SUSTAINED +GZ**

A. TAMIR, R. R. BURTON, and E. M. FORSTER (USAF, School of Aerospace Medicine, Brooks AFB; Texas and Rothe Development, Inc., San Antonio, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 54-56. refs

Six male subjects wearing anti-G suits were exposed to +4.5 Gz and +4.5-7 Gz simulated aerial combat maneuvers (SACM), sustained until terminated because of fatigue. Before and after

each G exposure, venous blood was withdrawn (using the finger-prick method) and analyzed for lactate concentration. Five samples were taken serially, at 1,3,6,10, and 20 min after each G exposure, to determine the peak level of blood lactate. Individual lactate levels varied, with peaks at 1,3, and 6 min; however, group levels were maximum at 3 min after the G exposure. Maximum lactate levels (mean \pm or - S.D.) of 27.8 \pm or - 11.3 mg percent and 42.7 \pm or - 19.4 mg percent were found for the 4.5-G and SACM exposures, respectively. Lactate recoveries were a simple exponential function, with a half life of approximately 10 min. The relationship between these data, following G exposure, and those measured after aerobic physical activities, is discussed. Author

A88-24547**NONINVASIVE ASSESSMENT OF CARDIAC PERFORMANCE BY IMPEDANCE CARDIOGRAPHY - DISAGREEMENT BETWEEN TWO EQUATIONS TO ESTIMATE STROKE VOLUME**

C. DE MEY and D. ENTERLING (SK & F-Institute for Applied Clinical Pharmacology, Goettingen, Federal Republic of Germany) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 57-62. refs

Impedance cardiography, phonocardiography, and ECG were registered prior to, during, and after 10 min of gradual passive upright tilt in 35 normal male subjects. Stroke volume (SV) was estimated according to both the standard equation of Kubicek et al. (1966, 1967) and a newly introduced equation by Sramek et al. (1981). Sramek's equation estimated larger SV values throughout. It furthermore estimated a larger SV response to upright tilt; a bias of -17 ml was identified for Sramek's minus Kubicek's approach. Corresponding disagreement was identified for cardiac output and systemic vascular resistance derived from SV. A far better agreement was identified when the data were expressed as percent of the supine base line prior to tilt. Under such transformation, Sramek's approach estimated slightly smaller SV responses to tilt; a bias of 4.2 percent was identified for the percent response of SV to upright tilt for Sramek's minus Kubicek's equation. Data generated by these two equations are, nevertheless, not readily interchangeable nor comparable. As Sramek's equation estimated consistently larger SV values than Kubicek's equation, it is unlikely that Sramek's equation could solve the issue of the quantitative inaccuracy which remains intrinsic to the usage of Kubicek's equation in impedance cardiography. Author

A88-24548* Stanford Univ., Calif.**DIFFERENTIATION OF MUSCARINIC CHOLINERGIC RECEPTOR SUBTYPES IN HUMAN CORTEX AND PONS - IMPLICATIONS FOR ANTI-MOTION SICKNESS THERAPY**

BRUCE G. MCCARTHY and STEPHEN J. PEROUTKA (Stanford University, Medical Center, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 63-66. Research supported by the John A. Hartford Foundation and Alfred P. Sloan Foundation. refs
(Contract NCA2-IR-745-504)

Radioligand binding studies were used to analyze muscarinic cholinergic receptor subtypes in human cortex and pons. Muscarinic cholinergic receptors were labeled by H-3-quinuclidinyl benzilate (H-3-QNB). Scopolamine was equipotent in both brain regions and did not discriminate subtypes of H-3-QNB binding. By contrast, the M1 selective antagonist pirenzepine was approximately 33-fold more potent in human cortex than pons. Carbachol, a putative M2 selective agonist, was more than 100-fold more potent in human pons than cortex. These results demonstrate that the human pons contains a relatively large proportion of carbachol-sensitive muscarinic cholinergic receptors. Drugs targeted to this subpopulation of muscarinic cholinergic receptors may prove to be effective anti-motion sickness agents with less side effects than scopolamine. Author

N88-15382# Army Research Inst. of Environmental Medicine, Natick, Mass.

ASSESSMENT OF PHYSICAL ACTIVITY INTENSITY BY HEART RATE DURING SLEEP LIMITED MILITARY OPERATIONS

ROBERT P. MELLO, JAMES A. VOGEL, JOHN F. PATTON, III, and BRUCE H. JONES 1987 20 p
(AD-A185913) Avail: NTIS HC A03/MF A01 CSCL 06D

This study estimated the intensity of physical activity of infantrymen by means of continuous heart rate (HR) recordings during a combat-simulated 5-day field operation. Subjects rotated daily through 4 different combat-simulated field maneuver areas and repeated the first day's schedule on the fifth day. Soldiers slept approximately 5 hours per night and physical activity was monitored by taping HR with Oxford-Medilog cassette recorders. Daily HR (excluding sleep and resupply time) decreased to a mean of 101 beats per min (bpm) on day one to a mean of 89 bpm on day five. A 10 km road march proved to be the single most demanding event. It is suggested that: (1) continuous cassette HR recording is a suitable method of monitoring the intensity of physical activity during strenuous field conditions; (2) sustained high physical intensity is minimal in infantrymen during extended field operations; (3) this intensity of activity is adequately supported by an aerobic capacity of 50 ml O₂/kg. min.; (4) the highest sustained HR is produced by marches or movements to contact; and (5) the physical fatigue and diminished sleep of combat operations may force infantrymen to perform at a slower rate regardless of operational demands as the exercise progresses.

GRA

N88-15383# Boston Univ., Mass. School of Medicine.

POLYCYTHEMIA AND HYDRATION STATUS: EFFECTS ON BLOOD VOLUME AND THERMOREGULATION DURING EXERCISE-HEAT STRESS

MICHAEL N. SAWKA, RICHARD R. GONZALEZ, ANDREW J. YOUNG, STEPHEN R. MUZA, and KENT B. PANDOLF Jul. 1987 30 p

(Contract N00014-79-C-0168; DA PROJ. 3E1-62777-A-879)
(AD-A185946; AD-F000114) Avail: NTIS HC A03/MF A01 CSCL 06J

We studied the effects of autologous erythrocyte reinfusion on blood volume and thermoregulation during exercise in the heat. Five heat-acclimated males attempted four Heat Stress Tests (HSTs): two pre- and two post-reinfusion. Autologous erythrocyte reinfusion was accomplished with 500 ml of a NaCl-glucose-phosphate solution containing about 60% hematocrit. Both pre- and post-reinfusion on a HST were done while euhydrated and one HST was done while hypohydrated (-5% of body weight). After 30 min of rest in a 20 C antechamber, the HST consisted of a 120-min exposure (2 repeats of 15 min rest and 45 min walking) in a hot (35 deg C, 45%rh) environment. The following new findings were made concerning acute polycythemia in heat-acclimated subjects: (1) the increased erythrocyte volume was associated with a small plasma volume expansion; (2) the plasma volume expansion was associated with an increased total circulating protein mass; (3) the increased total circulating protein mass defends plasma volume when hypohydrated; (4) polycythemia increased sweating rate and reduced core temperature during exercise-heat stress; and (5) this thermoregulatory advantage conferred by acute polycythemia was effective even during hypohydration. GRA

N88-15384# Naval Health Research Center, San Diego, Calif.

COMPUTER RESPONSE TIME MEASUREMENTS OF MOOD, FATIGUE AND SYMPTOM SCALE ITEMS: IMPLICATIONS FOR SCALE RESPONSE TIME USES Interim Report

DAVID H. RYMAN, PAUL NAITOH, CARL ENGLUND, and S. G. GENSER 27 Feb. 1987 26 p

(AD-A186093; NHRC-87-20) Avail: NTIS HC A03/MF A01 CSCL 05H

Response times (RT) in a series of computer-administered questionnaires were collected in two continuous operation time-shifted studies to evaluate how useful these measures might be in various research areas. These studies involved exercising

and non-exercising subjects at two start-of-day times (noon, midnight). Thirty subjects were tested over two continuous workdays (CW1 and CW2) of 20 hrs each with three hr nap allowed between days. The scales analyzed were the Vigor and Fatigue Scales of the Profile of Mood States (POMS), the Kogi Symptom Checklist, the School of Aerospace Medicine (SAM) Fatigue Scale, and the Naval Health Research Center Mood Questionnaire (NHRC MQ) Negative and Positive Mood Scales. The results demonstrate the RT measurement of questionnaire scales can be used as a measure of intensity and congruence of mood, as well as indicating scale validity. RT alone was not useful for indicating hasty responders (straight liners), but subjects using a constant scale response value were significantly faster (lower RT). The POMS Fatigue scale and RT were significantly correlated on both days indicating the usefulness of RT in showing scale validity (the more fatigue, the slower the response). GRA

N88-15385# Harvard Medical School, Boston, Mass. Dept. of Physiology and Biophysics.

PHARMACOLOGICAL RESETTING OF THE CIRCADIAN SLEEP-WAKE CYCLE Annual Technical Report, 1 May 1986 - 30 Apr. 1987

MARTIN C. MOORE-EDE 30 May 1987 6 p

(Contract AF-AFOSR-0187-86)

(AD-A186194; AFOSR-87-1360TR) Avail: NTIS HC A02/MF A01 CSCL 06O

This research project is investigating strategies to pharmacologically manipulate the circadian sleep-wake cycle in order to control the timing of alert function and of sleep in altered work schedule environments. In the past year we have investigated the benzodiazepines, diazepam (in hamsters) and triazolam (in squirrel monkeys), and have derived a phase response curve for each. In optically-enucleated hamsters, however, consistent phase shifts were not obtained suggesting that diazepam acts on light information-conveying pathways. Biochemical receptor binding studies are defining the benzodiazepine receptor density in various brain regions. In addition, the characterization of the circadian and homeostatic components of sleep in the squirrel monkey during sleep deprivation studies is being conducted in preparation for pharmacological manipulation with benzodiazepines. GRA

N88-15386# Army Research Inst. of Environmental Medicine, Natick, Mass.

LOAD CARRIAGE INDUCED ALTERATIONS OF PULMONARY FUNCTION

S. R. MUZA, W. A. LATZKA, Y. EPSTEIN, and K. B. PANDOLF May 1987 25 p

(AD-A186227) Avail: NTIS HC A03/MF A01 CSCL 06J

Load carriage systems supported by the trunk have been shown to decrease certain indices of pulmonary function. We investigated the hypothesis that these pulmonary function reductions are directly related to the backpack load carried due to the mechanical constraint it imposes of the thoracic cage. To investigate this hypothesis, 5 young males with no pulmonary disorders were tested while standing upright carrying well-fitted 0, 10 or 30 kg loaded U.S. Army ALICE backpacks. Forced vital capacity (FVC), forced expiratory volume (FEV1) and 15 s maximal voluntary ventilation (MVV15) were measured. With increasing load, FVC and FEV1 progressively decreased reaching 6 and 6.7 percent decrements respectively with 30 kg load. The MVV15 was decreased about 8.4 percent with the 10 kg load, but did not demonstrate any further decrement with the 30 kg load. Analysis of flow-volume loops obtained with the 0 and 30 kg loads showed that the reduction of FVC was not associated with any decrement of peak inspiratory or expiratory flows. These results indicate a limitation of the ventilatory pump caused by load carriage which is directly related to the load carried and characteristic of restrictive diseases of the respiratory system. GRA

N88-15387# California Univ., Los Angeles.

MEASUREMENT AND MODIFICATION OF SENSORIMOTOR SYSTEM FUNCTION DURING VISUAL-MOTOR PERFORMANCE

Final Report, 30 Sep. 1982 - 29 Jun. 1987

M. B. STERMAN, G. J. SCHUMMER, T. W. DUSHENKO, and J. C. SMITH 21 Aug. 1987 17 p

(Contract AF-AFOSR-0335-82)

(AD-A186351; AFOSR-87-1366TR) Avail: NTIS HC A03/MF A01 CSCL 05H

Both laboratory and in-flight studies were carried out in order to evaluate the utility and feasibility of EEG monitoring as a means of identifying central nervous system correlates of performance and G-force effects during military flight operations. Four studies were conducted, two with controlled laboratory simulation, and two in actual flight during military training missions. Data analysis focused on EEG power-spectral density characteristics and their temporal modulation, specifically in sensorimotor and visual cortical areas. Several consistent findings emerged. During competent performance, a unique discrepancy appeared between left and right hemispheres in central 8-15 Hz activity. This pattern disappeared as performance degraded. The temporal modulation of this activity also reflected these changes. During high G-force situations, power at frequencies below 8 Hz was progressively and non-specifically enhanced. Continued competent performance, however, was still reflected by the pattern described above. These findings are discussed in terms of their neurophysiological implications. GRA

N88-15388# Boston Univ., Mass. School of Medicine.

DEVELOPMENT AND APPLICATIONS OF NEW TECHNICAL ADVANCES TO PROBLEMS OF FLUID/ELECTROLYTE/MINERAL IMBALANCE IN MILITARY PERSONNEL Final Report, 1 Jul. 1985 - 1 Jan. 1987

MORTEZA JANGHORBANI Apr. 1987 51 p

(Contract DAMD17-85-G-5036; DA PROJ. 3E1-62777-A-879)

(AD-A186437) Avail: NTIS HC A04/MF A01 CSCL 06D

This constitutes the final report for the period 7/1/85 through 1/1/87 in the studies related to methods development for stable isotope tracers in heat research. Four segments have been described in this final report: (1) acquisition, installation, and testing of a two-analyzer system for measurement of stable isotopes, (2) development work related to stable isotopes of rubidium, (3) development of measurement aspects of stable isotopes of bromine, and (4) completion of analytical chemistry for stable isotopes of lithium. GRA

N88-15389# Joint Publications Research Service, Arlington, Va. **JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 3, MAY - JUNE 1987**

O. G. GAZENKO, ed. 12 Jan. 1988 151 p Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 96 p (JPRS-USB-88-001) Avail: NTIS HC A08/MF A01

Translations of articles from the Russian journal, Space Biology and Aerospace Medicine are presented. Typical article titles are: Trace element metabolism in man and animals in the presence of hypoxic states of diverse etiology; Cardiac contractility in weightlessness according to spatial ballistocardiography; Blood redistribution in man with lower body negative pressure; Nystagmometric distinctions of individual regularly exposed to vibration; Spleen lymphocyte nucleic acids in pregnant rats flown in space and their offspring; and Role of hemoglobin affinity for oxygen in efficiency of blood respiratory function.

N88-15390# Joint Publications Research Service, Arlington, Va.
TRACE-ELEMENT METABOLISM IN MAN AND ANIMALS IN THE PRESENCE OF HYPOXIC STATES OF DIVERSE ETIOLOGY

V. V. NASOLODIN and V. YA. RUSIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 9-18 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 10-16

Avail: NTIS HC A08/MF A01

Reported data and results obtained by the authors which describe metabolic pathways of trace elements in humans and animals during hypoxia of different origin are reviewed. Possible causes and symptoms of their deficiency are discussed and methods of restoring the balance of trace elements are presented. Author

N88-15391# Joint Publications Research Service, Arlington, Va.
PHYSIOLOGICAL AND BIOCHEMICAL ASPECTS OF TOXIC EFFECTS OF OXIDANTS IN MAN'S ENVIRONMENT (AIR, WATER)

Z. P. PAK and G. V. LOBACHEVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 19-31 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 16-23

Avail: NTIS HC A08/MF A01

A review is given of published data about physiological and biochemical aspects of the toxic effect of oxygen, ozone, hydrogen peroxide, nitrogen oxide and haloid containing disinfectants on the human body. The mechanism of action of various oxidants in terms of free radical reactions is analyzed. The oxidant sensitivity of membrane structures, sulfhydryl compounds, proteins, enzymes and the genetic apparatus of the cell is evaluated. The effect of oxidants on the function and structure of erythrocytes, red marrow, blood coagulation, immunity, histological and histochemical structure of organs and tissues is described. Author

N88-15393# Joint Publications Research Service, Arlington, Va.
CARDIAC CONTRACTILITY IN WEIGHTLESSNESS ACCORDING TO SPATIAL BALLISTOCARDIOGRAPHY

R. M. BAYEVSKIY, P. S. CHATTARJEE, I. I. FUNTOVA, and M. D. ZAKATOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 37-44 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 26-31

Avail: NTIS HC A08/MF A01

In the joint Soviet-Indian space flight, the method of spatial ballistocardiography was used to investigate the cardiac function in flight. The piezoelectric transducer was placed between the scapulae and its orientation was varied relative to the three axes of the body. Measurements were taken twice before, twice during and twice after flight. Ballistocardiograms were analyzed in terms of their amplitude, time and spectral parameters. It was found that in microgravity the energy of cardiac contractions developed spatial redistribution. It was also demonstrated that the cardiovascular function showed individual variability. Author

N88-15394# Joint Publications Research Service, Arlington, Va.
COSMONAUTS' HORMONAL RESPONSES AFTER BRIEF SPACEFLIGHTS

R. A. TIGRANYAN, N. F. KALITA, T. A. KISELEVA, V. M. IVANOV, YE. V. KOLCHINA, and B. V. AFONIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 45-49 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 32-35

Avail: NTIS HC A08/MF A01

After short term (7 day) space flights the following parameters were measured in blood of cosmonauts: cortisol, ACTH, aldosterone, thyrotropic hormone, thyroxine, thiodothyronine, somatotrophic hormones, insulin, testosterone, cyclic nucleotides, prostaglandins, activities of the kallikrein kinin, fibrinolytic and coagulatory systems, and plasma renin activity; in addition, renal excretion of aldosterone and total 17 oxycorticosteroids was determined. It was demonstrated that after short term flights the acute period of adaptation was accompanied by a moderate activation of the renin angiotensin aldosterone system, adrenal glucocorticoid function, pancreatic insular apparatus, kallikrein kinin system as well as increased cyclic AMP which is suggestive of a moderately expressed stress reaction. Author

N88-15395# Joint Publications Research Service, Arlington, Va.
HUMAN AND ANIMAL HYPOVOLEMIC REACTIONS TO INCREASING +GZ ACCELERATIONS

R. A. VARTBARONOV, G. D. GLOD, N. N. UGLOVA, and I. S. ROLIK *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 50-55 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 35-39

Avail: NTIS HC A08/MF A01

Maximal variations of the circulating blood and plasma volumes after water load and/or exposure to increasing +Gz were investigated in manned and animal studies. The animal study demonstrated that the relative changes in the circulating blood and plasma volumes can be calculated using hematocrit or hemoglobin values. On the 2d minute after exposure to increasing +Gz of up to 14.5 G the animals showed a decrease (by 11.7 percent) of the circulating blood volume which was primarily associated with plasma losses. The change was not appreciably modified by the use of an anti-G suit. In the manned studies the decrease was 5.9 percent during exposure to 7 G and 11 percent during exposure to 9 G with an anti-G suit used. These observations show that the acceleration duration and value play an important part in the mechanism of plasma filtration in response to an increase in the hydrostatic pressure. Author

N88-15397# Joint Publications Research Service, Arlington, Va.
BLOOD REDISTRIBUTION IN MAN WITH LOWER BODY NEGATIVE PRESSURE

V. A. DEGTYAREV, M. A. KAPLAN, L. YA. ANDRIYAKO, YU. A. BUBEYEV, and YU. I. REMIZOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 61-65 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 42-45

Avail: NTIS HC A08/MF A01

During exposure to lower body negative pressure (LBNP) of -10 to -60 mm Hg variations in the blood filling of body segments were measured, using Fe-59 labelled erythrocytes. Ten healthy volunteers were exposed to six LBNP sessions (in recumbency). The data obtained were related to changes in the blood filling of various body segments which were the most pronounced at LBNP -20 to -30 mm Hg. As the LBNP level increased, the changes in the blood filling of the pelvis and legs, head and thorax decreased. In the abdominal area this parameter remained essentially unaltered. The distinct variations in the thoracic blood filling were probably dependent on the amount of blood shifted to the

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decompressed area which may be related not only to the venous capacity in this area but also to the venous arterial reflexes and possibly to the specific transfer of reduced pressure in tissues.

Author

N88-15398# Joint Publications Research Service, Arlington, Va. **HUMAN METABOLISM AND PERIPHERAL CIRCULATION DURING ANTIORTHOSTATIC HYPOKINESIA**

V. YE. VOROBYEV, I. V. KOVACHEVICH, L. L. STAZHADZE, V. F. IVCHENKO, V. R. ABDRAKMANOV, V. N. KALYANOVA, S. G. VORONINA, and L. G. REPENKOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 66-70 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 44-49

Avail: NTIS HC A08/MF A01

Metabolism and peripheral circulation were investigated in head down tilt tests of varying duration. The greatest changes were seen on test day 30, when the subjects showed venous hyperoxia, lower oxygen arterio-venous difference and a significant decrease of oxygen tension in arterial blood and oxygen utilization in tissues. At the same time the subjects exhibited an increase in Pi and lactate and a maximum growth of 2,3-diphosphoglyceric acid. This exposure seems to produce a discrepancy between oxygen supply and oxygen requirements in tissues which gives rise to secondary tissue hypoxia. It is believed that the basic cause of these changes is disordered oxygen transport from blood to tissues. Author

N88-15399# Joint Publications Research Service, Arlington, Va. **DISTINCTIONS AND MECHANISMS OF EFFECTS OF EPINEPHRINE AND NOREPINEPHRINE ON CARDIAC PUMPING FUNCTION UNDER HYPOKINETIC CONDITIONS**

A. S. CHINKIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 71-75 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 49-52

Avail: NTIS HC A08/MF A01

The effect of epinephrine (E) and norepinephrine (NE) on cardiac output (CO) and heart rate (HR) of hypokinetic and control rats was studied. It was found that in the hypokinetic animals the E effect on CO was significantly weaker than in the controls while the NE effect was stronger. In most experiments the response to NE in the hypokinetic animals was greater than that to E. The mean HR increase was significantly different in the two groups but in the hypokinetic rats the response to E was less expressed. These data give reason to believe that the lower E effect on CO in the hypokinetic animals is associated with diminished alpha-adrenergic effects on the heart. Author

N88-15400# Joint Publications Research Service, Arlington, Va. **BIORHYTHMOLOGICAL ANALYSIS OF DYNAMICS OF PULMONARY VENTILATION PARAMETERS DURING ORTHOSTATIC TESTS**

V. A. GALICHIY *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 76-85 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 52-59

Avail: NTIS HC A08/MF A01

Pulmonary ventilation parameters (breathing depth, frequency and minute volume, and alveolar ventilation) of 5 healthy male test subjects who performed a 20 min tilt test were analyzed. During tilt tests the above parameters showed oscillations in a range of about 1 min. During the first 1 to 3 min of exposure the parameters exhibited an accentuated synchronization of the oscillations and the phenomenon of general autonomic switch over with the negative phase. From the 4th min till the 6.5th min the function of individual components of the pulmonary ventilation system mismatched and the respiration efficacy fell. Thereafter

this synchronization of the processes studied returned to normal. Adequate adaptation of pulmonary ventilation to tilting developed not earlier than during the 13 to 14 min.

Author

N88-15401# Joint Publications Research Service, Arlington, Va. **NYSTAGMOMETRIC DISTINCTIONS OF INDIVIDUALS REGULARLY EXPOSED TO VIBRATION**

T. A. NALIMOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 86-91 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 59-62

Avail: NTIS HC A08/MF A01

Workers regularly exposed to vibration whose work record was not less than 10 years were examined. Nystagmometric data derived from caloric and optokinetic tests performed before and after work shifts were analyzed. The amount of atypical reactions was the greatest in the caloric and optokinetic tests carried out before work shifts. This was suggestive of the trend toward normalization discerned in the afternoon reactions. The phenomenon of normalization can be added to the list of objective symptoms that are typical of vibration sickness. Author

N88-15402# Joint Publications Research Service, Arlington, Va. **MOTHER-FETUS SYSTEM AS OBJECT FOR INVESTIGATION OF MECHANISMS OF PHYSIOLOGICAL EFFECT OF WEIGHTLESSNESS**

L. V. SEROVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 92-97 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 63-66

Avail: NTIS HC A08/MF A01

The place of embryological investigations in the program of mammalian experiments onboard the Cosmos biosatellites is discussed. The mother fetus system is viewed as a specific loading test for studying the reserve potentials of the mammalian body in microgravity. It was demonstrated that mammals (Wistar rats) flown during the third term of their pregnancy can maintain homeostasis of the developing fetus within the limits that provide the normal development of physiological functions. Significant individual variations in animal responses to microgravity were also found. Author

N88-15405# Joint Publications Research Service, Arlington, Va. **BIOFEEDBACK CONTROL OF ALVEOLAR CARBON DIOXIDE TENSION TO ELIMINATE HYPOCAPNIA IN MAN IN THE PRESENCE OF HYPOXIA**

I. S. BRESLAV, A. M. SHMELEVA, and A. T. NORMATOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 109-113 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 74-77

Avail: NTIS HC A08/MF A01

Reactions of the respiratory system to the inhalation of a hypoxic gas mixture were compared when the test subjects practiced normal breathing or breathing with a stable alveolar carbon dioxide tension. In the latter case, the test subjects controlled their lung ventilation using the biofeedback technique. In this manner hyperventilation and related hypocapnia were eliminated. The possibility of practical application of biofeedback to the control of man's respiration in situations that may cause hypocapnia is discussed. Author

N88-15406# Joint Publications Research Service, Arlington, Va.
ROLE OF HEMOGLOBIN AFFINITY FOR OXYGEN IN EFFICIENCY OF BLOOD RESPIRATORY FUNCTION

K. P. IVANOV, A. YE. CHUYKIN, G. V. SAMSONOV, and N. P. KUZNETSOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 114-117 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 77-80

Avail: NTIS HC A08/MF A01

In acute experiments the oxygen transport properties of two solutions of modified stroma purified hemoglobin were investigated using anesthetized Wistar rats. The solutions were: (1) Hb = 8.0 g per 100 g, P sub 50 = 12.5 mm Hg; and (2) Hb = 4.4 g per 100 g, P sub 50 = 21.5 mm Hg. The solutions were used in stage by stage isovolumic substitution in rats of two groups. The modified hemoglobin solution with a lower hemoglobin oxygen affinity was found to be a more efficient blood substitute. In spite of its low oxygen capacity, it could sustain life activity at very low hematocrit values. When the oxygen capacity of blood is moderate or low, hemoglobin oxygen affinity plays a very important part in oxygen supply to different tissues, specifically to the heart. The latter determines the crucial compensatory physiological reaction to acute anemia, i.e., increase of cardiac output. Author

N88-15408# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT OF METHODS FOR THE STUDY OF SPACE MOTION SICKNESS

A. D. MATVEYEV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 122-132 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 83-88

Avail: NTIS HC A08/MF A01

Current theory on the pathogenesis of space motion sickness (SMS) served as the basis to develop methods for studying and preventing SMS: intralabyrinthine and interanalyzer conflict, onset in weightlessness of disturbances referable to dynamics of spinal fluid, as well as the authors own conception that development of circulatory static venous ischemia and hypoxia of the brain is the cause of SMS. The methods and instruments are described that were developed, and the results are submitted of inflight and ground based studies of vestibular function and SMS conducted by the author over a 20 year period. Author

N88-15409# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF ENERGY METABOLISM OF BIOLOGICAL SYSTEMS IN WEIGHTLESSNESS

M. G. TAIRBEKOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 133-134 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 89-90

Avail: NTIS HC A08/MF A01

On the basis of analysis of data in the literature and results of inhouse studies, it could be assumed that there should be less than normal energy expenditure by biological systems (in particular, cells) in weightlessness. Such a decline in expended energy could be expected primarily due to diminished energy used to maintain mechanical strength of the system. The dynamics and intensity of energy metabolism in microgravity was examined. It was concluded that conditions associated with weightlessness does not affect the level of basal energy metabolism in plants and insects when using the energy of chemical bonds for division, growth and differentiation of cells. Author

N88-15410# Joint Publications Research Service, Arlington, Va.
DIFFERENTIATION OF HEMOPOIETIC STEM CELLS DURING ADAPTATION TO HIGH ALTITUDE

O. I. ANDREYEVA, V. V. PUKHOV, and S. B. DANILYAROV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 135-137 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 90-91

Avail: NTIS HC A08/MF A01

It is known that exposure of a biological system to a hypoxic environment leads to stimulation of erythropoiesis and increase in number of red cells in peripheral blood. At the same time, no studies have been made of the distinction of differentiation of hemopoietic stem cells (HSC) during the period of adaptation to high altitude. Nor is there clarity as to the level on which mountain hypoxia alters the direction of differentiation. The distinctions of HSC differentiation during the period of adaptation to high altitude was investigated. Method and results are discussed. Author

N88-15412# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 21, NO. 4, JULY - AUGUST 1987

O. G. GAZENKO, ed. 13 Jan. 1988 158 p Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 96 p (JPRS-USB-88-002) Avail: NTIS HC A08/MF A01

Topics addressed in space biology and aerospace medicine include: effects of microwaves ionizing radiation; cosmos-1667 experiments; rat brain morphogenesis in weightlessness; circulatory response to antiorthostatic hypokinesia; effects on skeletal muscles during hypokinesia; hemodynamics; physiological effects; immunological effects; hypoxia; ecology; aviation psychology; hypercapnia; respiratory responses.

N88-15413# Joint Publications Research Service, Arlington, Va.
COMBINED EFFECT OF MICROWAVES AND IONIZING RADIATION

YU. G. GRIGORYEV, V. S. STEPANOV, G. V. BATANOV, L. I. BESKHELEBNOVA, Z. YA. MITYAYEVA, A. A. PARAMONOV, and R. M. SALIMOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 1-7 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 4-9

Avail: NTIS HC A08/MF A01

The response of different physiological systems to ionizing radiation as modified by UHF radiation of nonthermal intensity was investigated. The experimental rats were exposed to electromagnetic irradiation of the power flux density (PFD) 200 microW/sq cm 30 minutes daily for 8 days and the next day they were exposed to single total-body gamma-irradiation at a dose of 5.5 Gy. Pre-exposure to UHF irradiation reduced 1.5 times the mortality rate of the test animals as compared to the controls. Immunobiological examinations revealed a significant increase of the stimulation index in the mitogen (PHA) induced lymphocyte blast-transformation reaction and a decrease of the autopath count. The motor activity of the rats exposed for 20 minutes to gamma-irradiation at a dose of 0.34 Gy and the next day to UHF irradiation (PHA = 40 microW/sq cm) for 1 and 5 minutes remained essentially unchanged. The imprinting of the chicks irradiated in early embryogenesis for 5 minutes with UHF (PHA = 40 microW/sq cm) and then with gamma-rays at a dose of 0.36 Gy was disrupted. Author

N88-15416# Joint Publications Research Service, Arlington, Va. **CIRCULATORY RESPONSE OF MALES 45-52 YEARS OF AGE TO ANTIORTHOSTATIC HYPOKINESIA**

V. I. SOKOLOV, KH. KH. YARULLIN, N. D. VIKHAREV, M. V. SAZONOVA, and N. V. DEGTERENKOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 25-31 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 22-26
 Avail: NTIS HC A08/MF A01

Regional and central circulation reactions to 30 day antiorthostatic hypokinesia were investigated in 15 men, ages 45 to 52 years, with early signs of cerebrovascular and aortic atherosclerosis, neurocirculatory dystonia of the hypertensive type, and hypertensive disease of stage 1. Regional and central hemodynamics of the subjects of the three groups during and immediately after exposure developed in a different manner.
 Author

N88-15419# Joint Publications Research Service, Arlington, Va. **ROLE OF TESTING TOTAL GAS (O₂ AND CO₂) TENSION OF BLOOD PLASMA IN THE STUDY OF HUMAN GAS HOMEOSTASIS**

G. YA. GEBEL, V. A. DEGTAREV, V. N. DASAYEV, V. N. UTKIN, A. G. KRUGLOV, V. V. GUDENKO, and A. A. LILLOSON *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 41-55 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 31-41
 Avail: NTIS HC A08/MF A01

Sixty essentially healthy subjects were examined manometrically with blood withdrawn from the coronary sinus, pulmonary artery, aorta, veins of the right kidney and the right liver lobe. Together with the traditional parameters of the gas contents and gradients of plasma, it is proposed to use tests measuring additive O₂ and CO₂ parameters. It was demonstrated that the above organs can be discriminated using tests that are additive with respect to the gas pressure. It is emphasized that the tests proposed here, when used in addition to the traditional ones, allow identification of the gas and nongas parameters of homeostasis as a single system of tests to assess the human body function.
 Author

N88-15421# Joint Publications Research Service, Arlington, Va. **CHANGES IN REGIONAL AND CENTRAL HEMODYNAMICS DURING SEVEN-DAY WATER IMMERSION**

KH. KH. YARULLIN, L. G. SIMONOV, and S. A. VTORYY *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 62-69 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 45-50
 Avail: NTIS HC A08/MF A01

Regional and central hemodynamics were assessed at bi- and tetrapolar rheography and tachooscillography during 7 day dry immersion and 8 day head-down tilt. Blood redistribution evident from enhanced pulse filling of the brain, lungs, and arms was the most pronounced on day 3 to 5. The onset of the blood outflow to the liver was observed on immersion day 5 due to compensatory and adaptive reactions. Lack of exercise tolerance of cardiovascular system through its insufficient training was similar in the immersion and head-down tilt for all the 6 healthy males studied (aged 41 to 49) despite more obvious changes in regional hemodynamics during the immersion, which recovered of its fifth day.
 Author

N88-15422# Joint Publications Research Service, Arlington, Va. **SPECIFIC ORGANIC COMPOUNDS IN EXCRETA**

M. T. DMITRIYEV, A. G. MALYSHEVA, and YE. G. RASTYANNIKOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 70-78 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 50-56
 Avail: NTIS HC A08/MF A01

Chromato-mass-spectrometry was used to examine human wastes for the first time. The data on the excretion rate of specific organic compounds can be employed to predict the content of toxic metabolites in the enclosed environment, to give their biomedical characterization, and to diagnose unfavorable changes in the body.
 Author

N88-15424# Joint Publications Research Service, Arlington, Va. **PHYSIOLOGICAL AND IMMUNOLOGICAL ASPECTS OF HUMAN ADAPTATION TO TEMPERATURE ELEVATION IN A CLOSED ENVIRONMENT**

L. N. MUKHAMEDIYEVA, I. V. KONSTANTINOVA, V. V. ZHURAVLEV, YE. N. ANTROPOVA, G. P. TEPLINSKAYA, and YE. I. NIKITIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 85-90 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 60-64
 Avail: NTIS HC A08/MF A01

Physiological and immunological investigations have shown that on day 2 of adaptation to the warming enclosed environment the test subjects may develop pustular skin disease. A certain role in the disease is played by the autoinfection process aggravated by sensitization of the organism to autoantigens.
 Author

N88-15426# Joint Publications Research Service, Arlington, Va. **DIAGNOSTIC VALUE OF SOME LOAD TESTS IN EVALUATION OF NONSPECIFIC ELECTROCARDIOGRAPHIC CHANGES**

V. M. KONDRAKOV, V. I. KOLEDENOK, P. M. SUVOROV, and L. I. ARSENYEVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 96-100 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 67-69
 Avail: NTIS HC A08/MF A01

The examinations of 353 patients with various cardiovascular pathologies and changes in the end-portion of the ECG ventricular complex are described. For that purpose potassium chloride, obsidan, orthostatic, and hyperventilation tests were used. The examinations demonstrated that the ECG changes were of functional nature in 178 patients, of organic nature in 155 patients, and of mixed nature in 20 patients which was important for reliable diagnostic and expertise conclusions.
 Author

N88-15427# Joint Publications Research Service, Arlington, Va. **USE OF BIFIDUMBACTERIN FOR CORRECTION OF INTESTINAL DYSBACTERIOSIS**

N. N. LIZKO and G. I. GONCHAROVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 101-104 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 70-72
 Avail: NTIS HC A08/MF A01

The prospect of long-term manned spaceflights advances a number of problems for space biology and medicine, among which ecology of microorganisms and interaction of the macroorganism with its autoflora acquires importance. The effects of adverse environmental factors and stress are examined. The importance of the role of bifidoflora in maintaining a normal microbiocenosis in the intestine is briefly summarized. Development of a lactate product using a strain of bifidobacteria that sours milk was another aspect of the investigations. This product was tested on healthy adults.
 B.G.

N88-15428# Joint Publications Research Service, Arlington, Va.
REGULATION OF ENERGY METABOLISM DURING PARACHUTE JUMPS

M. M. DYAKONOV and V. R. PERSIANOVA *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 105-107 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 72-73
Avail: NTIS HC A08/MF A01

Virtually all people who make parachute jumps, regardless of how long they trained for them and the number of jumps, display considerable nervous and emotional tension. The nervous and psychological tension before jumps increases the utilization of energy. The bioenergetic processes that take place at the time of making parachute jumps was investigated. The findings enabled a deeper evaluation of the changes in energy metabolism that occurs during the parachute jump and the subsequent activity. It is deemed desirable to have a rather high amount of readily assimilated carbohydrates in the diet on days when jumps are to be made and the preceding days. At the same time, it is not desirable to postpone meals for too long in the period that follows the jump.

Author

N88-15429# Joint Publications Research Service, Arlington, Va.
SIMULATION OF EFFECT ON BIOLOGICAL SYSTEMS OF IMPACT WAVE FROM HEAVY CHARGED PARTICLE TRACK

YE. YE. KOVALEV, O. D. BRILL, L. V. NEVZGODINA, L. I. IVANOV, and V. A. YANUSHKEVICH *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 108-113 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 73-76
Avail: NTIS HC A08/MF A01

A flat impact wave generated upon absorption of a 50 ns laser pulse, with an energy of 10 to 15 J, in a thin opaque layer of black enamel about 1 sq cm in area, was used to obtain stable and controlled conditions of delivering radiation to the biological systems. Air-dried *Lactuca sativa* lettuce seeds, with relative moisture content of 6 percent, and swollen seeds were exposed. Immediately after irradiation, the seeds were allowed to germinate. The seeds were irradiated at several amplitude of impact wave-pressure in the range of several hundred to 13,000 atm. The impact wave has a noticeable effect on survival and delayed germination of dry seeds at pressures of only 200 to 300 atm. The impact wave also suppressed cell division effectively at 800 atm pressure. There were no chromosomal aberrations. B.G.

N88-15431# Joint Publications Research Service, Arlington, Va.
EFFECT OF INTERMITTENT HYPERCAPNIA ON VISUAL ANALYZER FUNCTION

T. I. GOLUBEVA and M. P. KUZMIN *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 118-120 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 78-80
Avail: NTIS HC A08/MF A01

The objective was to determine the response of man to increasing concentration of CO₂ during long-term exposure to moderate hypercapnia. Heretofore, attention was devoted mainly to the cardiorespiratory system and acid-base equilibrium in studies of man's adaptive reactions to high concentrations of CO₂. Yet all of the body's adaptive responses to environmental factors are coordinated with the function of the nervous system, while its functional state directly determines human work capacity under such conditions. It is known that dark adaptation reflects not only processes occurring in the receptor proper, but are closely related to the optical centers of the cerebral cortex, and for this reason it can determine their functional state to some extent. The study of dark adaptation of the eyes were used as an indicator of the human body response to intermittent hypercapnia. Author

N88-15432# Joint Publications Research Service, Arlington, Va.
MONONUCLEAR PHAGOCYTES DURING ADAPTATION OF ESSENTIALLY HEALTHY PEOPLE TO HIGH ALTITUDES

M. I. KITAYEV and A. G. GONCHAROV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 121-125 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 80-82
Avail: NTIS HC A08/MF A01

The mononuclear phagocyte system (MPS) of essentially healthy people was not discussed in literature as it pertains to adaptations to alpine regions. Yet, these cells perform important functions in the body. The cells are involved in granulopoiesis, synthesis of biologically active substances and regulation of the immune response at all of its stages. It can be assumed that the MPS is involved in maintaining immunological homeostasis in naturally occurring hypoxic environments. The object was to investigate the functional distances of blood monocytes during man's adaptation to the altitude of the Pamir region. Author

N88-15435# Joint Publications Research Service, Arlington, Va.
BIBLIOGRAPHY OF SPACE BIOLOGY AND MEDICINE

I. T. AKULINICHEV and A. A. SHIPOV *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 141-143 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 89-90
Avail: NTIS HC A08/MF A01

The space biology and medicine bibliography lists about 10,000 references published in the period 1971 to 1975. The bibliography offers the opportunity to make a scientific analysis of publications and assess the status of different directions of the discipline, intensity of publications, basic trends in development and emerging growth points of interest for future planning of scientific research. B.G.

N88-16265# Karolinska Inst., Stockholm (Sweden). Dept. of Baromedicine.**THE ESA ANTHORACK PROJECT: INTEGRATED RESEARCH IN HUMAN PHYSIOLOGY**

D. LINNARSSON *In* ESA, Proceedings of the 8th ESA Symposium on European Rocket and Balloon Programs and Related Research p 387-389 Aug. 1987
Avail: NTIS HC A21/MF A01

The Spacelab Anthorack experiments, hardware, and experiment management are described. Fluid balance, cardiovascular dynamics and blood, endocrine responses, pulmonary function, and metabolism are studied. Anthorack provides general power, cooling, recording, and computing facilities as well as services such as centrifuges, ergometers, ultrasonic monitors, and amplifiers to be shared by a limited number of investigators. Experiment specific equipment can also be accommodated. ESA

N88-16324# Joint Publications Research Service, Arlington, Va.
GENERAL BIOLOGICAL CHARACTER OF ADAPTIVE CAPACITY OF MAMMALIAN METABOLISM IN RESPONSE TO DIVERSE AND EXTREME ENVIRONMENTAL FACTORS
Abstract Only

B. M. GRAYEVSKAYA and N. N. ZOLOTAREVA *In its* USSR Report: Life Sciences. Biomedical and Behavioral Sciences p 81 5 Dec. 1986 Transl. into ENGLISH from Doklady Akademii Nauk SSSR (Moscow, USSR), v. 289, no. 1, Jul. 1986 p 250-252
Avail: NTIS HC A06/MF A01

Biochemical studies were conducted to determine optimal metabolic parameters delineating resistance to diverse and extreme environmental factors in mammals. Preliminary studies with two lines of mice (BALB/c and C57B1) differing in susceptibility to ionizing radiation demonstrated that blood glucose levels and changes in the level following epinephrine administration are indicative of adaptation, and reflect the status of the sympathetic

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nervous system. Within a given line of mice, the socially dominant individuals showed greater adaptability to stress and survivability. Data derived for several mammalian species showed that, on the basis of blood glucose levels and response to epinephrine challenge, susceptibility to environmental stress can be predicted with an accuracy of 80 percent on an individual basis. Optimal blood glucose levels and 15 and 30 minute glycemic responses to epinephrine are tabulated for humans, cattle, rats, mice, and dolphins. Author

N88-16325# Army Research Inst. of Environmental Medicine, Natick, Mass.

DEXAMETHASONE AS PROPHYLAXIS FOR ACUTE MOUNTAIN SICKNESS: EFFECT OF DOSE LEVEL

PAUL B. ROCK, T. S. JOHNSON, RICHARD F. LARSEN, CHARLES S. FULCO, and LAURIE A. TRAD 1 Jun. 1987 22 p (AD-A185848) Avail: NTIS HC A03/MF A01 CSCL 06E

Rapid exposure of unacclimatized individuals to high altitude causes a syndrome termed acute mountain sickness (AMS). Prophylactic treatment with high doses of dexamethasone is known to prevent AMS, but carries a high risk of side effects. To determine whether lower doses with less potential for side effects were effective in preventing AMS, 28 men between the ages of 18 and 32 were exposed to a simulated altitude of 4579 m for 45 h in a hypobaric chamber on two occasions while taking one of three doses of dexamethasone (4 mg, 1 mg or .25 mg every twelve hours) or a placebo in a double-blind, crossover design. Three independent measures for the presence of AMS showed that the 4 mg dose of dexamethasone reduced the incidence of AMS symptoms compared to placebo and compared to the other dose levels. Dexamethasone did not alter fluid balance or plasma volume changes, but treatment with 1 mg and 4 mg suppressed cortisol secretion. There was no evidence of adrenal cortical suppression after treatment with dexamethasone or placebo 48 h after discontinuing altitude exposure and drug treatment. The results indicate that doses of dexamethasone less than 4 mg twice daily may not be effective prophylactic treatment for AMS. GRA

N88-16326# Army Research Inst. of Environmental Medicine, Natick, Mass.

PREDICTION OF HUMAN THERMOREGULATORY RESPONSES AND ENDURANCE TIME IN WATER AT 20 AND 24C

PETER TIKUISIS, RICHARD R. GONZALEZ, and KENT B. PANDOLF 24 Jun. 1987 26 p (AD-A186223) Avail: NTIS HC A03/MF A01 CSCL 06J

A multi-compartmental mathematical model for predicting human thermoregulatory responses was applied to immersion in moderately cold water. Data were obtained from experiments where eight healthy male volunteers were immersed nude and up to the neck for 1 h in water at 20 and 24 degrees C under conditions of rest and exercise. Rectal temperature and metabolic rate were measured before and during immersion. Once agreement between the model prediction and experimental observation was obtained, the model was used for prediction beyond the duration of the experiment. Stabilization of core temperature was predicted after 4-5 h of immersion for rest and after 2-4 h for exercise. Stabilization for resting individuals has been observed in other experiments under similar conditions. These results suggest that linear extrapolations based on linear body cooling rates are inadequate for predicting endurance times in moderately cold water. In this study, predicted endurance times were based on the concept of relative exercise intensity and are in agreement with the limited data available. GRA

N88-16327# Army Research Inst. of Environmental Medicine, Natick, Mass.

EXERCISE THERMOREGULATION AFTER PROLONGED WAKEFULNESS

PETER TIKUISIS, RICHARD R. GONZALEZ, and KENT B. PANDOLF Jun. 1987 23 p (AD-A186224) Avail: NTIS HC A03/MF A01 CSCL 06J

The effect of 33 hours wakefulness on the control of forearm cutaneous blood flow and forearm sweating during exercise was

studied in three men and three women (follicular phase of the menstrual cycle). Subjects exercised for 30 min at 60% peak VO₂ while seated behind a cycle ergometer. Esophageal temperature (T_{es}), mean skin temperature (T_{sk}), and arm sweating to T_{es} tended to be lower, but was not significant. Arm skin temperature was not different between control and sleep loss experiments. Reflex cutaneous vasodilation during exercise appears to be reduced by both central and local factors following 33 hours of wakefulness. GRA

N88-16328# Army Research Inst. of Environmental Medicine, Natick, Mass.

EVIDENCE FOR HUMAN ADAPTIVE RESPONSE TO DEHYDRATION: INCREASE OF CIRCULATING PROTEIN MASS

MICHAEL N. SAWKA and C. B. WENGER Jun. 1987 9 p (AD-A186225) Avail: NTIS HC A02/MF A01 CSCL 06J

Previously, it was believed that humans do not adapt to dehydration. Data are presented here showing that within 15 hours after dehydration is reached, humans increase circulating protein mass to facilitate the redistribution of body water from the interstitial to the intravascular space. The increased resting circulating protein mass may also provide an advantage during situations in which dehydrated individuals have difficulty retaining their circulating protein, such as exercise in heat. GRA

N88-16329# Army Research Inst. of Environmental Medicine, Natick, Mass.

RATIONAL CONSIDERATIONS FOR MODELLING HUMAN THERMOREGULATION DURING COLD WATER IMMERSION

PETER TIKUISIS and RICHARD R. GONZALEZ 24 Jun. 1987 25 p (AD-A186226) Avail: NTIS HC A03/MF A01 CSCL 06J

Immersion in cold water brings about large changes in body temperature and metabolism that add to the complexity of modelling human thermoregulation. Three specific problems peculiar to such modelling are examined; they are: (1) finite-difference solution of the bioheat equation; (2) differences between predicted and measured initial conditions; and (3) prediction of convective heat loss. An optimization of the finite-difference solution of the simpler, but related, heat conduction problem is presented. A greater benefit is obtained by increasing the number of nodes rather than decreasing the integration time interval. A procedure is given for matching the predicted and measured initial values of the deep body temperature and the metabolic rate which allows a more accurate determination of set-point values for thermoregulation. To circumvent the acute sensitivity to the skin-water temperature difference using the conventional prediction of convective heat loss, use of a heat balance during steady-state of the skin temperature is outlined. GRA

N88-16330# Jyvaskyla Univ. (Finland). Dept. of Physics.

LATE RADIATION DAMAGE IN BONE, BONE MARROW AND BRAIN VASCULATURE, WITH PARTICULAR EMPHASIS UPON FRACTIONATION MODELS Ph.D. Thesis

MAUNU PITKAENEN Apr. 1986 61 p (DE87-753039; JYFL-RR-1/86) Avail: NTIS (US Sales Only) HC A04/MF A01

X-ray induced changes in rat and human bone and bone marrow vasculature and in rat brain vasculature were measured as a function of time after irradiation and absorbed dose. The absorbed dose in the organ varied from 5 to 25 Gy for fractionated irradiations. The number of fractions varied from 3 to 10 for the rats and from 12 to 25 for the human. Blood flow changes were measured using an 1-2-5I antipyrine or 8-6RbCl extraction technique. The red blood cell (RBC) volume was examined by 5-1Cr labelled red cells. Different fractionation models have been compared. Radiation induced reduction of bone and bone marrow blood flow were both time dose dependent. Reduced blood flow 3 months after irradiation would seem to be an important factor in the subsequent atrophy of bones. With a single dose of 10 Gy the bone marrow blood flow returned to the control level by 7 months after irradiation. In the irradiated bone the RBC volume

was about the same as that in the control side but in bone marrow the reduction was from 32 to 59 percent. The dose levels predicted by the nominal standard dose (NSD) formula produced about the same damage to the rat femur seven months after irradiation when the extraction of 8-6Rb chloride and the dry weight were concerned as the end points. However, the results suggest that the NSB formula underestimates the late radiation damage in bone marrow when a small number of large fractions are used. In the irradiated brains of the rats, the blood flow was on average 20.4 percent higher compared to that in the control group. There was no significant difference in brain blood flow between different fractionation schemes. The value of 0.42 for the exponent of N corresponds to the average value for central nervous system tolerance in the literature. The model used may be sufficiently accurate for clinical work provided the treatment schemes used do not depart too radically from standard practice. DOE

N88-16331*# Essex Corp., Orlando, Fla.
PRELIMINARY EVALUATION OF A MICRO-BASED REPEATED MEASURES TESTING SYSTEM

ROBERT S. KENNEDY, ROBERT L. WILKES, and NORMAN E. LANE 1985 32 p
 (Contract NAS9-17326)
 (NASA-CR-172038; NAS 1.26:172038; EOTR-85-1) Avail: NTIS HC A03/MF A01 CSCL 06E

A need exists for an automated performance test system to study the effects of various treatments which are of interest to the aerospace medical community, i.e., the effects of drugs and environmental stress. The ethics and pragmatics of such assessment demand that repeated measures in small groups of subjects be the customary research paradigm. Test stability, reliability-efficiency and factor structure take on extreme significance; in a program of study by the U.S. Navy, 80 percent of 150 tests failed to meet minimum metric requirements. The best is being programmed on a portable microprocessor and administered along with tests in their original formats in order to examine their metric properties in the computerized mode. Twenty subjects have been tested over four replications on a 6.0 minute computerized battery (six tests) and which compared with five paper and pencil marker tests. All tests achieved stability within the four test sessions, reliability-efficiencies were high (r greater than .707 for three minutes testing), and the computerized tests were largely comparable to the paper and pencil version from which they were derived. This computerized performance test system is portable, inexpensive and rugged. Author

N88-16332* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 307)

Feb. 1988 72 p
 (NASA-SP-7011(307); NAS 1.21:7011(307)) Avail: NTIS HC A05; NTIS standing order as PB88-9123000, \$9.00 domestic, \$18.00 foreign CSCL 06E

This bibliography lists 203 reports, articles, and other documents introduced into the NASA scientific and technical information system in January, 1988. Author

N88-16333# Army Research Inst. of Environmental Medicine, Natick, Mass.

OPERATION EVEREST 2: NUTRITION AND BODY COMPOSITION Final Report, Sep. - Nov. 1985

MADELEINE S. ROSE, CHARLES S. HOUSTON, CHARLES S. FULCO, GEOFFREY COATES, JOHN R. SUTTON (McMaster Univ., Hamilton, Ontario), and ALLEN CYMERMAN 21 Aug. 1987 34 p
 (Contract DAMD17-85-C-5206)
 (AD-A186449) Avail: NTIS HC A03/MF A01 CSCL 06J

Progressive body weight loss occurs during high mountain expeditions, but whether it is due to hypoxia, inadequate diet, malabsorption, or to multiple stresses of the harsh environment is unknown. To determine whether hypoxia alone causes such weight loss, six men, provided with a palatable ad libitum diet, were studied

during progressive decompression to 240 Torr for 40 days in a hypobaric chamber where hypoxia was the major variable. Caloric intake decreased 42.3% from 3136 kcal to 1789 kcal. The percent carbohydrate in the diet decreased from 62.1% to 53.2%. All subjects lost weight averaging about 7.4 +/- 2.2 kg. Hydrostatic weighing indicated that 4 subjects lost 2.7% body fat whereas two gained 0.65%. Computerized tomographic scans showed that most of the weight loss was derived from lean body mass. Data indicated that prolonged exposure to increasing hypoxia is associated with reduction in carbohydrate preference and body weight despite access to ample varieties and quantities of food. This study suggested that hypobaric hypoxia rather than the combined stress of the mountain environment is sufficient cause for the reduction in food intake reported by mountain expeditions at high altitudes. GRA

N88-16334# Army Research Inst. of Environmental Medicine, Natick, Mass.

INFLUENCE OF SKELETAL MUSCLE GLYCOGEN ON PASSIVE REWARMING AFTER HYPOTHERMIA

P. D. NEUFER, ANDREW J. YOUNG, MICHAEL N. SAWKA, and STEPHEN R. MUZA Aug. 1987 23 p
 (AD-A186451) Avail: NTIS HC A03/MF A01 CSCL 06O

Individuals performing work and athletes competing in cold conditions may experience, in addition to muscle glycogen depletion, mild to moderate hypothermia. It has been hypothesized that muscle glycogen may provide the substrate for shivering thermogenesis. To examine the influence of muscle glycogen on the thermal responses to passive rewarming subsequent to mild hypothermia, eight subjects completed two cold (18 C) water immersions followed by 75 min of passive rewarming (24 C air, resting in blanket). The experiments followed several days of different exercise/diet regimens eliciting either low or normal prewarming muscle glycogen levels. Cold water immersion was performed for 180 min or to a rectal temperature $T_{sub re}$ of less than 35.5 C. Rewarming increased $T_{sub re}$ similarly during both LMG and NMG. Independent of treatment, afterdrop responses were evident only in those individuals (body fat is less than 15 percent) whose body core cooled during immersion supporting the contention that afterdrop is a function of the kinetics of heat flow through a mass of tissue. Furthermore, these data indicate that low muscle glycogen levels do not impair rewarming time nor alter afterdrop responses during passive rewarming following mild to moderate hypothermia. GRA

N88-16335# Army Research Inst. of Environmental Medicine, Natick, Mass.

DETERMINATION OF THE EFFECT OF WALKING ON THE FORCED CONVECTIVE HEAT TRANSFER COEFFICIENT USING AN ARTICULATED MANNIKIN

S. K. CHANG, E. ARENS, and R. R. GONZALEZ May 1987 20 p
 (AD-A186452) Avail: NTIS HC A03/MF A01 CSCL 06J

This study addresses the effect of the walking motion on local convective heat transfer coefficient at various body sites, employing an articulated mannikin. The forced convective heat transfer coefficient ($h_{sub c}$) is determined by the naphthalene sublimation plate technique. Circular naphthalene disks were affixed to various body segments of the articulated mannikin. The mannikin then simulated walking at four different gaits under constant temperature (30 C) and wind speed (0.4-0.7 m./sec depending on the body segment) in an environmental chamber. The amount of naphthalene weight loss through sublimation was translated to $h_{sub c}$ using the Chilton-Colburn analogy between heat and mass transfer. The results showed that arm movement during walking, unexpectedly, diminished the effective local convective transfer coefficient. Increased gait actually resulted in a decrease in $h_{sub c}$, as measured on the arms and legs. On the nonmoving body trunk, no significant difference in $h_{sub c}$ was observed with increased gait. When the mannikin was held stationary and the chamber wind speed increased, a corresponding increase in $h_{sub c}$ was observed. Thus during walking, motion of the swinging limbs, the pendulum or pumping effect, tends to decrease the

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forced convective heat transfer coefficient as observed locally on the limbs. For the walking gaits applied in this study, a 5-7 percent decrease in $h_{sub c}$ was observed. GRA

N88-16336# Army Research Inst. of Environmental Medicine, Natick, Mass.

THE USE OF HEART RATE IN THE PRESCRIPTION AND EVALUATION OF EXERCISE PROGRAMS

REED W. HOYT 17 May 1987 21 p
(AD-A186454) Avail: NTIS HC A03/MF A01 CSCL 06D

The direct measurement of maximal oxygen uptake (VO_{2max}) during exercise to exhaustion provides a scientifically rigorous means of comparing the aerobic capacities of different individuals and of assessing the effects of endurance training on cardiorespiratory fitness. However, the complexity and expense of this approach has led to the development of simpler techniques designed to achieve the same ends. After a brief description of a maximal exercise test which can be used to compare the cardiorespiratory fitness of different individuals this paper will discuss in detail how to use the heart rate response to standardized exercise to monitor the effects of endurance training to the relative fitness of an individual. GRA

N88-16337# Army Research Inst. of Environmental Medicine, Natick, Mass.

OPERATION EVEREST 2: COMPARISON OF FOUR INSTRUMENTS FOR MEASURING BLOOD OXYGEN SATURATION

VINCENT A. FORTE, JR., MARK K. MALCONIAN, PAUL B. ROCK, PATRICIA M. YOUNG, LAURIE A. TRAD, BRUCE A. RUSCIO, JOHN R. SUTTON, CHARLES S. HOUSTON (Vermont Univ., Burlington.), and ALLEN CYMERMAN 15 Jun. 1987 25 p
(Contract DAMD17-85-C-5206)
(AD-A186456) Avail: NTIS HC A03/MF A01 CSCL 06L

The accuracy of four devices for measuring arterial and venous saturation (SO_2) was evaluated during a study of hypobaric hypoxia conducted with eight male subjects exposed progressively to simulated altitudes from sea level to 29,000 ft. Saturation was measured with the Lex-O₂-Con-K (galvanic cell; oxygen content (O₂ Con)/modified Siggard-Anderson Equation; Lex), IL-282 Co-Oximeter (spectrophotometric; Co-Ox), and the Radiometer ABL-300 (PO₂/Siggard-Anderson Equation; ABL-300). Non-invasive spectrophotometric measurements of SO_2 were made with an HP 47201A Ear-Oximeter (Ear-Ox). Saturation was calculated from O₂ Con. The Co-Ox, which correlates with the Van Slyke method over a wide physiological range was used as the reference method for measuring SO_2 . With the exception of the Ear-Ox, each instrument compared favorably with the Co-Ox over a broad range. In conclusion, the ABL-300 and the Lex are comparable in accuracy to the Co-Ox. GRA

N88-16338# Army Research Inst. of Environmental Medicine, Natick, Mass.

PORTABLE, AMBIENT AIR MICROCLIMATE COOLING IN SIMULATED DESERT AND TROPIC CONDITIONS

STEPHEN R. MUZA, NANCY A. PIMENTAL, HENRY M. COSIMINI, and MICHAEL N. SAWKA Apr. 1987 24 p
(AD-A186457) Avail: NTIS HC A03/MF A01 CSCL 06L

The feasibility of providing ambient air during exercise and conditioned air during rest on reducing physiological strain and optimizing tolerance time was examined. Six male soldiers attempted 250-min exposures in hot/dry and hot/wet environments. Subjects wore chemical protective clothing over the combat vehicle crewman uniform and an air-cooled vest. They alternated between 50 min of treadmill walking and 50 min of rest. During the walks, a backpack mounted blower provided a total of 10 or 18 cfm of air to the vest and face; while subjects received 18 cfm of conditioned air from an umbilical during rest. In the hot/wet environment, tolerance time was extended compared to a predicted tolerance time assuming no microclimate cooling. We concluded that the ambient air backpack reduced physiological strain and improved tolerance time of combat vehicle crewman during exercise in the heat. In addition, since the physiological and tolerance time

responses with the 10 cfm airflow were midway between the control and 18 cfm airflow results, further tests may find an intermediate airflow rate which significantly improves performance while minimizing the backpack blower size. GRA

N88-16339# Army Research Inst. of Environmental Medicine, Natick, Mass.

RAPID HYPOTHERMIA SUBSEQUENT TO ORAL NICOTINIC ACID AND IMMERSION IN WARM (30C) WATER

ROGER W. HUBBARD, LAWRENCE E. ARMSTRONG, and ANDREW J. YOUNG Mar. 1987 6 p
(AD-A186458) Avail: NTIS HC A02/MF A01 CSCL 06O

The purpose of this letter to the Editor is to describe the results of pilot studies conducted to evaluate body cooling by water immersion, with and without nicotinic acid. Nicotinic acid pretreatments resulted in greater body cooling than control trials. However, cooling rates were less than can be achieved with evaporative cooling techniques. The striking feature of the nicotinic acid trials involved the magnitude of body cooling achieved in relatively temperate water (30 C). GRA

N88-16340# Army Research Inst. of Environmental Medicine, Natick, Mass.

RESPIRATORY AND CARDIOVASCULAR RESPONSES TO COLD STRESS FOLLOWING REPEATED COLD WATER IMMERSION

S. B. MUZA, A. J. YOUNG, M. N. SAWKA, J. E. BOGART, and K. B. PANDOLF Jul. 1987 32 p
(AD-A186460) Avail: NTIS HC A03/MF A01 CSCL 06J

The effects of cold acclimation (CA) on the cardiorespiratory responses to cold air and water stress tests (CST) were studied in seven males before and after a CA program of daily 90 min cold water (18 C) immersions repeated five times a week for five consecutive weeks. The CST consisted of a 90 min resting exposure to cold air or water during which rectal temperature ($T_{sub re}$), oxygen consumption (VO_2), carbon dioxide production (VCO_2), minute ventilation ($V_{sub E}$), heart rate (HR), cardiac output (Q) and blood pressure (BP) were periodically measured. In cold air following CA, the VO_2 at 10 minutes was lower post than pre CA, however, no differences were found in cold water. The ($V_{sub E}$) increased during CST as a function of VCO_2 . The CA did not affect the ($V_{sub E}$)- VCO_2 relationship or the pattern of breathing during CST in cold air or water. The CA had no effect on Q or (a-V) O₂ difference, which both increased during the first 45 min of CST, then remained stable. BP increased significantly during the first cold water exposure, but not during the last cold water immersion. These data indicate the CA attenuated the onset of metabolic heat production during CST in air but did not alter its ultimate magnitude or the relationships between the cardiorespiratory variables and metabolic requirements. Also the thermoregulatory adjustments associated with CA altered the control of blood pressure during acute cold stress. GRA

N88-16341# Army Research Inst. of Environmental Medicine, Natick, Mass.

TEMPERATURE REGULATION AT REST AND EXERCISE DURING THE HUMAN MENSTRUAL CYCLE

MARGARET A. KOLKA, LOU A. STEPHENSON, and RICHARD R. GONZALEZ Jul. 1987 30 p
(AD-A186461) Avail: NTIS HC A03/MF A01 CSCL 06J

Thermoregulatory responses were studied in eight women during three separate experimental protocols in both the follicular (F) and luteal (L) phases of the menstrual cycle. Continuous measurements of esophageal temperature ($T_{sub es}$), mean skin temperature ($T_{sub sk}$), metabolism, and forearm sweating ($m_{sub s}$) were made during all experiments. Study 1 evaluated 35 minutes of seated cycle exercise. Study 2 involved both passive heat exposure and seated cycle exercise to elicit a 0.8 C increase in $T_{sub es}$. Study 3 evaluated high intensity exercise. The normal L increase in resting $T_{sub es}$ occurred in all eight subjects. $T_{sub sk}$ was higher during L than F in all experiments. During exercise, the $T_{sub es}$ threshold for sweating was higher in L,

with no change in the slope of m sub s to T sub e s between menstrual cycle phases. This rightward shift in T sub e s averaged 0.53 C for all conditions studied. Temperature regulation in healthy women varies with menstrual cycle phase as the onset of sweating occurs at an elevated T sub e s threshold in the luteal phase when resting core temperature is elevated. GRA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A88-20856
COPING WITH PILOT STRESS - RESTING AT HOME COMPARED WITH RESTING AWAY FROM HOME

CARY L. COOPER (Manchester, Victoria University, England) and STEVEN J. SLOAN (University of Wales Institute of Science and Technology, Cardiff) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1175-1182. refs

This study assessed the impact of 'resting at home' vs 'resting away from home' among 272 British commercial airline pilots. The purpose of the investigation was two-fold: to see whether resting at home and resting away from home are equivalent in the quality of rest they provide pilots (in view of the increasing trend in the industry for encouraging pilots to 'rest while away from home base'); and second, to highlight the factors that may be predictive of poor mental health and mood shifts while resting away or at home. On balance, pilots away from home managed to rest, but not really to relax (from a psychological perspective). Explanations of this are discussed, based on bivariate and multivariate statistical analyses. Author

A88-20860* Old Dominion Univ., Norfolk, Va.
INFLUENCE OF VISUAL AND MOTION CUES ON MANUAL LATERAL STABILIZATION

J.-K. HUANG (Old Dominion University, Norfolk, VA) and L. R. YOUNG (MIT, Cambridge, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1197-1204. refs

(Contract NSG-2032; NAG2-12; NAG2-88)

The ability of humans to detect and control their own lateral acceleration was measured by means of a closed-loop nulling task. Wide-field moving visual cues enhanced the operator's performance in nulling self-motion, especially at lower frequencies. Even visual cues, fixed relative to the operator, resulted in performance improvement relative to self-motion nulling in the dark. Describing function (frequency response) data was obtained for random acceleration conditions consisting of the visual field fixed relative to the laboratory, fixed relative to the subject, moving at constant velocity relative to the subject, and in the dark. The describing function data was corrected for the dynamics of operator manual control strategy. The resulting frequency responses were used to develop a linear model of self-motion detection which required a lead term of 1.5 rad/s to be added to the existing model in order to match the higher sensitivity at higher frequencies. Author

A88-20864* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PSYCHIATRIC COMPONENTS OF A HEALTH MAINTENANCE FACILITY (HMF) ON SPACE STATION

PATRICIA A. SANTY (NASA, Johnson Space Center; Flight Medicine Clinic, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1219-1224. refs

The operational psychiatric requirements for a comprehensive Health Maintenance Facility (HMF) on a permanently manned Space Station are examined. Consideration is given to the

psychological health maintenance program designed for the diagnosis of mental distress in astronauts during flight and for prevention of mental breakdown. The types of mental disorders that can possibly affect the astronauts in flight are discussed, including various organic, psychotic, and affective mental disorders, as well as anxiety, adjustment, and somatoform/dissociative disorders. Special attention is given to therapeutic considerations for psychiatric operations on Space Station, such as restraints, psychopharmacology, psychotherapy, and psychosocial support. I.S.

A88-20866
THE SUBJECTIVE PERCEPTION OF WORKLOAD IN LOW-TIME PRIVATE PILOTS - A PRELIMINARY STUDY

B. E. HASKELL (Wright State University, Dayton, OH) and GARY B. REID (USAF, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1230-1232. refs

Control of pilot workload may prevent performance failure of VRF pilots in adverse weather. Measurement of workload and the prediction of performance failure are the first steps. Twelve low-time noninstrument rated pilots were progressively tasked with flight maneuvers under simulated instrument meteorological conditions to the point of performance failure. For each of three simulated flights, 14 maneuvers, presented in groups, were performed. Perceived workload was reported by the Subjective Workload Assessment Technique (SWAT) of Reid et al. (1981, 1982). Five-hundred workload scores were obtained. Workload scores varied significantly between the groups of maneuvers. Instrument landing system approaches had the highest workloads, with descents the second highest. Workload scores were significantly higher when associated with performance failure. The SWAT proved to be a sensitive workload measure. It showed some promise as a predictor of performance breakdown. Author

A88-20999
A BEHAVIOURAL METHOD FOR ACCELERATING RE-ENTRAINMENT OF RHYTHMS TO NEW LIGHT-DARK CYCLES

N. MROSOVSKY and PEGGY A. SALMON (Toronto, University, Canada) Nature (ISSN 0028-0836), vol. 330, Nov. 26, 1987, p. 372, 373. NSERC-supported research. refs

To investigate the possibility that behavioral events alone can alter the rate of adjustment to new light-dark (LD) cycles, the rate of reentrainment of hamsters was studied. It was found that the rate of adjustment could be more than doubled simply by making the animals active on a single occasion in the middle of their normal rest period, immediately after the shift in the LD cycle. The application of this finding to jet lag and similar problems is addressed. C.D.

A88-21376
WHY LOW-FLYING FIGHTER PLANES CRASH - PERCEPTUAL AND ATTENTIONAL FACTORS IN COLLISIONS WITH THE GROUND

RALPH NORMAN HABER (Illinois, University, Chicago) Human Factors (ISSN 0018-7208), vol. 29, Oct. 1987, p. 519-532. USAF-supported research. refs

A detailed analysis of a recent jet fighter mishap is made in terms of perceptual and attentional factors that may have contributed to or caused the mishap. The crash occurred in clear air while the fighter was maneuvering over rugged terrain of irregular and unpredictable features. There were no mechanical failures and no evidence of pilot error. The analysis concentrates on the effects of the underinformativeness of the terrain; the difficulties of perceiving distance, ground clearance, and position under these conditions; the consequences of the high gravitational forces generated by the jet just prior to impact; and the competition for the pilot's visual attention. The effects of the combinations of these various factors are then considered. Finally, specific suggestions are made for improvements in training for low-altitude flight. Author

A88-21377

THE EFFECTS OF PANEL ARRANGEMENT AND LOCUS OF ATTENTION ON PERFORMANCE

JACQUELINE V. DOWNING (Virginia Polytechnic Institute and State University, Blacksburg) and MARK S. SANDERS (California State University, Northridge) *Human Factors* (ISSN 0018-7208), vol. 29, Oct. 1987, p. 551-562. refs

A 2 x 2 x 8 factorial design was used to determine the effects of mirror-imaged panel arrangement and locus of attention (i.e., whether the subject focused attention external to the control panel or internal to the control panel) on operator performance. Response time and error data were collected for both nonemergency and simulated emergency situations. For the nonemergency performance condition the mirror-image group took longer to operate the controls and made slightly more errors. Performance in emergency situations was particularly degraded in the mirror-imaged condition. More instances of strain and fatigue were reported by the subjects using the mirror-imaged panel. The use of mirror-imaged complex control panels in high-stress environments is not recommended when separate panels are being operated by the same person. Author

A88-21901

PROSPECTS FOR THE DEVELOPMENT OF TECHNIQUES OF OCCUPATIONAL PSYCHOLOGICAL SELECTION [PERSPEKTIVY RAZVITIYA TEKHNIЧЕСКИХ SREDSTV PROFESSIONAL'NOGO PSIKHOLOGICHESKOGO OTBORA]

I. V. ZAKHAROV, B. V. KULAGIN, and A. F. BOGACHEV *Voenno-Meditsinskii Zhurnal* (ISSN 0026-9050), Sept. 1987, p. 43-45. In Russian. refs

The types of equipment presently used for conducting psychological and psychophysiological tests for occupational selection is discussed together with the functional possibilities of individual devices and the areas of their application. All of the devices considered as well as most modern computer-controlled systems have a significant drawback: they are not universal and cannot be used for testing all selection parameters. The paper discusses the features of a novel universal testing system which is being developed on the principle of type blocks, allowing the use of blocks in different combinations. This feature of the new system will make it possible to redesign the system to fit the needs of each particular test. The system will be built on the basis of the Elektronika-60 microcomputer. I.S.

A88-22330*# Loyola Univ., Chicago, Ill.

CREW PRODUCTIVITY ISSUES IN LONG-DURATION SPACE FLIGHT

JOHN M. NICHOLAS (Loyola University, Chicago, IL), H. CLAYTON FOUSHEE (NASA, Ames Research Center, Moffett Field, CA), and FRANCIS L. ULSCHAK (H. Lee Moffitt Cancer Research Institute, Tampa, FL) *AIAA, Aerospace Sciences Meeting, 26th, Reno, NV, Jan. 11-14, 1988. 13 p. refs* (AIAA PAPER 88-0444)

Considerable evidence suggests the importance of teamwork, coordination, and conflict resolution to the performance and survival of isolated, confined groups in high-technology environments. With the advent of long-duration space flight, group-related issues of crew functioning will take on added significance. This paper discusses the influence of crew roles, status, leadership, and norms on the performance of small, confined groups, and offers guidelines and suggestions regarding organizational design, crew selection, training, and team building for crew productivity and social well-being in long-duration spaceflight. Author

A88-22331#

ONBOARD TRAINING FOR THE SPACE STATION

DONA M. ERB (Mitre Corp., Houston, TX) *AIAA, Aerospace Sciences Meeting, 26th, Reno, NV, Jan. 11-14, 1988. 8 p. refs* (AIAA PAPER 88-0445)

For perhaps the first time, training for work in space has been defined as a necessary component of onboard activities. This paper describes the problems which drive the onboard training requirements. Three modes of training are described as solutions

to these problems. Examples of potential implementation techniques for the training, using new technologies, are included. The three proposed modes of onboard training are: (1) an off-line capability to be used for computer-assisted instruction and procedural reviews, (2) a job performance assistance mode to provide rapid access to instruction and other forms of on-line help, and (3) a simulation mode for rehearsing robotic and other dynamic system activity. Author

A88-22951

DISTRACTOR-TARGET INTERACTIONS DURING DIRECTED VISUAL ATTENTION

Z. D. ZIMBA and H. C. HUGHES (Dartmouth College, Hanover, NH) *Spatial Vision* (ISSN 0169-1015), vol. 2, no. 2, 1987, p. 117-149. refs

The spatial extent of directed visual attention is considered in a group of experiments using precuing in a suprathreshold luminance detection paradigm. An attempt is made to determine whether increased spatial selectivity could be found when luminous markers indicated the exact location of the expected visual target. When attention is focused on a marked location along the horizontal meridian, a transition in performance typically occurs at the vertical meridian. K.K.

A88-22952

A THEORY ON THE DETERMINATION OF 3D MOTION AND 3D STRUCTURE FROM FEATURES

SHUN-ICHI AMARI (Tokyo, University, Japan) and MINORU MARUYAMA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) *Spatial Vision* (ISSN 0169-1015), vol. 2, no. 2, 1987, p. 151-168. refs

The present paper proposes a mathematical theory and a method of recognition of both the 3D structure and the motion of a moving object from its monocular image. Initially, characteristic features are extracted from the 2D perspective image of the object. Because motion of the object induces a change in its 2D perspective image, it also induces a change in the features which depends on the 3D structure and the velocity of the object. This suggests the possibility of detecting the 3D structure and the motion directly from the features and their changing rate, without the need for calculating optical flows. An analysis is made of the relation between the 3D rigid motion of a surface element and the change in local linear features. From this relation, a method is proposed for calculating the velocity of and the normal to the surface element without considering any correspondence of points. An optical flow can also be calculated by this method. Two simple computer simulations are provided. Author

A88-23518

ASTRONAUT SELECTION AND OPERATIONAL TASKS RELATED TO SPACELAB MISSIONS [AUSWAHL VON ASTRONAUTEN UND OPERATIONELLE AUFGABEN IM UMFELD VON SPACELAB-MISSIONEN]

PAUL KUKLINSKI, KLAUS-MARTIN GOETERS, and ANKE PUTZKA (DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) *DFVLR-Nachrichten* (ISSN 0011-4901), Nov. 1987, p. 10-13. In German.

The procedures followed in selecting the five FRG astronaut candidates named in August 1987 are outlined, and a general overview of DFVLR aerospace medicine operations is given. Of 1799 applicants, 321 met the professional requirements; 245 passed the medical-history evaluation; 23 were found to be psychologically qualified; and 13 passed the general and specialized medical tests to form the group from which the five candidates were chosen. Consideration is given to the responsibilities of the Space Medicine Board and the Medical Board in selection and training, mission support, and postmission care and evaluation; the specific tasks of the operational psychology and operational medicine departments; cooperation with NASA medical staff; and the role of aerospace medicine in the planned ESA/DFVLR Crew Training Center. T.K.

A88-23527

THE MEDICAL SELECTION OF FRENCH ASTRONAUTS IN 1986 [LA SELECTION MEDICALE DES SPATIONAUTES FRANCAIS EN 1986]

A. DIDIER (Service de Sante pour l'Armee de l'Air, Ecole d'Application; Centre Principal d'Expertise Medicale du Personnel Navigant, Paris, France), B. COMET (CNES, Paris, France), H. ILLE (Centre Principal d'Expertise Medicale du Personnel Navigant, Paris, France), and J. P. GOURBAT (Hopital d'Instruction des Armees Dominique Larrey, Versailles, France) *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 110-113. In French. refs

Medical testing of French astronauts performed both in 1985 to select individuals for the roles of experimenters and engineers, and in 1986 to select individuals for the long-duration Franco-Soviet flight, is discussed. The 1985 selection process consisted of three stages, including Coriolis acceleration testing, clinical examinations, and psychological assessments. More rigorous testing was necessary for the Franco-Soviet flight in order to select astronauts capable of dealing with physiopathological consequences of long-term flight such as bone demineralization, dehydration, hypercalciuria, and the increased possibility of infection. R.R.

A88-23536

INCIDENCE OF EMERGENCY SITUATIONS IN FLIGHT AND PSYCHOLOGICAL CONSEQUENCES FOR FLIGHT PERSONNEL AND PASSENGERS [INCIDENCES ET CONSEQUENCES PSYCHOLOGIQUES DES SITUATIONS D'URGENCE EN VOL CHEZ LE PERSONNEL NAVIGANT ET LES PASSAGERS]

J. LAVERNE, E. LAFONTAINE (Air France, Paris), C. J. BLANC, and J. SIROT *Medecine Aeronautique et Spatiale*, vol. 26, 2nd Quarter, 1987, p. 166-170. In French. refs

N88-15392# Joint Publications Research Service, Arlington, Va. SOME ASPECTS OF SOCIOPSYCHOLOGICAL SCREENING OF FLYING SCHOOL APPLICANTS

V. I. YEVDOKIMOV and P. P. PARKHOMENKO *In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 32-36* 12 Jan. 1988 Transl. into ENGLISH from *Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR)*, v. 21, no. 3, May - Jun. 1987 p 23-26

Avail: NTIS HC A08/MF A01

One hundred and fifty nine applicants who passed entrance examinations and were admitted to the flight school were kept under careful psychological observation and follow up. It was found that those applicants who grew and developed in unfavorable conditions, i.e., under the influence of risk factors which include young age to start smoking, nervous shocks in childhood and adolescence, unstable family relationships, alcoholic parents, etc., failed and were expelled from the school due to different reasons in a greater number of cases. Thus professional selection should include accentuated attention to risk factors that accompanied the years of personality formation which may help predict their inadequacies in psychic adaptation to the flying profession.

Author

N88-15433# Joint Publications Research Service, Arlington, Va. NEW US BOOK ON AVIATION PSYCHOLOGY REVIEWED

A. A. GYURDZHIAN, V. F. TOKAREV, and YU. YU. SHIPKOV *In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 126-137* 13 Jan. 1988 Transl. into ENGLISH from *Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR)*, v. 21, no. 4, Jul. - Aug. 1987 p 82-88

Avail: NTIS HC A08/MF A01

The history of aviation psychology in the U.S., basic concepts of aviation psychology, directions, and prospects of its development are covered. The professional performance of a pilot is submitted to psychological analysis. The main guidelines of engineering psychology and its application to the design of information display systems and controls are discussed. Perceptual phenomena of flight work is examined. Individual tendencies and abilities of flight

personnel, their work capacity and quality of performance are evaluated. Different aspects of pilot training are discussed. The advantages of using the systems method to organize air traffic control, conduct research with optimum and mutually complementary distribution of functions among man and machine are discussed. Finally, the methodology of research in aviation psychology, starting with the onset of some problem to practical introduction and the theoretical generalization are discussed.

B.G.

N88-15436# Navy Personnel Research and Development Center, San Diego, Calif.

EVOKED BRAIN ACTIVITY AND PERSONNEL PERFORMANCE Technical Report, FY86 - FY87

GREGORY W. LEWIS and RICHARD C. SORENSON Oct. 1987 42 p

(AD-A185922; AD-F000114; NPRDC-TR-88-1) Avail: NTIS HC A03/MF A01 CSCL 05H

Prior research has suggested that brain recordings such as the neuroelectric evoked potential (EP) and neuromagnetic fields may substantially augment personnel assessment procedures. Such procedures include the measurement and prediction of on-job performance. Areas covered in this report include a discussion of individual difference measurement and its history, followed by a description of evidence for the relationship between neuroelectric recordings and aptitude. Emphasis is given to relationships between EP recording and on-job performance assessment that this Center found over the last 12 years. Finally, a discussion follows of new techniques that we and others are examining and developing to improve the sensitivity of brain function measures, using the neuromagnetic evoked field (EF). Relationships between the EF and on-job performance are described. GRA

N88-15437# Minnesota Univ., Minneapolis. Dept. of Psychology.

COMPUTING SUPPORT FOR BASIC RESEARCH IN PERCEPTION AND COGNITION Interim Report, 31 Jul. 1986 - 31 Jul. 1987

CHARLES R. FLETCHER, GORDON E. LEGGE, MARY J. NISSEN, and NEAL F. VIEMEISTER 31 Aug. 1987 24 p

(Contract AF-AFOSR-0280-86)

(AD-A186192; AFOSR-87-1312TR) Avail: NTIS HC A03/MF A01 CSCL 05H

This report describes the progress made during the first year of an equipment grant which has provided a common computing environment for four laboratories conducting research in perception and cognition at the University of Minnesota. Research in the Cognitive Psychology Laboratory has shown that learning a procedural skill can occur in the absence of any declarative learning. Progress has also been made toward developing a computer simulation of this process. In the Visual Psychophysics Laboratory several image-enhancement algorithms have been developed as well as a psychophysical procedure for evaluating those algorithms. Research in the Auditory Psychophysics Laboratory has concentrated on developing a model of the detection and recognition of complex auditory signals by human observers. A subset of the model has been implemented as a computer simulation and several experiments have been completed to guide its future direction. In the Psycholinguistics Laboratory a computer model of text comprehension and recall has been constructed. Several experiments have been completed that confirm assumptions built into the model and show a good correspondence between its performance and that of human subjects. GRA

N88-15438# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

ROLES OF KNOWLEDGE IN MOTOR LEARNING Ph.D. Thesis
CHRISTOPHER G. ATKESON 2 Feb. 1987 158 p
(Contract N00014-82-K-0334; N00014-85-K-0124)
(AD-A186420; AI-TR-942) Avail: NTIS HC A08/MF A01 CSCL 051

This thesis applies the computational approach to motor learning. It describes the constraints that enable performance improvement with experience, the constraints that must be satisfied by a motor learning system, what is being computed in order to achieve learning, and why it is being computed. The particular tasks used to access motor learning are loaded and unloaded free arm movement, and the thesis includes work on rigid body load estimation, arm model estimation, optimal filtering for model parameter estimation and trajectory learning from practice. Learning algorithms were developed and implemented in the context of robot arm control. Some of the roles of knowledge in learning are demonstrated. Powerful generalizations can be made on the basis of knowledge of system structure, as is demonstrated in the load and arm model estimation algorithms. Improving the performance of parameter estimation algorithms used in learning involves knowledge of the measurement noise characteristics, as is shown in the derivation of optimal filters. Using trajectory errors to correct commands requires knowledge of how command errors are transformed into performance errors, i.e., an accurate model of the dynamics of the controlled system, as is demonstrated in the trajectory learning work. GRA

N88-15439# Katholieke Universiteit, Nijmegen (Netherlands). Psychologisch Lab.

LOCAL VERSUS GLOBAL MINIMA IN VISUAL PATTERN COMPLETION
F. BOSELIE 1986 84 p
(PB87-234803; R-86-FU-08) Avail: NTIS HC A05/MF A01 CSCL 051

The phenomenon of visual completion poses two problems: (1) when will a subject see one figure in front of another in contrast to several nonoverlapping figures in the same plane? and (2) exactly what will be seen behind the occluding figure? Recently, Buffart et al. (1981, 1983) argued that both questions can be answered by coding theory. Coding theory consists of the idea that a global minimum principle is operative in perception and that perception will result in an interpretation which can be represented by a code with minimal information load. Contrary to this view, it is claimed here that only those completion- and mosaic-interpretations which exploit the local advantage of continuity of sides behind occluding surfaces or avoid the local disadvantage of describing an angle on a common contour twice, will be perceptually salient. When both a locally simple completion- and a locally simple mosaic-interpretation can be made, preference will be strongest for the type of interpretation which is globally more simple. GRA

N88-16342# Naval Health Research Center, San Diego, Calif.
ANTARCTICA AS A MODEL FOR THE HUMAN EXPLORATION OF MARS Final Report

LAWRENCE A. PALINKAS 19 Jul. 1987 23 p
(AD-A185835; NAVHLTHRSCHC-87-16) Avail: NTIS HC A03/MF A01 CSCL 05H

Among the many issues to be addressed in planning for the eventual human exploration of Mars are the processes of social adaptation and psychological adjustment to prolonged isolation in an extreme environment. An understanding of these two interrelated processes is critical from the standpoint of personnel selection, crew organization, and task performance. The human experience of exploration and research in Antarctica can contribute much to this understanding. This paper provides a brief historical overview of the experience of social adaptation and psychological adjustment of Antarctic expeditions. Factors which currently influence these processes in the Antarctic, including social organization, Antarctic culture social and psychological resources used for coping with stress, and environmental resources and constraints, are examined. This paper also describes the effect of these processes on the

health and performance of Antarctic winter-over personnel. The relevance of the Antarctic experience to planning for extended missions on Mars is discussed. GRA

N88-16343# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

TARGET SIZE AND LUMINANCE EFFECTS ON ACCOMMODATION AND VERGENCE M.S. Thesis

LEON NORSE MCLIN, JR. 1987 187 p
(AD-A185861; AFIT/CI/NR-87-88T) Avail: NTIS HC A09/MF A01 CSCL 06D

This investigation, using Schor's (Schor and Kotulak 1986) dual interaction model of accommodation and vergence sought to determine how three different stimuli, namely dynamic size changes, voluntary effort, and luminance changes might influence accommodation and vergence. The mutual independence of the accommodative convergence and convergence accommodation crosslinks are primary features of this model. The AC/A and CA/C ratios were used as a tool to determine whether changing size or voluntary efforts was primarily influencing accommodation or vergence. Another main feature of this model is the separate tonic adapters for vergence and accommodation that occur after the crosslinks. Schor et al., (1986) found that tonic aftereffects of accommodation are masked in darkness. We investigated the effect of different luminance levels on these tonic aftereffects. In chapter 2, changing size was found to produce changes in both accommodation and vergence and these changes occur in a ratio like the AC/A ratio rather than the CA/C ratio. In chapter 3, voluntary effort is shown to produce changes in accommodation and vergence in proportions of an AC/A ratio rather than a CA/C ratio. In chapter 4, accommodative aftereffects were shown to be masked in scotopic luminance levels and partially masked at mesopic luminance levels when the accommodative loop was opened with a pinhole. GRA

N88-16344# Research Inst. of National Defence, Stockholm (Sweden).

OVERLEARNING AND POSITIVE THINKING ALLEVIATE NEGATIVE EFFECTS OF STRESS ON PERFORMANCE

GERRY LARSSON Aug. 1987 11 p In SWEDISH; ENGLISH summary
(FOA-C-50051-5.3; ISSN-0347-7665; ETN-88-91409) Avail: NTIS HC A03/MF A01

The impact of different stressors on performance was studied. A company of army conscripts performed a test on a training simulator in calm conditions and in noisy conditions when they were exhausted. This effect was alleviated by a high amount of overlearning. Conscripts who appraised the situation as challenging used much self-talk of positive thinking character and performed well. Those who appraised the situation as threatening used much self-talk of negative thinking character and performed poorly. ESA

N88-16345# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A COMPARISON OF THE EFFECTS OF GROUP DYNAMICS ON INDIVIDUALS ASSIGNED TO INTEGRAL AND NON-INTEGRAL AIRCREWS M.S. Thesis

PAUL M. SOWADA Sep. 1987 104 p
(AD-A186467; AFIT/GSM/LSR/87S-32) Avail: NTIS HC A06/MF A01 CSCL 05H

This study compared and contrasted the effects of group dynamics using Strategic Air Command KC-135 officer aircrew members who operate under an integral crew concept and Military Airlift Command officer aircrew members who operate under a non-integral crew concept. The study compared level of group cohesiveness and intragroup communications between the two types of crew structures. It also examined the degree of confidence crewmembers had in the people with whom they flew, attitudes regarding flying safety norms, and the type of crew structure preferred in a combat environment. Finally, this study sought to determine if crewmembers perceived that navigators had a greater opportunity to assume a leadership role in the crew with whom

they flew if performing their duties under an integral crew structure. GRA

N88-16346# Gulf and Western Applied Science Labs., Waltham, Mass.

RESEARCH ON VISUAL INFORMATION PROCESSING WITH SPECIAL REFERENCE TO OCULOMOTOR BEHAVIOR IN THE AREAS OF EXPLORATION, RECOGNITION AND SEARCH Final Technical Report, Mar. 1986 - Mar. 1987

LEONARD F. SCINTO Mar. 1987 37 p
(Contract DAAA15-86-C-0025)
(AD-A186598) Avail: NTIS HC A03/MF A01 CSCL 06D

The research sought to understand a certain fundamental aspect of visual information processing in the areas of recognition, exploration and search behavior. Progress was made in the following areas. (1) Laboratory Reconfiguration. During the six months of this contract ASL undertook to upgrade and augment the eye movement recording equipment at HEL. One major effort was devoted to writing a data acquisition program to record and analyze pupil diameter data. (2) Data Collection & Analysis. An entirely new hardware and software data acquisition environment had to be designed and built and a new I/O configuration designed for the PDP 11 computer. GRA

N88-16347# Naval Health Research Center, San Diego, Calif.

GROUP ADAPTATION AND INDIVIDUAL ADJUSTMENT IN ANTARCTICA: A SUMMARY OF RECENT RESEARCH Final Report

L. A. PALINKAS 13 Aug. 1987 39 p
(AD-A186605; NHRC-87-24) Avail: NTIS HC A03/MF A01 CSCL 05H

The relationship between group adaptation and individual adjustment has been the focus of recent research on the long-term effects of prolonged isolation in the Antarctic. A series of studies conducted at the Naval Health Research Center examined the health and service records of enlisted Navy personnel who applied to the Operation Deep Freeze Program between 1963 and 1974. The objective of these studies was to determine if follow-up incidence rates and performance criteria were significantly different between a group of winter-over personnel and a control group of enlisted personnel who were screened and qualified for winter-over duty but assigned elsewhere. Results indicated that the overall incidence rate for the winter-over group was significantly lower than the rate for the control group. An increase in total disease incidence was observed among the winter-over group within a year of their return from the Antarctic, but this increase failed to attain statistical significance relative to the rate of the control group. In addition, individuals with high needs for achievement and control over others were found to be at reduced risk for long-term disease incidence. These results are examined in light of personality traits which facilitate adjustment to stressful life events and the sociocultural systems of Antarctic stations which support and promote values enabling personnel to adapt to prolonged isolation. GRA

N88-16348# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

CIRRUS: AN AUTOMATED PROTOCOL ANALYSIS TOOL Technical Report, 15 Jun. 1986 - 31 Oct. 1987

KURT VANLEHN and STEVE GARLICK 15 Apr. 1987 24 p
Presented at the 4th International Workshop on Machine Learning, Los Altos, Calif., 1987
(Contract N00014-86-K-0349; N00014-85-C-0688; PROJ. RR0-4206)
(AD-A186646; PCG-6) Avail: NTIS HC A03/MF A01 CSCL 05I

Cirrus is a tool for protocol analysis. Given an encoded protocol of a subject solving problems, it constructs a modal that will produce the same protocol as the subject when it is applied to the same problems. In order to parameterize Cirrus for a task domain, the user must supply it with a problem space: a vocabulary of attributes and values for describing spaces, a set of primitive operators, and set of macro operators. Cirrus model of the subject is a hierarchical plan that is designed to be executed by an agenda

based plan follower. Cirrus main components are a plan recognizer and a condition inducer. The condition inducer is based on Quinlan's ID3. Cirrus has potential applications not only in psychology but also as the student modelling component in an intelligent tutoring system. GRA

N88-16349# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

DERIVING DESCRIPTIONS OF THE MIND Technical Report, 15 Jun. 1986 - 31 Oct. 1987

STEVE GARLICK and KURT VANLEHN 7 Jul. 1987 61 p
(Contract N00014-86-K-0349)
(AD-A186647; PCG-7) Avail: NTIS HC A04/MF A01 CSCL 05I

Cirrus is a tool for protocol analysis. Given an encoded protocol of a subject solving problems, it constructs a model that will produce the same protocol as the subject when it is applied to the same problems. In order to parameterize Cirrus for a task domain, the user must supply it with a problem space: a vocabulary of attributes and values for describing spaces, a set of primitive operators, and a set of macro-operators. Cirrus' model of the subject is a hierarchical plan that is designed to be executed by an agenda-based plan follower. In this paper, the philosophical and mathematical foundations of Cirrus are explored. GRA

N88-16350# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

CHANGING THE LAYERS OF MIND Technical Report, 15 Jun. 1986 - 31 Oct. 1987

KURT VANLEHN 2 Jul. 1987 19 p
(Contract N00014-86-K-0349; N00014-86-K-0678)
(AD-A186648; PCG-12) Avail: NTIS HC A03/MF A01 CSCL 05H

It is common in cognitive science to assume that the mind is composed of layers of programmable machines. The machine of the top layer runs the end user program which, roughly speaking, performs the task at hand. Every other machine runs a program that implements the memories and primitive processes of the machine above it in the stack of layers. The bottom machine is actual neuronal hardware. A natural part of the layering principle in computer systems design is that the layers can be changed. In particular, any layer, except the hardware layer, can be replaced without changing the others. This essay examines the physiological implications of the hypothesis that layers can be changed. GRA

N88-16351*# Essex Corp., Orlando, Fla.

STABILITY, RELIABILITY AND CROSS-MODE CORRELATIONS OF TESTS IN A RECOMMENDED 8-MINUTE PERFORMANCE ASSESSMENT BATTERY

R. L. WILKES, R. S. KENNEDY, W. P. DUNLAP, and N. E. LANE
Apr. 1986 53 p
(Contract NAS9-17326)
(NASA-CR-172039; NAS 1.26:172039; EOTR-86-4) Avail: NTIS HC A04/MF A01 CSCL 05I

A need exists for an automated performance test system to study drugs, agents, treatments, and stresses of interest to the aviation, space, and environmental medical community. The purpose of this present study is to evaluate tests for inclusion in the NASA-sponsored Automated Performance Test System (APTS). Twenty-one subjects were tested over 10 replications with tests previously identified as good candidates for repeated-measure research. The tests were concurrently administered in paper-and-pencil and microcomputer modes. Performance scores for the two modes were compared. Data from trials 1 to 10 were examined for indications of test stability and reliability. Nine of the ten APT system tests achieved stability. Reliabilities were generally high. Cross-correlation of microbased tests with traditional paper-and-pencil versions revealed similarity of content within tests in the different modes, and implied at least three cognition and two motor factors. This protable, inexpensive, rugged, computerized battery of tests is recommended for use in repeated-measures studies of environmental and drug effects on performance. Identification of other tests compatible with microcomputer testing and potentially capable of tapping previously unidentified factors

is recommended. Documentation of APTS sensitivity to environmental agents is available for more than a dozen facilities and is reported briefly. Continuation of such validation remains critical in establishing the efficacy of APTS tests. Author

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A88-20854

THE EFFECTS OF DIFFERENT LEVELS OF TASK COMPLEXITY ON THREE VOCAL MEASURES

G. R. GRIFFIN and C. E. WILLIAMS (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1165-1170. Navy-supported research. refs

Interactive voice query and control systems are being considered as an alternative method of interfacing pilots with aircraft systems in high performance aviation environments. Before engineers integrate interactive voice systems into aircraft, knowledge is needed concerning what types of vocal changes, if any, are likely to occur as a result of environmental and task-induced stress. Recordings of the vocal utterances of 20 subjects, obtained as the subjects performed psychomotor and dichotic listening tasks, were subjected to acoustical analyses to evaluate the effects of task complexity on three measures: fundamental frequency, $f(0)$, peak amplitude (intensity), and word duration. The analyses revealed significant increases in $f(0)$ (p less than 0.05) and amplitude (p less than 0.01) and a significant decrease in word duration (p less than 0.01) as a function of increased task complexity. These findings suggest that task-induced vocal changes must be considered in the design of voice recognition systems for use in complex, high performance aviation environments. Author

A88-20865

CYCLE TIME CONTROL OF AN ONBOARD OXYGEN GENERATION SYSTEM

J. J. BEAMAN, S. Y. WANG, and G. Y. MASADA (Texas, University, Austin; Abex Corp., Aerospace Div., Oxnard, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Dec. 1987, p. 1225-1229. USAF-supported research. refs

The outlet oxygen concentration of an onboard oxygen generation system (OBOGS) is controlled in this study by varying the cycle time of a pressure swing adsorption process. The control of the oxygen concentration is highly desirable since both high and low concentrations of oxygen can cause physiological problems. This cycle time control method can be easily implemented using a dc motor and a simple electronic controller. The physiological requirements recommended for high-performance tactical aircraft can be met by this method with either an open-loop or closed-loop configuration. The open-loop configuration requires the measurement of crew breathing flowrate and cabin pressure. The closed-loop configuration requires an additional measurement of oxygen concentration, but it has the advantage of being more adaptive to system variability during setup and operation. The method in either configuration requires very little adjustment and setup time in order to meet the specifications. Author

A88-21076

A DISHWASHER FOR THE SPACE STATION

R. GARY WILSON and JON D. TROMBLEE (Whirlpool Corp., Evansville, IN) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. (SAE PAPER 871411)

This paper describes a dishwasher ground test unit which has been designed to wash eating utensils in the microgravity environment of the Space Station. The basic wash process is described as well as the methods used for controlling the wash and rinse water. The required interfaces to the Space Station are discussed and the amount of resources consumed during a complete wash cycle are presented. The paper is concluded with a discussion of several growth versions of the dishwasher which will accommodate increases in the number of crew persons on board the Space Station. Author

A88-21077* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ACCOMMODATING LIFE SCIENCES ON THE SPACE STATION

ROGER D. ARNO (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p. refs (SAE PAPER 871412)

The NASA Ames Research Center Biological Research Project (BRP) is responsible for identifying and accommodating high priority life science activities, utilizing nonhuman specimens, on the Space Station and is charged to bridge the gap between the science community and the Space Station Program. This paper discusses the approaches taken by the BRP in accommodating these research objectives to constraints imposed by the Space Station System, while maintaining a user-friendly environment. Consideration is given to the particular research disciplines which are given priority, the science objectives in each of these disciplines, the functions and activities required by these objectives, the research equipment, and the equipment suits. Life sciences programs planned by the Space Station participating partners (USA, Europe, Japan, and Canada) are compared. I.S.

A88-21078* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

OSSA SPACE STATION WASTE INVENTORY

DARYL N. RASMUSSEN, CATHERINE C. JOHNSON (NASA, Ames Research Center, Moffett Field, CA), JOHN J. BOSLEY, GEORGE L. CURRAN (Bionetics Corp., Moffett Field, CA), and RICHARD MAINS (Mains Associates, Berkeley, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p. refs (SAE PAPER 871413)

NASA's Office of Space Science and Applications has compiled an inventory of the types and quantities of the wastes that will be generated by the Space Station's initial operational phase in 35 possible mission scenarios. The objective of this study was the definition of waste management requirements for both the Space Station and the Space Shuttles servicing it. All missions, when combined, will produce about 5350 kg of gaseous, liquid and solid wastes every 90 days. A characterization has been made of the wastes in terms of toxicity, corrosiveness, and biological activity. O.C.

A88-21080

SPACE STATION HABITAT AND LABORATORY MODULE RACK FLIGHT TESTING IN THE SPACEHAB MODULE

ROBERT CITRON and THOMAS C. TAYLOR (Spacehab, Inc., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p. refs (SAE PAPER 871416)

The Spacehab Module is a pressurized volume scheduled to be launched by the Space Shuttle and providing an opportunity for the flight testing of Space Station hardware prior to deployment of the hardware to the IOC Space Station. The module will be available in 1990 and can provide a variety of support systems designed to reduce the technical development risk to Space Station

participants. The Spacehab Module flight testing capability simulating the Space Station interior environment is expected to be available five years before Initial Operating Configuration, creating a low cost, lower risk development lead-in rack testing capability for the commercial customer anticipating activities at Space Station. Author

A88-21081* Rockwell International Corp., Downey, Calif.
ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS ANALYSIS FOR A SPACE STATION LIFE SCIENCES ANIMAL EXPERIMENT

KENNETH T. SO (Rockwell International Corp., Downey, CA), JOHN B. HALL, JR. (NASA, Langley Research Center, Hampton, VA), and CLIFFORD D. THOMPSON (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 13 p. refs (SAE PAPER 871417)

NASA's Langley and Goddard facilities have evaluated the effects of animal science experiments on the Space Station's Environmental Control and Life Support System (ECLSS) by means of computer-aided analysis, assuming an animal colony consisting of 96 rodents and eight squirrel monkeys. Thirteen ECLSS options were established for the reclamation of metabolic oxygen and waste water. Minimum cost and weight impacts on the ECLSS are found to accrue to the system's operation in off-nominal mode, using electrochemical CO₂ removal and a static feed electrolyzer for O₂ generation. O.C.

A88-21089* Hamilton Standard, Windsor Locks, Conn.
SIMULATION AND CONTROL OF A SPACE STATION AIR REVITALIZATION SYSTEM

JAMES L. YANOSY (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and LAWRENCE F. ROWELL (NASA, Langley Research Center, Hampton, VA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p. refs (SAE PAPER 871425)

A computer simulation tool is written to investigate simulation and control of a Space Station air revitalization system. Candidate subsystems for various air revitalization roles in the Space Station have been and continue to be tested. However, integration and control of these subsystems into an effective system which revitalizes the air in all habitable areas needs to be evaluated. From such an evaluation, the size of subsystems, size and location of accumulators, and decisions on bussing of carbon dioxide, hydrogen, oxygen, and nitrogen can be affected. In addition, various control approaches can be assessed. The computer simulation model is described and its applications are presented. Author

A88-21091* McDonnell-Douglas Astronautics Co., Huntsville, Ala.

INTERMODULE VENTILATION STUDIES FOR THE SPACE STATION

ROY G. DAVIS (McDonnell Douglas Astronautics Co., Huntsville, AL) and JAMES L. REUTER (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 13 p. refs (Contract NAS8-36407) (SAE PAPER 871428)

This paper examines the ability of the Space Station intermodule ventilation system to maintain centralized control of CO₂ removal and O₂ supply. The resulting concentration gradients that will arise are calculated by assuming steady state, ideal gas, isothermal conditions, and perfect mixing of air within and between the pressurized elements. In order to estimate the degree of mixing actually obtained for a given ventilation scheme, a program has been developed based on a potential flow solution technique. Preliminary results from this study indicate that substantial short circuiting and recirculation air flow patterns could arise if a simple duct and diffuser air exchange method at the docking port interface were employed. Author

A88-21092
ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM FOR JAPANESE EXPERIMENT MODULE

K. SHIRAKI (National Space Development Agency of Japan, Tokyo), H. FUJIMORI, and A. HATTORI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987.

11 p
 (SAE PAPER 871429)

As a result of the preliminary study for the environmental control and life support system (ECLSS) of the Japanese Experimental Module (JEM), the functions of the JEM ECLSS are defined as follows: atmosphere control and supply, temperature and humidity control (including intramodule and intermodule air ventilation), atmosphere revitalization (CO₂ removal, contamination control and monitoring), fire detection and suppression, water management, and rescue provision, while the supply and recovery/processing of gas and water depend on the Space Station core ECLSS. Also, advanced technology developments for cabin air flow distribution system, regenerative CO₂ removal system, and gas/water separating system were performed. Author

A88-21093
COLUMBUS ECLSS

H.-P. LEISEIFER and H. PREISS (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 5 p.

(SAE PAPER 871430)

An account is given of the design features and performance requirements of the environmental control and life support system (ECLSS) envisioned for the ESA Columbus program's Attached Pressurized Module (APM) and Man-Tended Free Flier (MTFF). Since the APM is designed to function only as a working habitat, the ECLSS requirements for its crew of three will be accommodated by the NASA Space Station. The ECLSS for the MTFF module will by contrast provide all functions required by a three-man crew during a twice-yearly seven-day sojourn. O.C.

A88-21094
ECLSS FOR THE EUROPEAN SPACEPLANE HERMES

A. INGEMAR SKOOG (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987.

10 p
 (SAE PAPER 871431)

An account is given of the design requirements and features of the Hermes environment control and life support system (ECLSS). While the design defined is based on expendable technologies justified by the short mission durations anticipated in the near term, future growth through the integration of regenerative technologies for such processes as water recycling and atmosphere revitalization. Attention is given to the special ECLSS water management considerations that arise from the presence of a fuel cell electrical power supply. O.C.

A88-21095
EVA FOR A EUROPEAN SCENARIO

NIKOLAUS HERBER (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. (SAE PAPER 871432)

A new project has been established in the European Space Scenario namely the build up of a European EVA capability, based on both the request for European autonomy and the realization that EVA is a part of manned spaceflight. As a major element of EVA Systems, a medium pressure hybrid suit is proposed allowing a prebreathing-free transition from the Hermes cabin (700 hPa) into the suit. Development risk factors seems to be medium - with the exception of some critical items - so that a basic European EVA capability might be available for the first Hermes flight on 1996. Author

A88-21096* Life Systems, Inc., Cleveland, Ohio.
ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM REQUIREMENTS AND TECHNOLOGY NEEDS FOR ADVANCED MANNED SPACE MISSIONS

FEROLYN T. POWELL (Life Systems, Inc., Cleveland, OH), MELAINE SEDEJ, and CHIN LIN (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 15 p. (SAE PAPER 871433)

NASA has completed an environmental control and life support system (ECLSS) technology R&D plan for advanced missions which gave attention to the drivers (crew size, mission duration, etc.) of a range of manned missions under consideration. Key planning guidelines encompassed a time horizon greater than 50 years, funding resource requirements, an evolutionary approach to goal definition, and the funding of more than one approach to satisfy a given perceived requirement. Attention was given to the ECLSS requirements of transportation and service vehicles, platforms, bases and settlements, ECLSS functions and average load requirements, unique drivers for various missions, and potentially exploitable commonalities among vehicles and habitats. O.C.

A88-21097* Texas A&M Univ., College Station.
A UNIVERSITY TEAM APPROACH TO REGENERATIVE CONCEPTS

ORAN W. NICKS (Texas A & M University, College Station) and CINDA CHULLEN (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs (SAE PAPER 871434)

An interdisciplinary team of university-affiliated scientists and engineers has undertaken the design of a controlled ecological life support system that employs physical, chemical, and biological components to supply and efficiently recycle food, atmospheric gases, water, and waste products. An Integrated Waste and Water Management System furnishes the basic capabilities for waste product preprocessing and for the establishment of baseline comparisons with proven physical and chemical systems. Attention is given to the relationships between food and oxygen supply and the mass fraction of algae in food, as well as to the potential for O₂ production. O.C.

A88-21098
LIGHTING CONSIDERATIONS IN A CONTROLLED ENVIRONMENTAL LIFE SUPPORT SYSTEM

M. W. OLESON, T. J. SLAVIN, and R. L. OLSON (Boeing Aerospace Co., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. (SAE PAPER 871435)

Plant growth lighting design options are explored for CELSS type systems. Plant lighting systems are reviewed for terrestrial horticulture applications and then extrapolated for use on space vehicles. Several in-space lighting systems are discussed as to their relative merits from both a biological and engineering viewpoint. Two promising candidate CELSS lighting systems are described in detail. One of these is an indirect solar illumination concept using fiber optic technology. Finally, interim results from an orbital lighting cycle plant growth experiment are presented. These experiments provide data on various plants grown under lighting conditions that could result from using solar illumination techniques. The lighting conditions are based on low earth orbit Space Station's orbital cycles. The primary objective in these experiments is to determine maximum plant food production with minimum electrical power consumption. Author

A88-21100* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

DESIGN AND PERFORMANCE OF THE KSC BIOMASS PRODUCTION CHAMBER

RALPH P. PRINCE, WILLIAM M. KNOTT, JOHN C. SAGER, and SUZANNE E. HILDING (NASA, Kennedy Space Center, Cocoa Beach, FL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 7 p. refs (SAE PAPER 871437)

NASA's Controlled Ecological Life Support System program has instituted the Kennedy Space Center 'breadboard' project of which the Biomass Production Chamber (BPC) presently discussed is a part. The BPC is based on a modified hypobaric test vessel; its design parameters and operational parameters have been chosen in order to meet a wide range of plant-growing objectives aboard future spacecraft on long-duration missions. A control and data acquisition subsystem is used to maintain a common link between the heating, ventilation, and air conditioning system, the illumination system, the gas-circulation system, and the nutrient delivery and monitoring subsystems. O.C.

A88-21106* Hamilton Standard, Windsor Locks, Conn.
THERMOELECTRIC INTEGRATED MEMBRANE EVAPORATION SUBSYSTEM TESTING

GERARD F. DEHNER (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and DON F. PRICE (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 7 p. refs (SAE PAPER 871446)

An advanced preprototype Thermoelectric Integrated Membrane Evaporation Subsystem (TIMES) has been developed to provide high quality water recovery from various types of wastewater on extended duration space flights. The subsystem has undergone extensive wastewater processing testing, in order to evaluate its potential as an essential part of the Space Station Water Reclamation System. A discussion of the operating performance of the TIMES is presented in this paper, with special attention given to the water quality attained for a number of simulated Space Station wastewater feedstocks. Author

A88-21107* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

RECENT DEVELOPMENTS IN WATER QUALITY MONITORING FOR SPACE STATION RECLAIMED WASTEWATERS

JOHN W. SMALL (Astro International Corp., Houston, TX), CHARLES E. VEROSTKO (NASA, Johnson Space Center, Houston, TX), ARTHUR T. LINTON (Hamilton Standard Management Services, Houston, TX), and RAY BURCHETT (Phoenix Electrodes, Inc., Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs (SAE PAPER 871447)

This paper discusses the recent developments in water quality monitoring for Space Station reclaimed wastewaters. A preprototype unit that contains an ultraviolet absorbance organic carbon monitor integrated with pH and conductivity sensors is presented. The preprototype has provisions for automated operation and is a reagentless flow-through system without any gas/liquid interfaces. The organic carbon monitor detects by ultraviolet absorbance the organic impurities in reclaimed wastewater which may be correlated to the organic carbon content of the water. A comparison of the preprototype organic carbon detection values with actual total organic carbon measurements is presented. The electrolyte double junction concept for the pH sensor and fixed electrodes for both the pH and conductivity sensors are discussed. In addition, the development of a reagentless organic carbon analyzer that incorporates ultraviolet oxidation and infrared detection is presented. Detection sensitivities, hardware development, and operation are included. Author

A88-21108* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE SPACE STATION AIR REVITALIZATION SUBSYSTEM DESIGN CONCEPT

C. D. RAY, K. Y. OGLE, R. W. TIPPS, R. L. CARRASQUILLO, and P. WIELAND (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 15 p. refs (SAE PAPER 871448)

The current status of the Space Station (SS) Environmental Control and Life Support System (ECLSS) Air Revitalization Subsystem (ARS) design is outlined. ARS performance requirements are provided, along with subsystem options for each ARS function and selected evaluations of the relative merits of each subsystem. Detailed computer models that have been developed to analyze individual subsystem performance capabilities are also discussed. A summary of ARS subsystem level testing planned and completed by NASA Marshall Space Flight Center (MSFC) is given. Author

A88-21109

A SMOKE REMOVAL UNIT

P. J. BIRBARA (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and J. T. LEONARD (U.S. Navy, Naval Research Laboratory, Washington, DC) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p.

(SAE PAPER 871449)

A smoke removal unit (SRU) for the clearing and maintenance of atmospheres in spacecraft cabins, ships, and submarine compartments after a fire has been the object of a development effort encompassing both a test phase, conducted under controlled and instrumented laboratory fire conditions, and a design phase which incorporated the knowledge thus gained. The concept of standardized smoke and toxic gas filters is found to be an effective means for the achievement of postfire clearing of closed environments under a variety of fire conditions; a self-contained, semiportable SRU of this type has been designed. O.C.

A88-21110

STATIC FEED ELECTROLYZER TECHNOLOGY ADVANCEMENT FOR SPACE APPLICATION

FRED A. FORTUNATO and KENNETH A. BURKE (Life Systems, Inc., Cleveland, OH) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987.

15 p (SAE PAPER 871450)

NASA's Static Feed Electrolyzer development effort is aimed not only at application in the Space Station Environmental Control/Life Support System, but also its Propulsion and Reboost System, EVA systems, and Electric Power System. The water electrolysis process will generate metabolic oxygen for the crew, and furnish reactants for CO₂ removal and reduction, for propulsion/reboost systems, and for fuel cell electric power generation. Attention is presently given to the role of these applications in the design optimization of the electrolyzer, which is envisioned to be based on alkaline chemistry. O.C.

A88-21111* Hamilton Standard, Windsor Locks, Conn.

PERFORMANCE EVALUATION OF SPE ELECTROLYZER FOR SPACE STATION LIFE SUPPORT

A. C. ERICKSON, M. C. PUSKAR, J. A. ZAGAJA (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT), and P. S. MILLER (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p.

(SAE PAPER 871451)

An static water-vapor feed electrolyzer has been developed as a candidate for Space Station life-support oxygen generation. The five-cell electrolysis module has eliminated the need for phase separation devices, pumps, and deionizers by transporting only water vapor to the solid polymer electrolyte cells. The introduction of an innovative electrochemical hydrogen pump allows the use

of low-pressure reclaimed water to generate gas pressures of up to 230 psia. The electrolyzer has been tested in a computer-controlled test stand featuring continuous, cyclic, and standby operation (including automatic shutdown with fault detection). Author

A88-21112* San Jose State Univ., Calif.

STABILITY OF IRA-45 SOLID AMINE RESIN AS A FUNCTION OF CARBON DIOXIDE ABSORPTION AND STEAM DESORPTION CYCLING

PETER C. WOOD (San Jose State University, CA) and THEODORE WYDEVEN (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 16 p. refs (SAE PAPER 871452)

The removal of CO₂ from the NASA Space Station's cabin atmosphere, which may be undertaken by a solid-amine water (steam)-desorbed system, is presently evaluated with a view to long-term amine resin stability and adsorption/desorption cycling by means of an automated laboratory flow-testing facility. While the CO₂-adsorption capacity of the IRA-45 amine resin used gradually decreased over time, the rate of degradation significantly decreased after the first 10 cycles. Attention is given to the presence (and possible need for removal) of trimethylamine in the process air downstream of the resin bed. O.C.

A88-21113* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ENVIRONMENTAL CONTROL AND LIFE SUPPORT TESTING AT THE MARSHALL SPACE FLIGHT CENTER

RICHARD G. SCHUNK and WILLIAM R. HUMPHRIES (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 13 p.

(SAE PAPER 871453)

The Space Station Environmental Control and Life Support System (ECLSS) test program at the Marshall Space Flight Center (MSFC) is addressed. The immediate goals and current activities of the test program are discussed. Also described are the Core Module Integration Facility (CMIF) and the initial ECLSS test configuration. Future plans for the ECLSS test program and the CMIF are summarized. Author

A88-21114

INITIAL RESULTS OF INTEGRATED TESTING OF A REGENERATIVE ECLSS AT MSFC

JOHN K. JACKSON, EDSON A. WORDEN (Boeing Aerospace Co., Seattle, WA), ROBERT B. BOYDA (Life Systems, Inc., Cleveland, OH), and RICHARD L. JOHNSON (AirResearch Manufacturing Co., Torrance, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p.

(SAE PAPER 871454)

The environmental control and life support system (ECLSS) presently discussed encompasses a four-bed molecular sieve, a static-feed water electrolysis subsystem, and a urine pretreatment mixing unit. These subsystems are undergoing independent tests, upon whose completion 'open door' integrated system tests will be conducted to demonstrate suitability. These will lead to 'closed door' ECLSS testing to verify system operation over a range of imposed metabolic loads, ambient temperatures, and relative humidities for durations of 30 or more days. O.C.

A88-21115* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

TECHNOLOGY DEMONSTRATOR PROGRAM FOR SPACE STATION ENVIRONMENTAL CONTROL LIFE SUPPORT SYSTEM

ALAN M. ADAMS, GORDON K. PLATT, WILLIAM C. CLAUNCH, and WILLIAM R. HUMPHRIES (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 7 p. (SAE PAPER 871456)

The main objectives and requirements of the NASA/Marshall Space Flight Center Technology Demonstration Program are discussed. The program consists of a comparative test and a 90-day manned system test to evaluate an Environmental Control and Life Support System (ECLSS). In the comparative test phase, 14 types of subsystems which perform oxygen and water reclamation functions are to be examined in terms of performance maintenance/service requirements, reliability, and safety. The manned chamber testing phase involves a four person crew using a partial ECLSS for 90 days. The schedule for the program and the program hardware requirements are described. I.F.

A88-21116 BIOISOLATION ON THE SPACE STATION - OF MICE AND MEN

PAUL DOLKAS and TERI SCHNEPP (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. (SAE PAPER 871457)

The results of three months of testing using rodents in a breadboard biological isolator cage are presented. These cages are designed to provide isolation using microbial air filters on both inlet and outlet. Four different types of filters were tested: a conventional HEPA filter (rated 99.97-percent efficient at 0.3 microns), a 'hospital' grade HEPA filter (95-percent efficient at 0.3 microns), and two grades of 'Filtrete' - a proprietary 3 M polypropylene material (rated 84-percent and 97.3-percent, respectively, at 0.3 microns). Test results showed excellent performance on all filters, meeting or exceeding the strict particulate and microbial air quality standards proposed for the outlet of the animal holding facility: class 100 and 10 Colony Forming Units/cu m. In addition, it was discovered that the fiberglass batting used inside the cage to contain animal waste served as an effective microbial filter by itself. Author

A88-21124* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

BIOTECHNOLOGY OPPORTUNITIES ON SPACE STATION

JESS DEMING, KEITH HENDERSON, ROBERT W. PHILLIPS (NASA, Johnson Space Center, Houston, TX), BERNISTINE DICKEY, PHYLLIS GROUNDS (RCA Government Services; Management and Technical Services Co., Houston, TX) et al. SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 7 p. (SAE PAPER 871468)

Biotechnology applications which could be implemented on the Space Station are examined. The advances possible in biotechnology due to the favorable microgravity environment are discussed. The objectives of the Space Station Life Sciences Program are: (1) the study of human diseases, (2) biopolymer processing, and (3) the development of cryoprocessing and cryopreservation methods. The use of the microgravity environment for crystal growth, cell culturing, and the separation of biological materials is considered. The proposed Space Station research could provide benefits to the fields of medicine, pharmaceuticals, genetics, agriculture, and industrial waste management. I.F.

A88-21125* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WATER MANAGEMENT REQUIREMENTS FOR ANIMAL AND PLANT MAINTENANCE ON THE SPACE STATION

C. C. JOHNSON, D. RASMUSSEN (NASA, Ames Research Center, Moffett Field, CA), and G. CURRAN (Bionetics Corp., Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs (SAE PAPER 871469)

Long-duration Space Station experiments that use animals and plants as test specimens will require increased automation and advanced technologies for water management in order to free scientist-astronauts from routine but time-consuming housekeeping tasks. The three areas that have been identified as requiring water management and that are discussed are: (1) drinking water and humidity condensate of the animals, (2) nutrient solution and transpired water of the plants, and (3) habitat cleaning methods. Automation potential, technology assessment, crew time savings, and resupply penalties are also discussed. Author

A88-21126* Life Systems, Inc., Cleveland, Ohio. **ELECTROCHEMICALLY REGENERABLE CARBON DIOXIDE/MOISTURE CONTROL TECHNOLOGY FOR AN ADVANCED EXTRAVEHICULAR MOBILITY UNIT**

M. C. LEE, M. SUDAR (Life Systems, Inc., Cleveland, OH), and R. J. CUSICK (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p. refs (Contract NAS9-17307) (SAE PAPER 871470)

Regenerable CO₂/moisture removal techniques that reduce the expendables and logistics requirements are needed to sustain people undertaking EVAs for the Space Station. Here, the development of electrochemically regenerable CO₂ absorption (ERCA) technology to replace the nonregenerable LiOH absorber for the advanced Portable Life Support System (PLSS) is reported. During EVA the ERCA uses a mechanism involving gas absorption into a liquid absorbent for the removal and storage of the metabolically produced CO₂ and moisture. Following the EVA, the expended absorbent is regenerated onboard the Space Station by an electrochemical CO₂ concentrator. The ERCA concept has the ability to effectively satisfy the high metabolic CO₂ and moisture removal requirements of PLSS applications. This paper defines the ERCA concept and its advantages for the PLSS application, reviews breadboard test data, and presents physical characteristics of the breadboard and projected flight hardware. Author

A88-21127* Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

DEVELOPMENT OF A REGENERABLE HUMIDITY AND CO₂ CONTROL SYSTEM FOR AN ADVANCED EMU

TIMOTHY A. NALETTE (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and ROBERT J. CUSICK (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 10 p. refs (SAE PAPER 871471)

A 5-h-regenerable nonventing humidity and CO₂ control subsystem (HCCS) technology demonstration unit is being developed for potential use in an Advanced Extravehicular Mobility Unit for Space Station application. The HCCS incorporates a weak-base-anion exchange resin packed in a metal-foam-matrix heat exchanger. This system simultaneously removes CO₂ and water vapor, with the resulting exothermic heat of reaction rejected to the heat exchanger. The system has no moving parts, resulting in a highly reliable simple configuration. Regeneration may be accomplished via internal heating and vacuum. Author

A88-21128

HIGH PRESSURE WATER ELECTROLYSIS FOR THE SPACE STATION

JOHN R. NASON and PAUL G. TREMBLAY (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. refs (SAE PAPER 871473)

The benefits and penalties associated with the generation of high pressure gases using the SPE water electrolysis subsystem are presented. The Space Station has a number of requirements for oxygen and hydrogen generation at very high pressures (between 1000 and 6000 psia) including emergency pressurization and repressurization of habitability and laboratory modules, recharge of the Extravehicular Mobility Unit (EMU) oxygen tanks, and propulsion capability for Station reboost and attitude control. The traditional trade study parameters of weight, volume, power, and heat rejection are considered. The ramifications of the use of a high pressure, solid polymer electrolyte-based system are discussed with respect to Space Station safety and maintenance.

Author

A88-21129* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DEVELOPMENT OF A THERMAL CONTROL COATING FOR SPACE SUITS

BERNADETTE SQUIRE and BRUCE WEBBON (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. refs (SAE PAPER 871474)

Past space suits and the current Shuttle suit, which are constructed primarily from fabric, use the Integrated Thermal and Micrometeoroid Garment, which insulates the astronaut from his environment. The new generation of hard suits affords designers the opportunity to incorporate thermal control into the suit structure. Environmental influence on the suit temperature and heat flux can then be minimized with a high reflectance coating. Candidate coatings have been identified and ranked on the basis of thermophysical properties; wear, corrosion and atomic oxygen degradation resistance; and coating process and cost. Laboratory determination of properties, thermal cycling and wear resistance tests are underway to identify the optimum coating. A computer model is being developed to evaluate various environmental configurations. Preliminary results are presented here.

Author

A88-21130* Sterling Software, Palo Alto, Calif.

AN INNOVATIVE EXERCISE METHOD TO SIMULATE ORBITAL EVA WORK - APPLICATIONS TO PLSS AUTOMATIC CONTROLS

RENEE LANTZ (Sterling Software, Palo Alto, CA), H. VYKUKAL, and BRUCE WEBBON (NASA, Ames Research Center, Moffett Field, CA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p. refs (SAE PAPER 871475)

An exercise method has been proposed which may satisfy the current need for a laboratory simulation representative of muscular, cardiovascular, respiratory, and thermoregulatory responses to work during orbital extravehicular activity (EVA). The simulation incorporates arm crank ergometry with a unique body support mechanism that allows all body position stabilization forces to be reacted at the feet. By instituting this exercise method in laboratory experimentation, an advanced portable life support system (PLSS) thermoregulatory control system can be designed to more accurately reflect the specific work requirements of orbital EVA.

Author

A88-21132

TACTICAL LIFE SUPPORT SYSTEM TEST AND EVALUATION

ALANKAR GUPTA, ADAM J. P. LLOYD, and JON K. ROBINSON (Boeing Commercial Airplane Co.; Boeing Military Airplane Co., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 10 p. (Contract F33615-83-C-0651) (SAE PAPER 871477)

An integrated Tactical Life Support System was developed with the objective of providing increased altitude and G protection, and defense against chemical and ocular (laser, nuclear flash) threats. This paper provides a description of the system, its laboratory testing, and its flight testing on an F-15 airplane at Edwards AFB.

Author

A88-21133

PERSONAL THERMAL CONTROL SYSTEM (PTCS) FOR AIRCREW THERMAL PROTECTION

ADRIANO A. CIRIOLI and KRIS KRISHNAN (FCD Corp., Hamden, CT) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. refs (SAE PAPER 871478)

Studies have indicated that aircrew heat stress due to chemical warfare protective gear can be considerably reduced by body torso cooling. In order to provide torso cooling using a liquid vest, a cockpit mounted refrigeration system was developed as a portion of the Tactical Life Support System (TLSS) for protection of aircrews flying USAF advanced tactical fighters. The performance characteristics, design parameters, and testing of the refrigeration system known as the Personal Thermal Control System (PTCS) are discussed. The PTCS demonstrated compliance with all performance requirements, and flight testing showed that body cooling is desirable.

Author

A88-21141

SPACECRAFT WATER SYSTEM DISINFECTION TECHNOLOGY - PAST, PRESENT, AND FUTURE NEEDS

CHARLES E. WILLIS and JOHN R. SCHULTZ (KRUG International, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. refs (SAE PAPER 871487)

The possibility of microbial contamination and spread in spacecraft water systems during long-duration missions calls for initial system disinfection, initial water supply disinfection, and maintenance of disinfection throughout the water distribution system. Attention must also be given to episodic system disinfection capabilities and the isolation of the water supply from any back-contamination or cross-contamination. Especially severe design criteria must be met in all these cases by the closed recycling systems envisioned for such long duration space missions as those of the NASA Space Station.

O.C.

A88-21142* Umpqua Research Co., Myrtle Creek, Ore.

REVIEW OF WATER DISINFECTION TECHNIQUES

GERALD V. COLOMBO (Umpqua Research Co., Myrtle Creek, OR) and RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 7 p. refs (SAE PAPER 871488)

Throughout the history of manned space flight the supply of potable water to the astronauts has presented unique problems. Of particular concern has been the microbiological quality of the potable water. This has required the development of both preflight water system servicing procedures to disinfect the systems and inflight disinfectant addition and monitoring devices to ensure continuing microbiological control. The disinfectants successfully used to date have been aqueous chlorine or iodine. Because of special system limitations the use of iodine has been the most successful for inflight use and promises to be the agent most likely to be used in the future. Future spacecraft potable, hygiene, and experiment water systems will utilize recycled water. This will present special problems for water quality control. NASA is currently

conducting research and development to solve these problems.

Author

**A88-21145
TOXICOLOGICAL ASPECTS OF WATER RECYCLE AND
DISINFECTION**

RICHARD J. BULL (Washington State University, Pullman) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p. refs
(SAE PAPER 871491)

Two sources of toxic chemicals are readily recognized in recycling wastewater for potable purposes: those introduced by the prior use of the water and those introduced during treatment and distribution of the water. Historically, the focus in water treatment has been directed towards the former source and with little attention being paid to the latter. In a system with a source that is made up of primarily domestic types of waste, the production of by-products with treatment chemicals and the leaching of materials from surfaces that contact potable water are important sources of toxic chemicals. The most instructive example involves by-products generated during disinfection. A system such as that contemplated for the Space Station may well magnify these problems unless the treatment is designed to prevent chemicals from these sources from accumulating in the water system. The present paper focuses on the genesis of these problems and the toxicological hazards that result.

Author

A88-21147* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

INFLIGHT MICROBIAL ANALYSIS TECHNOLOGY

DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX) and HARLAN D. BROWN (KRUG International, Technology Life Sciences Div., Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 5 p.
(SAE PAPER 871493)

This paper provides an assessment of functional characteristics needed in the microbial water analysis system being developed for Space Station. Available technology is reviewed with respect to performing microbial monitoring, isolation, or identification functions. An integrated system composed of three different technologies is presented.

Author

**A88-21148
ON-ORBIT SERVICING ENHANCEMENTS WITH CREWLOCK
EVA OPERATIONS FROM THE SPACEHAB MODULE**

WILLIAM E. HAYNES (Science Applications International Corp., La Jolla, CA), THOMAS C. TAYLOR, and ROBERT CITRON (SPACEHAB, Inc., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p.
(SAE PAPER 871496)

The design and the operation principles of the Crewlock device (to be used in conjunction with the Spacehab module) for EVA operations are discussed. In Crewlock, the task of transiting from a volume at one pressure to another volume at a different pressure is approached in a manner different from that of airlocks. A Crewlock transit chamber is close form-fit to the transiting body; thus, the loss of and possible contaminants from pressurant gases become negligible; the need for pumps is eliminated; the mass, volume, and complexity of the lock is reduced; and the time required for transit is shorter. The Spacehab module will accommodate the Crewlock and provide storage space for the added suit components and expendables. By using Crewlock in a Spacehab module, the permissible working EVA's on a single Shuttle flight will be limited only by the Shuttle stay time and the crew endurance; if alternate crewmembers are available, the Space Station assembly manhours can be increased to over 100 hrs for a ten day orbit stay. I.S.

**A88-21149
DEVELOPMENT OF AN AUTOMATED CHECKOUT, SERVICE,
AND MAINTENANCE SYSTEM FOR AN EVAS SPACE
STATION**

FRED J. ABELES and ANTHONY C. BEARDSLEY (Grumman Corp., Space Systems Div., Bethpage, NY) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 10 p.
(SAE PAPER 871497)

The EVA System envisioned for the NASA Space Station requires a checkout, service and maintenance (COSM) system, whose architecture is presently defined. COSM will be responsible for EVA sequencing, operational checkouts, calibration, fault detection/isolation, and postperformance checkout. The COSM computer system architecture is designed to satisfy the unique demands of the preprototype requirements, including the provision of a communication port for the Space Station data management system. O.C.

A88-21150* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NEW TOOLS FOR EVA OPERATIONS

C. E. WHITSETT (NASA, Johnson Space Center, Houston, TX) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p.
(SAE PAPER 871499)

Effective extravehicular-activity (EVA) operations depend upon having the proper tools from simple wrenches to smart powered socket drives to powered adjustable foot restraints. The Space Shuttle carries a standard toolkit in the cargo bay for emergencies. Many special tools have been developed for the recent satellite repair missions; i.e., Solar Max, Westar/Palapa, and Leasat. Many more are being developed to maintain the Hubble Space Telescope on orbit for 15 years. The EVA tools developed and used in space to date are summarized and some of the new tools now in development are described herein. Finally, the requirements are given for several additional tools which may be needed in the future. Author

A88-21156* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**STATUS OF THE SPACE STATION WATER RECLAMATION AND
MANAGEMENT SUBSYSTEM DESIGN CONCEPT**

R. M. BAGDIGIAN and P. L. MORTAZAVI (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 11 p. refs
(SAE PAPER 871510)

A development status report is presented for the NASA Space Station's water reclamation and management (WRM) system, for which the candidate phase change-employing processing technologies are an air evaporation subsystem, a thermoelectric integrated membrane evaporation subsystem, and the vapor compression distillation subsystem. These WRM candidates employ evaporation to effect water removal from contaminants, but differ in their control of the vapor/liquid interface in zero-gravity and in the recovery of the latent heat of vaporization. O.C.

**A88-21157
SHOWER WATER RECOVERY BY REVERSE OSMOSIS**

THOMAS J. SLAVIN, HANS H. PETERS, and TUAN Q. CAO (Boeing Aerospace Co., Space Systems Div., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 13 p. refs
(SAE PAPER 871511)

The laboratory reverse osmosis system for which test results are presented has been developed with a view to the recovery of wash water generated by space vehicle crews on long-duration missions. The system devised employs hollow-fiber, tube side-feed membranes of polyamide deposited on polysulfone hollow-fiber substrates. Attention is given to general reverse osmosis membrane performance on baseline deionized water, soap, and salt solutions; reverse osmosis performance on wash water, using actual shower

water as a test medium; and bacteriological control measures for the processing of shower water. O.C.

A88-21158* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TEST RESULTS OF A SHOWER WATER RECOVERY SYSTEM
CHARLES E. VEROSTKO, DONALD F. PRICE, RAFAEL GARCIA, DUANE L. PIERSON, RICHARD L. SAUER (NASA, Johnson Space Center, Houston, TX) et al. SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 16 p. refs
(SAE PAPER 871512)

A shower test was conducted recently at NASA-JSC in which waste water was reclaimed and reused. Test subjects showered in a prototype whole body shower following a protocol similar to that anticipated for Space Station. The waste water was purified using reverse osmosis followed by filtration through activated carbon and ion exchange resin beds. The reclaimed waste water was maintained free of microorganisms by using both heat and iodine. This paper discusses the test results, including the limited effectiveness of using iodine as a disinfectant and the evaluation of a Space Station candidate soap for showering. In addition, results are presented on chemical and microbial impurity content of water samples obtained from various locations in the water recovery process. Author

A88-21159

DEVELOPMENT OF A NON-PHASE-CHANGE WASTE-WATER TREATMENT SUBSYSTEM

S. B. MCCRAY, R. J. RAY, C. A. THORNTON, D. D. NEWBOLD (Bend Research, Inc., OR), and H. H. PETERS (Boeing Aerospace Co., Seattle, WA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 19 p. refs
(SAE PAPER 871514)

This paper describes the continued development of a non-phase-change waste-water subsystem for use in the planned manned Space Station. Comparisons of various membrane-based technologies when operated side by side on feed solutions of synthetic wash water are presented. The effects of soap type and operating temperature on membrane-module performance were determined. A preliminary ranking of these modules indicated that several of the reverse-osmosis and ultrafiltration technologies are excellent candidates for use in the subsystem. At this time, a hybrid system configuration consisting of a first-stage ultrafiltration module followed by a second-stage reverse-osmosis module appears to be the most appropriate for use in the subsystem. Author

A88-21160

REGENERATIVE CO₂-CONTROL - A TECHNOLOGY DEMAND FOR EUROPEAN MANNED SPACE PROGRAMS

HELMUT PREISS, WALTER BREITLING, and HELMUT FUNKE (Dornier System GmbH, Friedrichshafen, Federal Republic of Germany) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p. DFVLR-supported research.
(SAE PAPER 871515)

A development status evaluation is presented for spacecraft regenerative CO₂-control systems applicable to such anticipated long term missions as that of the Columbus manned module, without the unacceptable mass and volume penalties associated with the use of expendable chemical agents. Attention is given to the breadboard configuration developed for such a system, and to the initial test results obtained, with a view to the selection of absorber materials, methods for regeneration, the design of evaporators, and the interfacing of the breadboard apparatus with a test data-acquisition system. O.C.

A88-21161

EXPERIMENTAL STUDY FOR CARBON DIOXIDE REMOVAL SYSTEM IN SPACE STATION

T. ETOH, T. NIHEI, K. OTSUJI, S. SATOH, and S. HATANO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 9 p.
(SAE PAPER 871516)

As the result of the human metabolism in the Space Station, carbon dioxide is discharged into the cabin atmosphere. It is indispensable to remove the carbon dioxide and keep it below the allowable level for life support in a closed environment. The regenerative carbon dioxide removal system is necessary for the Space Station to decrease the life-cycle cost. The Solid Amine Water Desorbed (SAWD) system is considered as a competitive option among several candidate systems. In the SAWD process, the carbon dioxide gas is adsorbed by the ion-exchange-type solid amine, which is bedded in the canisters, and desorbed by heating the solid amine with the direct steam flow. The adsorption and desorption stage of the canisters are proceeded alternatively by the automatic control. For the application in the Space Station, the SAWD system shall embody less resources as well as high performance and reliability. Author

A88-21162

AN EXPERIMENTAL STUDY OF THE BOSCH AND THE SABATIER CO₂ REDUCTION PROCESSES

K. OTSUJI, O. HANABUSA, T. SAWADA, S. SATOH, and M. MINEMOTO (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 8 p.
(SAE PAPER 871517)

An experimental comparison has been conducted in order to evaluate the relative merits of the Bosch and Sabatier systems for CO₂ cracking and oxygen recovery, with a view to the obviation of consummable supply requirements in long duration manned space missions. The test data evaluation has given attention to the most equitable basis for CO₂ cracking process comparison, the system configurations of the two processes, their reduction efficiency, their energy requirements, and their course of product carbon treatment. The preliminary results obtained favor the Sabatier reaction, in virtue of its high productivity and dense carbon deposition. O.C.

A88-21163

EVOLUTIVE CONCEPT OF AN EVA SPACE SUIT

LOUIS LEMAIGNEN and MARC WEIBEL (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 12 p.
(SAE PAPER 871518)

After a short review of the European needs for EVAs (space Extra Vehicular Activities), the paper analyzes the different requirements and constraints of a space station and of a space plane for the EVA aspects. The leading factors which affect the space suit design are presented and analyzed at the light of the evolution of American and Soviet space suits. Among these factors, are: conflict of vehicle and suit pressure choices, protection against radiation, cost of EVA in terms of weight, volume and energy, interfaces with the carrier vehicle, maintainability and vulnerability. From this analysis, two types of suits seem to emerge as optimal solutions. An evolutive approach is proposed in which a common hard upper torso fulfils the requirements of both the space station and the space plane. Modular items are used in accordance with the vehicle to service. The geometrical concept is presented with CAE analysis of the donning procedure. The technology of the major suit components is shortly discussed. Author

A88-21165

SUPERCRITICAL WATER OXIDATION - TREATMENT OF HUMAN WASTE AND SYSTEM CONFIGURATION TRADEOFF STUDY

GLENN T. HONG, PATRICK K. FOWLER, WILLIAM R. KILLILEA, and KATHLEEN C. SWALLOW (Modar, Inc., Natick, MA) SAE, Intersociety Conference on Environmental Systems, 17th, Seattle, WA, July 13-15, 1987. 17 p. refs (SAE PAPER 871444)

Supercritical water oxidation (SCWO) is a waste treatment and water recycling technology currently being developed for NASA. Results are presented for SCWO of urine and feces in a laboratory unit sized approximately for an 8-person crew. Essentially complete conversion of organic carbon to CO₂ or char, and of organic nitrogen to N₂ and N₂O, were demonstrated. All major heteroatoms (S, P, Cl, Na, K, Ca, and Mg) were efficiently removed from the process stream as ash. A tradeoff study was carried out to evaluate which configurations of a SCWO subsystem would be most favorable for use in a space facility. Author

A88-21623* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TELEPRESENCE MASTER GLOVE CONTROLLER FOR DEXTEROUS ROBOTIC END-EFFECTORS

SCOTT S. FISHER (NASA, Ames Research Center, Moffett Field, CA) IN: Intelligent robots and computer vision; Proceedings of the Fifth Meeting, Cambridge, MA, Oct. 28-31, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 396-401. refs

This paper describes recent research in the Aerospace Human Factors Research Division at NASA's Ames Research Center to develop a glove-like, control and data-recording device (DataGlove) that records and transmits to a host computer in real time, and at appropriate resolution, a numeric data-record of a user's hand/finger shape and dynamics. System configuration and performance specifications are detailed, and current research is discussed investigating its applications in operator control of dexterous robotic end-effectors and for use as a human factors research tool in evaluation of operator hand function requirements and performance in other specialized task environments. Author

A88-21625* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AN ADA RUN-TIME CONTROL ARCHITECTURE FOR TELEROBOTS

J. BALARAM and G. RODRIGUEZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Intelligent robots and computer vision; Proceedings of the Fifth Meeting, Cambridge, MA, Oct. 28-31, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 462-469.

This paper describes the architecture and Ada language implementation of a process-level run-time control subsystem for the Jet Propulsion Laboratory (JPL) telerobot system. The concept of run-time control in a combined robot-teleoperation environment is examined and the telerobot system at JPL is described. An Ada language implementation of the JPL Telerobot Run-Time Controller (RTC) is described by highlighting the functional behavior of the subsystem, defining the internal modules, and providing a functional flow time sequence of internal module activity. Author

A88-21627* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN INTEGRATED APPROACH FOR THE DESIGN AND EVALUATION OF HUMAN-MACHINE INTERFACES

WALT F. TRUSZKOWSKI (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Intelligent robots and computer vision; Proceedings of the Fifth Meeting, Cambridge, MA, Oct. 28-31, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 509-516. refs

An integrated environment for the design and evaluation (from a human factors point-of-view) of human-machine interfaces is proposed. Four major components of an experimental environment currently under study are identified and discussed. A scenario

highlighting the relationships of these four components in an integrated operational environment is presented. Current status, issues to be addressed and future plans for this activity are discussed. Author

A88-21647* Rockwell International Corp., Downey, Calif.

AN ORBITING CONTROL STATION FOR FREE-FLYING TELEOPERATORS - PRELIMINARY DESIGN METHODOLOGY

M. M. CLARKE, E. Y. MOK, W. B. ROSENFELD (Rockwell International Corp., Space Station Systems Div., Downey, CA), and A. QUINN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Space Station automation II; Proceedings of the Meeting, Cambridge, MA, Oct. 28-30, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 155-160. refs

This paper summarizes work being done to develop the preliminary design of a control station for the free-flying teleoperator/telerobot ROBIN. The four-step development process involves telerobot capability definition, mission analysis, requirements generation, and design solution. The ROBIN servomanipulator requirements are listed, and a telerobotic control station requirement tree is shown. C.D.

A88-21649* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SYSTEM ARCHITECTURE FOR TELEROBOTIC SERVICING AND ASSEMBLY TASKS

F. WALLACE HARRISON, JR. and JACK E. PENNINGTON (NASA, Langley Research Center, Hampton, VA) IN: Space Station automation II; Proceedings of the Meeting, Cambridge, MA, Oct. 28-30, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 165-171. refs

The architecture of an integrated telerobotics laboratory which is being used for research on the mechanisms, controls, sensing, and operator interface required to accomplish space telerobotic tasks is described. The laboratory hardware is considered, including manipulator and controller, end effector, and vision. The virtual architecture, a common reference model for most of the laboratory applications, is discussed. Teleoperator and robotics system simulations which have been performed using the system are discussed. C.D.

A88-21651* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE NASA TELEROBOT TECHNOLOGY DEMONSTRATOR

P. S. SCHENKER, R. L. FRENCH, A. R. SIROTA, and J. R. MATIJEVIC (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Space Station automation II; Proceedings of the Meeting, Cambridge, MA, Oct. 28-30, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 178-188. refs

The ongoing development of a telerobot technology demonstrator is reported. The demonstrator is implemented as a laboratory-based research testbed, and will show proof-of-concept for supervised automation of space assembly, servicing, and repair operations. The demonstrator system features a hierarchically layered intelligent control architecture which enables automated planning and run-time sequencing of complex tasks by a supervisory human operator. The demonstrator also provides a full bilateral force-reflecting hand control teleoperations capability. The operator may switch smoothly between the automated and teleoperated tasking modes in run-time, either on a preplanned or operator-designated basis. Author

A88-21659* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COOPERATIVE HUMAN-MACHINE FAULT DIAGNOSIS

ROGER REMINGTON and EVERETT PALMER (NASA, Ames Research Center, Moffett Field, CA) IN: Space Station automation II; Proceedings of the Meeting, Cambridge, MA, Oct. 28-30, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 253-259. refs

Current expert system technology does not permit complete automatic fault diagnosis; significant levels of human intervention

are still required. This requirement dictates a need for a division of labor that recognizes the strengths and weaknesses of both human and machine diagnostic skills. Relevant findings from the literature on human cognition are combined with the results of reviews of aircrew performance with highly automated systems to suggest how the interface of a fault diagnostic expert system can be designed to assist human operators in verifying machine diagnoses and guiding interactive fault diagnosis. It is argued that the needs of the human operator should play an important role in the design of the knowledge base. Author

A88-22122#**AN IMPEDANCE CONTROLLED FORCE REFLECTING HAND CONTROLLER - DESIGN, IMPLEMENTATION, AND EXPERIMENTATION**

J. D. B. PAINES (MIT, Cambridge, MA) AIAA, Aerospace Sciences Meeting, 26th, Reno, NV, Jan. 11-14, 1988. 10 p. refs (AIAA PAPER 88-0172)

The potential importance of space telemanipulator systems is reviewed, along with past studies of master-slave manipulation using a generalized force reflecting master arm. Problems concerning their dynamic interaction with the human operators arm have been revealed in the use of these systems. A study is outlined to investigate the optimization of the dynamics of master-slave manipulation, and a set of specifications determined for the apparatus necessary to perform this investigation. This apparatus is a one degree of freedom force reflecting hand controller with closed loop servo control which enables it to simulate arbitrary dynamic properties to high bandwidth. Design of the complete system is discussed, as is its performance. The experimental adjustment of the hand controller's dynamics for optimum manual control performances is described. Author

A88-22733**ESTIMATING PILOT WORKLOAD AND ITS IMPACT ON SYSTEM PERFORMANCE**

RONALD VIENNEAU and FRANK GOZZO (IBM Corp., Federal Systems Div., Owego, NY) IN: AHS, Annual Forum, 43rd, Saint Louis, MO, May 18-20, 1987, Proceedings. Volume 1. Alexandria, VA, American Helicopter Society, 1987, p. 91-102. refs (Contract DAAK51-84-C-0006)

The advent of integrated avionics has drastically increased the potential capabilities of commercial and military aircraft. In light of the complexity of these systems, pilot workload and its implication on system performance are now critical aspects of the design process. This paper proposes a methodology by which pilot workload can be estimated and improved in early program stages, thus reducing technical, schedule, and cost risk during full-scale development and production. Highlights of the methodology are discussed as well as a summary of its successful application to IBM's single-pilot rotorcraft design during the Advanced Rotorcraft Technology Integration (ARTI) study. Author

A88-22775* Systems Technology, Inc., Hawthorne, Calif. CLASSIFICATION OF RESPONSE-TYPES FOR SINGLE-PILOT NOE HELICOPTER COMBAT TASKS

DAVID G. MITCHELL, ROGER H. HOH (Systems Technology, Inc., Hawthorne, CA), and ADOLPH ATENCIO, JR. (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) IN: AHS, Annual Forum, 43rd, Saint Louis, MO, May 18-20, 1987, Proceedings. Volume 2. Alexandria, VA, American Helicopter Society, 1987, p. 663-675. refs (Contract NAS2-11304)

Two piloted simulations have recently been conducted to evaluate both workload and handling qualities requirements for operation of a helicopter by a single pilot in a nap-of-the-earth combat environment. An advanced cockpit, including a moving-map display and an interactive touchpad screen, provided aircraft mission, status, and position information to the pilot. The results of the simulations are reviewed, and the impact of these results on the development of a revised helicopter handling qualities specification is discussed. Rate command is preferred over attitude command in pitch and roll, and attitude hold over groundspeed

hold, for low-speed precision pointing tasks. Position hold is necessary for Level 1 handling qualities in hover when the pilot is required to perform secondary tasks. Addition of a second crew member improves pilot ratings. Author

A88-22919**RADIATION HAZARDS ON SPACE MISSIONS**

JOHN R. LETAW (Severn Communications Corp., Severna Park, MD), REIN SILBERBERG, and C. H. TSAO (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, DC) Nature (ISSN 0028-0836), vol. 330, Dec. 24, 1987, p. 709, 710. Navy-DOE-supported research. refs

Calculations of the radiation dose equivalents to astronauts from Galactic cosmic radiation (GCR) and from energetic solar particle events are presented. Previous results identifying GCR as a significant factor in the space radiation dose are extended. In particular, the components of the radiation dose are determined, and the relationship between dose and shielding thickness is determined. Shielding requirements are proposed for future spaceflights. A storm shelter protected by at least 9 cm of aluminum or its equivalent is recommended for all spaceflights outside the magnetosphere. On long-duration flights, such as a Mars mission, all habitable spaces should be shielded with 7.5 cm aluminum or its equivalent. C.D.

A88-22957**OFF TO SEE THE WIZARD**

GARY GRAF Space World (ISSN 0038-6332), vol. X-4-280, April 1987, p. 26-29.

A redesigned spacesuit is considered to be a necessary complement to the Space Station. The new suit is to operate at the Station's constant pressure of one earth atmosphere, and should be maintainable in orbit. Experiments conducted at NASA-Ames have led to the belief that the suit should be made entirely out of metal or other rigid material with joints of reinforced fabric or metal to give the astronaut the mobility needed for space work. K.K.

A88-23669* California Univ., Berkeley.**VISUAL ENHANCEMENTS IN PICK-AND-PLACE TASKS - HUMAN OPERATORS CONTROLLING A SIMULATED CYLINDRICAL MANIPULATOR**

WON S. KIM, FRANK TENDICK, and LAWRENCE W. STARK (California, University, Berkeley) IEEE Journal of Robotics and Automation (ISSN 0882-4967), vol. RA-3, Oct. 1987, p. 418-425. refs

(Contract JPL-956873; NCC2-86)

A teleoperation simulator has been constructed with vector display system, joysticks, and a simulated cylindrical manipulator, in order to quantitatively evaluate various display conditions. The first of two experiments thus conducted investigated the effects of perspective parameter variations on human operators' pick-and-place performance, using a monoscopic perspective display. The second experiment involved visual enhancements of the monoscopic perspective display, by adding a grid and reference lines, by comparison with visual enhancements of a stereoscopic display; results indicate that stereoscopy generally permits superior pick-and-place performance, but that monoscopy nevertheless allows equivalent performance when defined with appropriate perspective parameter values and adequate visual enhancements. O.C.

A88-23670* California Univ., Berkeley.

A COMPARISON OF POSITION AND RATE CONTROL FOR TELEMANIPULATIONS WITH CONSIDERATION OF MANIPULATOR SYSTEM DYNAMICS

WON S. KIM, FRANK TENDICK, LAWRENCE W. STARK (California, University, Berkeley), and STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field, CA) IEEE Journal of Robotics and Automation (ISSN 0882-4967), vol. RA-3, Oct. 1987, p. 426-436. refs
(Contract JPL-956873; NCC2-86)

Position and rate control are the two common manual control modes in teleoperations. Human operator performance using the two modes is evaluated and compared. Simulated three-axis pick-and-place operations are used as the primary task for evaluation. First, ideal position and rate control are compared by considering several factors, such as joystick gain, joystick type, display mode, task, and manipulator work space size. Then the effects of the manipulator system dynamics are investigated by varying the natural frequency and speed limit. Experimental results show that ideal position control is superior to ideal rate control, regardless of joystick type or display mode, when the manipulation work space is small or comparable to the human operator's control space. Results also show that when the manipulator system is slow, the superiority of position control disappears. Position control is recommended for small-work-space telemanipulation tasks, while rate control is recommended for slow wide-work-space telemanipulation tasks. Author

A88-24101

NASA TO EVALUATE TWO SUIT DESIGNS FOR SPACE STATION

CAROLE A. SHIFRIN Aviation Week and Space Technology (ISSN 0005-2175), vol. 129, Jan. 11, 1988, p. 36-39.

Two different space suit configurations are undergoing testing to evaluate usefulness in EVAs associated with the NASA Space Station, which will be of longer duration than heretofore. NASA's Johnson Space Center developed the Zero Prebreathe Suit (ZPS) Mk.3, while NASA Ames developed the AX-5. Both designs use a rear torso hatch for ingress and egress; while the ZPS uses a combination of hard and soft elements, however, the AX-5 is composed entirely of solid, articulated segments. During testing, crew members will engage in assembly and construction tasks simulating the building of the Space Station structures. O.C.

A88-24163

AIRCREW HELMETS AND HELMET MOUNTED DEVICES; PROCEEDINGS OF THE SYMPOSIUM, LONDON, ENGLAND, FEB. 10, 1987

Symposium sponsored by the Royal Aeronautical Society. London, Royal Aeronautical Society, 1987, 162 p. For individual items see A88-24164 to A88-24176.

The present conference discusses the operational scenario for aircrew helmets and helmet-mounted devices, methods toward the achievement of aircrew helmet requirements, a procurement process-related perspective on aircrew helmet-mounted devices, nuclear flash-protection goggles for aircrews, and cockpit rear view displays. Also discussed are a proprietary helmet-pointing system, a helmet-mounted sight evaluation exerciser, earphone active noise reduction systems, the role of aircrew voice communication systems' noise-cancellation techniques, night vision goggles for aircrews, a cockpit-design methodology for the use of night-vision goggles in fixed wing combat aircraft, human factors in night vision goggles' design, the effects of off-axis loading on head mobility, and the biodynamic implications of helmet-mounted devices. O.C.

A88-24164

AIRCREW HELMETS - USER REQUIREMENTS AND HOW THEY ARE ACHIEVED

ROY W. GAMBLIN (Helmets, Ltd., Saint Albans, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 2.1-2.8.

A wide range of helmet requirements for protection, mission performance and user acceptance is described. It is difficult for producers of helmet systems to meet different levels of protective performance while offering a wide choice of helmet mounted devices. Particular attention is given to the problem of weight, which can exceed 8 lbs; chinstrap and napestrap arrangement; and increasing input energies from the current level of about 100 Joules while lowering deceleration to 200 G or below. It is concluded that designers of devices and helmets must acknowledge the dominance of user acceptance as the ultimate arbitrator. A.S.

A88-24165

AIRCREW HELMET MOUNTED DEVICES AND HELMET SYSTEMS - A PROCUREMENT VIEW

K. BRIGDEN (Ministry of Defence Procurement Executive, London, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 3.0-3.5.

General criteria for helmet systems in the UK are analyzed. Problems of shell, liner and harness, as well as external finish, reflective strip, and clear visor are discussed. Ocular, oral, and other helmet-mounted devices are listed and described. The requirements of information flow critical to survival and the correct performance of the man/machine interface are discussed. It is concluded that not the cost of the devices but the cost of introduction is holding back the procurement of many of these helmet-mounted devices/systems. A.S.

A88-24166

NUCLEAR FLASH PROTECTION GOGGLES FOR AIRCREW

A. D. PARSONS and R. W. WHATMORE (Plessey Research /Caswell/, Ltd., Allen Clark Research Centre, Towcester, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 4.1-4.7. Research supported by the Ministry of Defence Procurement Executive.

This paper describes in summary the development of an electro-optic goggle using PLZT ceramic for the protection of aircrew from flash blindness due to the detonation of nuclear weapons. The principles of operation and requirements are discussed, as are the practical means for implementing the solution in a lightweight goggle compatible with RAF NBC equipment. The optical performance of the goggle is described and means for providing resistance to moisture is discussed. Author

A88-24173

HUMAN FACTORS ASPECTS OF THE DESIGN OF NVG'S

R. HOLMES (GEC Avionics, Ltd., Rochester, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 12.0-12.11.

Human factors engineering is more important in such head-mounted equipment as night vision goggles (NVGs) than in other types of avionics. It extends to such difficulties as their design to fit all helmet shapes and to provide adequate adjustment capability for all head shapes. The types of optical presentation needed, the method of NVG use at low altitude, and the approach to crash safety-related problems, are additional human factors considerations. It is recommended that the NVG/helmet combination be superceded in time by the development of a helmet-integrated imaging system. O.C.

A88-24174**THE EFFECTS OF OFF-AXIS LOADING ON HEAD MOBILITY**

D. H. GLAISTER (Royal Air Force Institute of Aviation Medicine, Farnborough, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 13.1-13.4.

Helmet-mounted devices increase effective head mass; unless great care is taken over the distribution of components, or additional mass is added as counterweight, the head's normal center-of-gravity will be displaced. An increase or imbalance in crewman head loading can create problems that are exacerbated by the sustained acceleration undergone during high performance aircraft maneuvering. Sudden loads are of especially great concern. Attention is given to a sophisticated predictive model and the results of experimental investigations concerning the loadings resulting from added head mass and center-of-gravity offsets under G-loads; performance endpoints are taken to be head immobilization and neck structure damage. O.C.

A88-24176**THE BIODYNAMIC IMPLICATIONS OF HELMET MOUNTED DEVICES**

D. J. ANTON (Royal Air Force Institute of Aviation Medicine, Farnborough, England) IN: Aircrew helmets and helmet mounted devices; Proceedings of the Symposium, London, England, Feb. 10, 1987. London, Royal Aeronautical Society, 1987, p. 15.1-15.13. refs

An evaluation is made of the consequences for crewmember neck loading during both normal flight and emergency conditions that emerge from the addition of miniaturized sighting, display, and protection equipment to helmets; these consequences vary according to the mass added and the method used to integrate the mass onto the helmet. Attention is given to changes in impact protection and resistance to induced angular acceleration, as well as to the effects on other parts of the body of helmet-mounted items that may become detached in the course of an emergency ejection sequence. Neck muscle fatigue, soft-tissue neck injuries, vertebral injuries, and long-term degenerative diseases are the consequences considered. O.C.

A88-24538**HIGH-G TRAINING FOR FIGHTER AIRCREW**

KENT K. GILLINGHAM and JOHN P. FOSDICK (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 12-19. refs

The objectives of the high-G training course for the USAF fighter aircrew, conducted at the USAF School of Aerospace Medicine, are discussed together with the results achieved. The high-G training includes discussions of the G-time tolerance curve and demonstrations of an effective anti-G straining maneuver (AGSM) and of the effect of anti-G suit. Exposure to centrifuge-induced G-stress allowed the trainees to determine their G tolerance and to practice AGSM. As a result of the training, the trainees exhibited mean relaxed and AGSM-G tolerances on the gradual-onset run (without anti-G suit inflation) of 5.2 and 8.3 G, respectively, with 41 percent of the trainees reaching the 9-G run limit without G-induced loss of consciousness. With the anti-G suit inflated, 94 percent of the trainees completed the 9-G, 15-sec rapid-onset run (ROR); 93 percent were able to tolerate the 9-G, 10-s ROR while looking back over their left shoulder. I.S.

A88-24539**PREVENTION OF LOSS OF CONSCIOUSNESS WITH POSITIVE PRESSURE BREATHING AND SUPINATING SEAT**

JOHN W. BURNS (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 20-22. refs

The benefits afforded by a supinating seat and an assisted positive-pressure breathing maneuver (APPB) in providing protection against G-induced loss of consciousness, G-LOC, (in addition to protection afforded by the anti-G suit, the anti-G valve,

and the anti-G straining maneuver, AGSM) are examined. It was shown that APPB augments sustained +Gz tolerance and reduces the amount of straining necessary to maintain a specific +Gz level. The supinating seat has been shown to double the relaxed G tolerance at a back angle of 75 deg from the vertical, when compared to relaxed tolerance at a 13-deg or 30-deg position. However, problems of cockpit engineering, escape, head-rest angle, restricted rear visibility, and pilot acceptance of a high-angle supinated seat might preclude the use of a seat with sufficient back angle to provide 'no strain' G protection. Therefore, the addition of APPB to a limited protective seat is useful for providing acceptable G tolerance. I.S.

A88-24540**CURRENT AND EMERGING TECHNOLOGY IN G-LOC DETECTION - NONINVASIVE MONITORING OF CEREBRAL MICROCIRCULATION USING NEAR INFRARED**

D. H. GLAISTER (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 23-28.

This paper considers a system which could detect the incipient G-induced loss of consciousness (G-LOC) objectively and provide a signal that would be used to initiate an autopilot mode of flight until the recovery of the pilot. A noninvasive state-of-consciousness detector was constructed which can monitor the oxidative status of the brain, using four near-IR wavelengths to measure the relative quantities in the brain of hemoglobin (Hb), oxygenated hemoglobin (HbO₂), blood volume (BV), and oxidative status of cytochrome c oxidase. The instrument was tested on subjects in a G-centrifuge at 3, 4, and 5 +Gz, with onset rates of 1 G/sec. The results showed reproducible changes, during increasing G, in the values of Hb, BV, and HbO₂, which might be used to determine the onset of G-LOC. I.S.

A88-24541**CURRENT AND EMERGING TECHNOLOGY IN G-LOC DETECTION - PULSE WAVE DELAY FOR +GZ TOLERANCE ASSESSMENT**

LEONID HREBIEN (U.S. Navy, Naval Air Development Center, Warminster, PA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 29-31.

It was found that pulse-wave delay increases linearly with +Gz experienced by conscious subjects and that G-tolerance limits, as measured using conventional light bars, occur repeatedly at the same pulse-wave delays or delta delay. When protective modalities, such as anti-G suits or supinating seats, are used, the delta delays increase at a slower rate as a function of +Gz. G-tolerance thresholds occur at higher +Gz levels with protection, but the delta pulse-wave delays reach the same value for all tolerance levels. This parameter can be used to warn expert systems of the approach of G-LOC during actual flight; it provides an objective measure of G protection provided by new or modified anti-G equipment. Therefore, this tool can be used in the research setting to evaluate the efficacy of G-protective equipment in an objective manner. Author

A88-24542**ADVANCES IN ANTI-G VALVE TECHNOLOGY - WHAT'S IN THE FUTURE?**

R. E. VAN PATTEN (USAF, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 32-35. refs

The fundamental shortcomings of conventional anti-G valve technology are examined, and the principles underlying three advanced anti-G valves being currently developed are discussed. The design of one of these, the servo-controlled rapid acting anti-G valve (SCAG), makes use of a conventional pneumatic servovalve design philosophy with a low-pressure pilot stage; the anti-G suit filling schedule of SCAG (i.e., the suit pressure versus +Gz) is defined by an electronic controller that uses accelerometer inputs and the pressure feedback loop. The second, called the 'bang-bang servo anti-G valve', operates as the thermostat on an air

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conditioner; the controller is either on or off, depending on the presence or absence of a control signal. In the third valve concept, the adaptive 1553 interfaced sero valve, the dedicated microprocessor associated with the valve allows the system to respond to flight control inputs to achieve the most rapid response possible. The design will have a provision for interfacing with advanced concept anti-G suits; the valve then will 'know' the current and the antecedent acceleration history of the aircraft. I.S.

A88-24544 **SOFT CONTACT LENS WEAR AT ALTITUDE - EFFECTS OF HYPOXIA**

W. J. FLYNN, R. E. MILLER, II, T. J. TREDICI, and M. G. BLOCK (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 44-48. refs

In the U.S. Air Force, aircraft can be divided into two categories: aircraft with cabin pressures equivalent to high altitudes and aircraft with cabin pressures equivalent to lower altitudes, with longer duration exposures. The purpose of this study was to determine the effects of soft contact lens wear under atmospheric pressures simulating these two types of aircraft environments. Ten subjects were tested at 7620 m in hypobaric chamber flights of 75 min, and eight subjects were tested in hypobaric chamber flights at 3048 m for 4 h. Four subjects were also tested in dry air to further simulate cabin conditions. Vision and physiologic response were monitored by measurements of visual acuity, contrast sensitivity, and slit-lamp biomicroscopy examinations. The results of this study indicate that the physiologic responses of the cornea to soft contact lens wear at altitude are subject to higher levels of manifested stresses, but these occurred without measurable degradation in vision and did not preclude normal wear of soft contact lenses. Author

A88-24545 **DYNAMIC MOISTURE PERMEATION THROUGH CLOTHING**

NAOSHI KAKITSUBA, KATHY GAUL, HENRY MICHNA, and IGOR B. MEKJAVIC (Simon Fraser University, Burnaby, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Jan. 1988, p. 49-53. Research supported by the Science Council of British Columbia and NSERC. refs

Dynamic moisture permeation through clothing often occurs during thermal transience, causing an imbalance between evaporative heat loss from the skin (Esk) and that from the clothing surface (Ecl). A device was designed to observe Esk and Ecl simultaneously. It consists of two relative humidity sensors coupled with thermistors, so that densities of water vapor at two points within the boundary layer can be calculated. The rate of local evaporation is then estimated from Fick's law of diffusion. Local evaporation rates from the skin and clothing surface at the chest, arm, and thigh were measured during exposure to controlled ambient temperature varying from 20 to 40 C. The subjects wore four different types of helicopter pilot suits: Nomex/Neoprene, Goretex, cotton ventile, and Nomex/Insulite. For the Goretex and cotton ventile suits, consisting of relatively permeable and hygroscopic fabrics, a sudden increase in Esk, exponential decay of Esk, and a gradual increase in Ecl were observed. These appear to be associated with the onset of sweat secretion, moisture build-up within the clothing, and water gain in the fabric, respectively. Thus, the device may be useful for observing dynamic moisture permeation through clothing. Author

A88-24778 **THE OPERATING PRINCIPLES OF MAN-MACHINE SYSTEMS [ZAKONOMERNOSTI FUNKTSIONIROVANIIA ERGATICHESKIKH SISTEM]**

GEORGII MIKHAILOVICH ZARAKOVSKII and VADIM VLADIMIROVICH PAVLOV Moscow, Izdatel'stvo Radio i Sviaz', 1987, 232 p. In Russian. refs

A theory of man-machine systems, based on an 'organismic' approach and Anokhin's functional-system concept, is presented. A systems approach is used to examine the psychophysiological features and quantitative characteristics of the execution of specific

tasks by the human operator and of operator activity in general. Mathematical models and methods for the complex analysis and synthesis of man-machine systems are examined along with the features characterizing the interaction between the human operator, the technical facilities, and the work environment. B.J.

N88-15407# Joint Publications Research Service, Arlington, Va. **INVESTIGATION OF EFFECT OF SILVER COMPOUNDS ON MICROFLORA IN WATER RECLAIMED FROM ATMOSPHERIC MOISTURE CONDENSATE IN A CLOSED ENVIRONMENT**

M. I. SHIKINA, YU. YE. SINYAK, S. V. CHIZHOV, and N. B. KOLESINA In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 3, May - June 1987 p 118-121 12 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 3, May - Jun. 1987 p 80-82 Avail: NTIS HC A08/MF A01

The effect of different silver compound on microorganisms in water reclaimed from the atmospheric condensate in an enclosed environment was investigated. The following microorganisms were examined: *Alcaligenes faecalis*, *Citrobacter freundii*, *Aeromonas hydrophilla*, *Staphylococcus epidermitis*, etc. The ionic silver concentrations in solution varied from 0.1 to 10 mg/l. The efficiency of the silver compounds was found to depend on the microbial strain, ionic silver concentration in solution and time of exposure. The microflora of the reclaimed water proved to be highly resistant to the preservatives which was strongly associated with the bacterial, physical and chemical composition of the products preserved. Author

N88-15434# Joint Publications Research Service, Arlington, Va. **NEW BOOK ON SPACE ECOLOGY REVIEWED**

V. P. PISHAK In its JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, Volume 21, No. 4, July - August 1987 p 138-140 13 Jan. 1988 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 21, no. 4, Jul. - Aug. 1987 p 88-89 Avail: NTIS HC A08/MF A01

The effect of space on Earth ecological systems and wise environmental protection are described. Topics addressed include: solar activity (electromagnetic and corpuscular radiation, solar activity and geophysical perturbations); effect of space factors on processes occurring in the biosphere; the ecological role of physical factors that depend on solar activity; experimental analysis of the biological effect of weak electromagnetic fields of ultralow frequencies; and solar activity and biological rhythms. B.G.

N88-15440# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

RESOURCES, CONFUSIONS AND COMPATIBILITY IN DUAL AXIS TRACKING: DISPLAYS, CONTROLS AND DYNAMICS Ph.D. Thesis

MARTIN L. FRACKER 1987 137 p (AD-A185871; AFIT/CI/NR-87-105T) Avail: NTIS HC A07/MF A01 CSDL 05H

Dual axis compensatory tracking was investigated as a function of whether error displays were integrated or separated, whether axis controls were integrated into one stick or remained separate, and whether the control dynamics on the two axes were the same or different. Tracking error increased and control activity decreased as a function of the summed difficulty of the two control dynamics. Integrated displays and integrated controls both led to increased confusions between tracking axes although error was unaffected. Importantly, performance was also affected by whether the integrality of displays matched that of controls. These results suggest that dual axis tracking is subject to separate effects of resource competition, confusions, and Wickens' compatibility of proximity principle. GRA

N88-15441# MacAulay-Brown, Inc., Fairborn, Ohio.
HUMAN PERFORMANCE DATA NEEDED FOR TRAINING DEVICE DESIGN DECISIONS Final Report, 1 Sep. 1985 - 4 Apr. 1986

GARY A. KLEIN and CHRISTOPHER P. BREZOVIC Mar. 1987
 59 p Prepared in cooperation with Klein Associates, Inc., Yellow Springs, Ohio
 (Contract F33615-82-C-0513)
 (AD-A185988; REPT-86-86.1-F; AAMRL-TR-87-010) Avail: NTIS HC A04/MF A01 CSCL 05I

The goal of this project was to study the types of human perception and performance information that training device designers need in making design decisions. There were two objectives: (1) to identify the types of human performance data needed to make these decisions and (2) to make recommendations about decision support for training device designers. A total of 50 experienced designers were studied. For a subset of 42 of these designers, the interviews focused on critical design decisions where there was a need for perception/information processing data. Several types of data were collected from these interviews. One finding indicated that for the sample of critical decisions studied, systematic decision-making strategies were used in a minority of cases. A second result was the identification of frequent questions about human performance data. A third finding revealed the heavy reliance on informal experiments and analogous cases for guidance in resolving design questions, and the lesser reliance on published literature. Implications were presented for the development of Designers' Associate. Future research areas were presented, primarily with methods for helping designers to extrapolate from research data and from analogues cases. GRA

N88-15442# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

EVALUATION OF THE SHASTA WATERLESS SYSTEM AS A REMOTE SITE SANITATION FACILITY

C. J. MARTEL Aug. 1987 28 p
 (AD-A186000; CRREL-SR-87-16) Avail: NTIS HC A03/MF A01 CSCL 06I

The waterless toilet manufactured by Shasta Manufacturing, Inc. of Redding, California, was evaluated for possible use at remote military sites and guard stations. A telephone survey of six recreational areas indicated that park personnel were generally pleased with the performance of these units. On-site visits did not encounter offensive odors. Proper ventilation and liquid level control were found to be key factors in successful operation. A rational approach to sizing these units was developed on the basis of local pan evaporation rates. GRA

N88-15443# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

QUANTIFYING SOME INFORMATION PROCESSING ASPECTS OF THE PILOT'S INSTRUMENT CROSSCHECK M.S. Thesis

JOSEPH L. BUNECKE 1987 81 p
 (AD-A186114; AFIT/CI/NR-87-127D) Avail: NTIS HC A05/MF A01 CSCL 01D

An aircraft instrument panel contains a multitude of data sources from which a pilot gathers the information needed to safely and efficiently control and navigate the aircraft during flight. In order to insure that instrument indications remain within specified tolerances, pilots switch their attention among/between the various displays by employing a visual scanning technique called crosscheck. While most studies of the pilot's eye movements attempt to model the crosscheck under ideal conditions in an effort to describe an optimal scan, this study approaches the issues from a training perspective to identify a potential cause of and to propose a possible solution to non-optimal scanning. I've divided this analysis into eight chapters. To provide the context for this research, the first describes the task environment in which the pilot uses the crosscheck. In the second and third sections, I review pertinent literature to establish the crosscheck as a skill and use the Multiple Resource theory of attention (Wickens, 1984) as a base to present my rationale for teaching this visual scanning behavior in a part-task scenario. I speculate as to the potential

benefits of teaching and developing crosscheck skills using a graphics-capable computer training-aid in the fourth section. In the final four chapters, I analyze the experimental data gathered by one such training-aid and describe the implications of the results in terms of the present methods of crosscheck instruction. GRA

N88-15444# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

USING MULTIPLE DIALOG MODES IN A USER-SYSTEM INTERFACE TO ACCOMODATE DIFFERENT LEVELS OF USER EXPERIENCE: AN EXPERIMENTAL STUDY Ph.D. Thesis

RODERICK A. TAYLOR 1986 196 p
 (AD-A186115; AFIT/CI/NR-87-126D) Avail: NTIS HC A09/MF A01 CSCL 05H

This dissertation investigated a normative theory that says computer users have different dialog needs depending on their level of experience in using a computer. It was developed from the human factors and user-system interface research built upon differences in expert and novice problem solving strategies, memory, and learning. Experts want to control the interaction with a computer as with a command language whereas novices want to be led through their interaction as with menus and prompts. Since most computer interfaces only provide one dialog mode, some portion of a population having a wide range of user experience is not having their user-system interface needs met. This research hypothesizes that the answer to satisfy the needs of a mixed population to have multiple dialog modes that the user is free to choose form and switch between as required. The hypotheses that experts and novices would perform better and be more satisfied with multiple dialog modes than with just one mode were tested empirically in a controlled laboratory setting. Both novice and expert computer users used one of three types of user-system interfaces (menu, command language, or both modes) to perform the same data task. GRA

N88-15445# Emory Univ., Atlanta, Ga. Dept. of Mathematics and Computer Science.

NEW METHODS FOR NUMERICAL SOLUTION OF ONE CLASS OF STRONGLY NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATIONS Annual Report

V. I. OLIKER and P. WALTMAN 1986 12 p
 (Contract AF-AFOSR-0285-84)
 (AD-A186166; AFOSR-87-1191TR) Avail: NTIS HC A03/MF A01 CSCL 12A

The physical phenomena described by nonlinear partial differential equations have become at present the central theme of investigations by many researchers. A good understanding of most physical processes requires accounting for nonlinear effects and, consequently, methods for studying nonlinear equations have to be developed. Among nonlinear equations the Dirichlet problem for the Monge-Ampere equation is the model case for fully nonlinear equations. GRA

N88-15446# Presearch, Inc., Fairfax, Va.
TRANSIENT CLASSIFIER SYSTEMS AND MAN-MACHINE INTERFACE RESEARCH Final Technical Report, 8 Sep. 1986 - 7 Mar. 1987

ROBERT SAX and RICHARD KRAM 31 Aug. 1987 109 p
 (Contract N00014-86-C-0812; RRO-4209)
 (AD-A186213; PI-TR-738) Avail: NTIS HC A06/MF A01 CSCL 17A

The results of the experiment showed that transient detection and classification performance are highly independent, and both are very sensitive to signal-to-noise ratio (SNR). Unknown transients were recognized rapidly; however, performance at low SNR was not comparable to that against known transients. Transient specific syntax proved to be an even stronger determinant of performance than the known vs. unknown condition. Novice performance in detecting a target by its transient emissions was comparable to theoretical best current broadband techniques. Experienced sonar operators outperformed the novices by 12 dB. The automatic classification algorithm research demonstrated use of syntactic and semantic state variable feature-space representations to

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perform computationally efficient classification of transient patterns (50 times real-time in FORTRAN) and large-scale reduction of data (500:1). The algorithm recognized many singular and correlated transient events. An unexpected and exciting result was recognition and modal separation of mixed mode tonal signals as correlated transients in the time domain. GRA

N88-15447# School of Aerospace Medicine, Brooks AFB, Tex.
MAN RATING THE B-1B MOLECULAR SIEVE OXYGEN GENERATION SYSTEM Final Report, Dec. 1984 - Dec. 1985
JOHN B. TEDOR and JAMES P. CLINK Aug. 1987 54 p
(AD-A186275; USAFSAM-TR-87-4) Avail: NTIS HC A04/MF A01
CSCL 01C

This report sets forth the findings of a test and evaluation (man rating) of the molecular sieve oxygen generation system developed for the 1B Long Range Combat Aircraft. A series of unmanned and manned tests, covering the range of aircraft operating conditions, were conducted on a duplicate of the aircraft breathing system which was assembled in an environmental chamber. The control variables were cabin and aircraft ambient pressure, inlet air temperature and pressure, cabin temperature, and demand flow; and the dependent variables were oxygen concentration, pressure swings in the mask, and time required for backup oxygen to reach the crew after rapid decompression (RD). Oxygen output met or exceeded specification requirements for all but two test points. Under nominal aircraft operating conditions and the maximum average demand flow of 160 liters per minute (1pm), oxygen concentration fell slightly below specification requirements at 25,000 and 28,000 ft cabin altitude. These discrepancies are not considered significant (i.e., will not compromise crew safety), because the probability is very slight that a demand flow rate as high as 160 1pm will ever occur (tests showed that 6 persons taking moderately heavy, rapid breaths generated 135 1pm average demand at ground level). Furthermore, the oxygen partial pressure, in the worst case, was equivalent to breathing air at only 4,000 ft pressure altitude.

GRA

N88-15448# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Thermophysiology Group.

IMPROVEMENT OF THE CONSTRUCTION OF PROTECTIVE CLOTHING FOR BETTER WEARABILITY AND COMFORT Final Report

W. A. LOTENS Oct. 1986 100 p Prepared in cooperation with Ten Cate Over-All Fabrics, Almelo, Netherlands and Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft, Netherlands
(Contract TEX-23-NL-(N))
(IZF-1986-26; TD-86-4547; ETN-88-91307) Avail: NTIS HC A05/MF A01

The waterproofness and vapor permeability of rainwear samples were determined, and tests were developed. Technologies underlying the vapor permeability of waterproof samples are based on microporosity, continuous films, microfiber weaves and multilayer fabrics. Samples of the first two technologies show excellent vapor permeability, but for continuous films, this depends on the humidity. Semipermeables cause equal thermal strain as impermeables in cold or cool environments but less strain in the heat. For hard work, the moisture accumulation is lower in semipermeables, but still too high. Ventilation due to motion may be increased by good design and is far from negligible, although wind appears to be more powerful. Ventilation and permeability are linked together in a mathematical model that allows the prediction of condensation inside the garment, for an optimal design as to thermal strain and sweat accumulation. ESA

N88-15449# Report Store, Lawrence, Kans.
DEVELOPMENT OF SOVIET STATE ERGONOMIC STANDARDS (GOST) Final Report
NOEMI S. GALTON and BERNARD O. WILLIAMS Aug. 1987
21 p
(Contract DAAL02-87-P-3303)
(AD-A185536; HEL-FI-2-87) Avail: NTIS HC A03/MF A01
CSCL 05H

This report outlines the operating procedures of the Soviet State Standards System and identifies the agencies responsible for developing ergonomics standards. Available open information about the relation of State Standards (GOST) and Military applications is provided. The report includes a translation of the short section on Development and Use of Human Factors Engineering Standards from Ergonomics, Principles and Recommendations. The 1983 joint COMECOM human factors handbook. GRA

N88-15450# Report Store, Lawrence, Kans.
SOVIET STATE ERGONOMIC STANDARDS (GOST) Final Report
BERNARD O. WILLIAMS and VICTOR MERKIN Sep. 1987
34 p
(Contract DAAL02-87-P-3314)
(AD-A185537; HEL-FI-3-87) Avail: NTIS HC A03/MF A01
CSCL 05H

This report identifies ninety-two Soviet standards pertinent to ergonomics. Indexes list the standards by numerical identifier, chronology, industry or commodity, and the type of subject of the standard. GRA

N88-16352# Naval Underwater Systems Center, Newport, R.I.
PROCEEDINGS OF THE DOD WORKLOAD ASSESSMENT WORKSHOP ON WORKLOAD ASSESSMENT TECHNIQUES AND TOOLS HELD IN DAYTON, OHIO ON 27-28 SEPTEMBER 1986
HEIDI M. FIEDLER 15 Sep. 1987 352 p Workshop held in Dayton, Ohio, 27-28 Sep. 1986
(AD-A185650; NUSC-TD-6608) Avail: NTIS HC A16/MF A01
CSCL 05H

A major function of human factors engineering throughout the system development process is to ensure that system demands do not exceed the information processing capabilities of the human operator. Processing overload is a central factor leading to breakdowns in operator performance and to the compromises in system safety and effectiveness that can result from such decrements. Mental work is the term which refers to that portion of an operators limited processing capacity which is actually required to perform a particular task or system function. The principal objective of workload assessment is to specify the amount of expanded processing capacity so that existing or potential overloads can be identified and decrements in operator performance avoided. Because of its critical role in the system development process, workload assessment has been the subject of considerable research over the past 10 years (e.g., Moray 1979). One product of these research efforts has been the development and application of a large number of individual workload assessment techniques. A recent comprehensive review (Wierwille and Williges, 1978) of the workload assessment literature, for example, identified 28 different techniques that had been used to derive measures of load. A substantial number of these empirical assessment techniques, can be classified as belonging to one of three categories of workload measures: (1) subjective opinion procedures, (2) performance-based techniques, and (3) physiological techniques. GRA

N88-16353*# Life Systems, Inc., Cleveland, Ohio.
**ELECTROCHEMICAL CARBON DIOXIDE CONCENTRATOR
 SUBSYSTEM DEVELOPMENT Final Report**
 E. P. KOSZENSKI, D. B. HEPPNER, and C. T. BUNNELL Mar.
 1986 92 p
 (Contract NAS2-11783)
 (NASA-CR-177411; NAS 1.26:177411; TR-600-4) Avail: NTIS
 HC A05/MF A01 CSCL 05H

The most promising concept for a regenerative CO₂ removal system for long duration manned space flight is the Electrochemical CO₂ Concentrator (EDC), which allows for the continuous, efficient removal of CO₂ from the spacecraft cabin. This study addresses the advancement of the EDC system by generating subsystem and ancillary component reliability data through extensive endurance testing and developing related hardware components such as electrochemical module lightweight end plates, electrochemical module improved isolation valves, an improved air/liquid heat exchanger and a triple redundant relative humidity sensor. Efforts included fabrication and testing the EDC with a Sabatier CO₂ Reduction Reactor and generation of data necessary for integration of the EDC into a space station air revitalization system. The results verified the high level of performance, reliability and durability of the EDC subsystem and ancillary hardware, verified the high efficiency of the Sabatier CO₂ Reduction Reactor, and increased the overall EDC technology engineering data base. The study concluded that the EDC system is approaching the hardware maturity levels required for space station deployment. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A88-21513

CHEMISTRY BETWEEN THE STARS

WILLIAM M. IRVINE (Five College Radio Astronomy Observatory, Amherst, MA) Planetary Report (ISSN 0736-3680), vol. 7, Nov.-Dec. 1987, p. 6-9.

The chemical processes that took place prior to the earth's formation are discussed. By understanding the nature and evolution of chemical complexity throughout the universe, it is possible to acquire a better understanding of the early chemical state of the solar system. The primordial element hydrogen is discussed as well as molecular clouds and surviving molecules. It is noted that NASA's observatories have been proposed to study the entire electromagnetic spectrum from long-wavelength radio waves to high-energy X-rays and gamma rays. ESA's counterpart missions include the Infrared Space Observatory and the Far-Infrared Space Telescope. K.K.

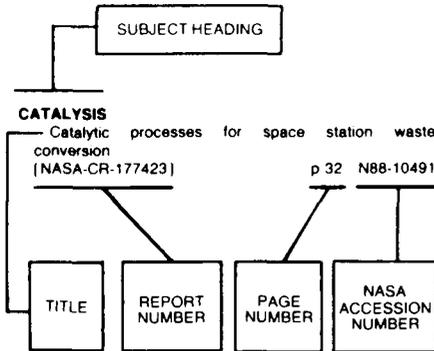
A88-21514

THE ORIGIN OF LIFE

JAMES P. FERRIS (Rensselaer Polytechnic Institute, Troy, NJ) Planetary Report (ISSN 0736-3680), vol. 7, Nov.-Dec. 1987, p. 10, 12, 28.

It is postulated that life originated a little less than 4 billion years ago and that it had an atmosphere consisting of carbon dioxide, water vapor and nitrogen, with little or no methane, ammonia or hydrogen. The complex molecules of life started to form in this environment by reactions among simple molecules brought to earth by interstellar dust, comets, and meteorites, as well as substances formed by electric discharges, ultraviolet light and other energy sources acting on earth's primitive atmosphere. It has been found that genetic information can be stored in RNA and that RNA can carry out the functions of both DNA and protein. In effect, RNA may have been the first biological polymer. K.K.

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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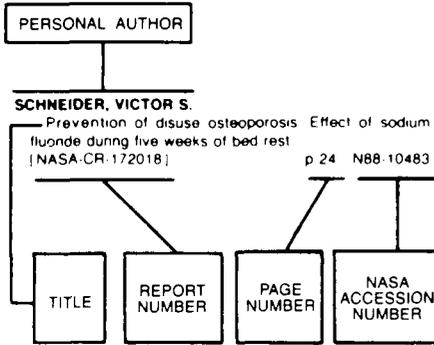
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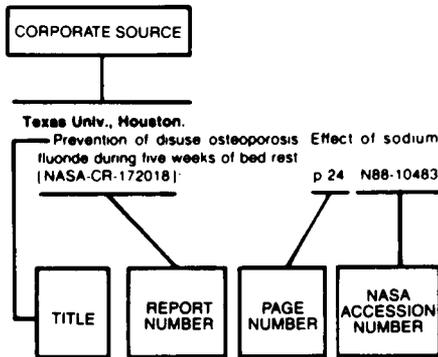
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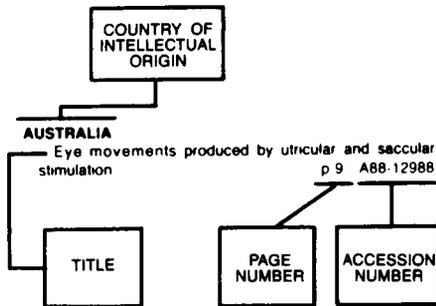
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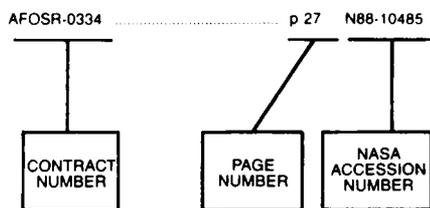
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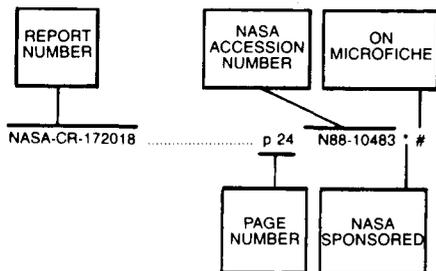
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