

NASA SP-7011 (357)  
January 1992

# AEROSPACE MEDICINE AND BIOLOGY

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BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH  
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A CONTINUING BIBLIOGRAPHY WITH INDEXES



NASA SP-7011 (357)

January 1992

# **AEROSPACE MEDICINE AND BIOLOGY**

A CONTINUING BIBLIOGRAPHY WITH INDEXES

**NASA** National Aeronautics and Space Administration  
Scientific and Technical Information Program  
Washington, DC 1992



# INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 186 reports, articles and other documents originally announced in December 1991 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of *Aerospace Medicine and Biology* was published in July 1964. -

Accession numbers cited in this issue are:

<i>STAR</i> (N-10000 Series)	N91-31078 — N91-32031
<i>IAA</i> (A-10000 Series)	A91-52999 — A91-57068

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on 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. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard 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 include the original accession numbers from the respective announcement journals.

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

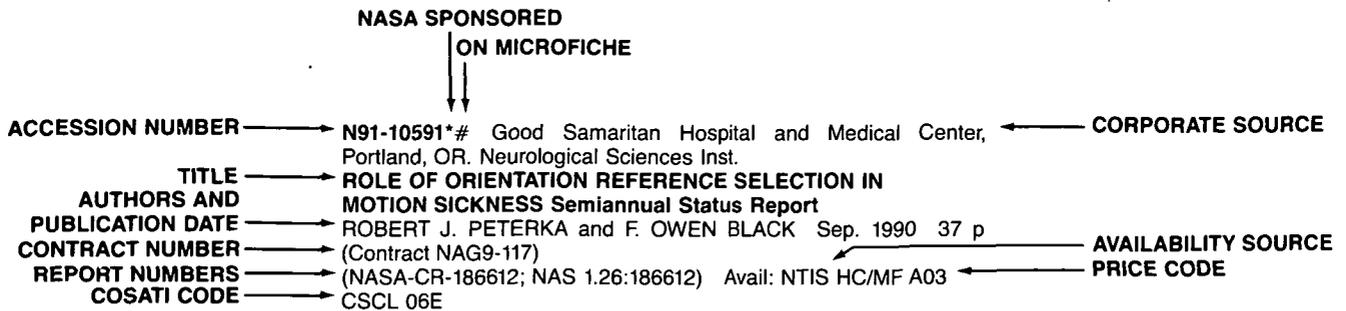
A cumulative index for 1991 will be published in early 1992.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

# TABLE OF CONTENTS

	Page
<b>Category 51 Life Sciences (General)</b>	<b>333</b>
<b>Category 52 Aerospace Medicine</b> Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.	<b>338</b>
<b>Category 53 Behavioral Sciences</b> Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.	<b>349</b>
<b>Category 54 Man/System Technology and Life Support</b> Includes human engineering; biotechnology; and space suits and protective clothing.	<b>352</b>
<b>Category 55 Space Biology</b> Includes exobiology; planetary biology; and extraterrestrial life.	<b>363</b>
<b>Subject Index</b> .....	<b>A-1</b>
<b>Personal Author Index</b> .....	<b>B-1</b>
<b>Corporate Source Index</b> .....	<b>C-1</b>
<b>Foreign Technology Index</b> .....	<b>D-1</b>
<b>Contract Number Index</b> .....	<b>E-1</b>
<b>Report Number Index</b> .....	<b>F-1</b>
<b>Accession Number Index</b> .....	<b>G-1</b>
<b>Appendix</b> .....	<b>APP-1</b>

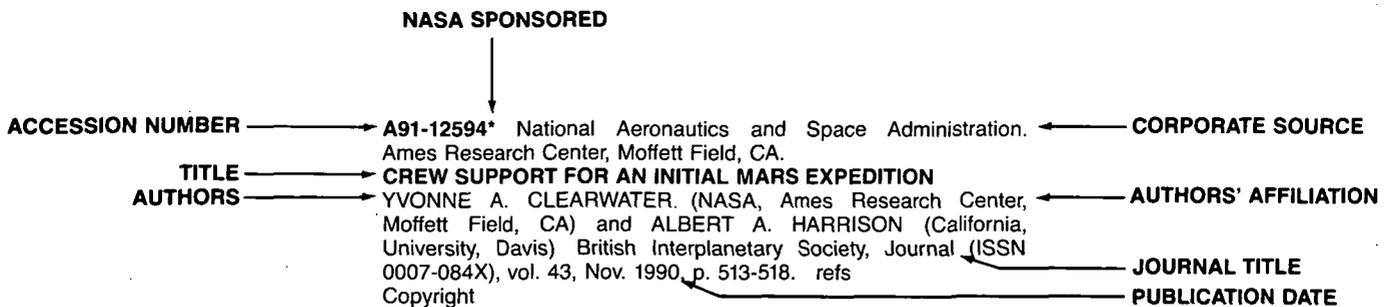
## TYPICAL REPORT CITATION AND ABSTRACT



Three areas related to human orientation control are investigated: (1) reflexes associated with the control of eye movements and posture; (2) the perception of body rotation and position with respect to gravity; and (3) the strategies used to resolve sensory conflict situations which arise when different sensory systems provide orientation cues which are not consistent with one another or with previous experience. Of particular interest is the possibility that a subject may be able to ignore an inaccurate sensory modality in favor of one or more other sensory modalities which do provide accurate orientation reference information. This process is referred as sensory selection. This proposal will attempt to quantify subject's sensory selection abilities and determine if this ability confers some immunity to the development of motion sickness symptoms.

Author

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



Mars crews will undergo prolonged periods of isolation and confinement, travel unprecedented distances from earth and be subjected to formidable combinations of hardships and dangers. Some of the biomedical, psychological and social challenges of the first manned Mars expedition are reviewed and means of aligning humans, technology and space habitats in the interests of mission success are identified.

Author

## LIFE SCIENCES (GENERAL)

**A91-53889\*** Pennsylvania State Univ., Hershey.  
**CEREBROSPINAL FLUID PRESSURE IN CONSCIOUS  
HEAD-DOWN TILTED RATS**

WALTER B. SEVERIS, BRET A. MORROW (Pennsylvania State University, Hershey), and LANNY C. KEIL (NASA, Ames Research Center, Moffett Field, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 944-946. refs (Contract NCC2-127)  
Copyright

The acute effects of a 1-h -45 deg head-down tilt on continuously recorded cerebrospinal fluid pressure (PCSF) of conscious rats are studied in order to investigate the shift of blood volume into the thoracic cavity in microgravity. PCSF, evaluated in 15-min time blocks over a 3-h experiment, increased slightly (less than 0.05) during the first 30 min of a control hour at 0 deg. There was a transient increase for about 5 min immediately after tilt (-45 deg) that may have been due to head movement after the position change. PCSF was statistically unchanged (above 0.05) during the second (-45 deg) hour and the third (0 deg) recovery hour. It is shown that the dynamics of intracranial pressure regulation can accommodate the acute cephalad fluid shift after tilting. P.D.

**A91-53890\*** Chicago Univ., IL.  
**CYCLIC AMP-RECEPTOR PROTEINS IN HEART MUSCLE OF  
RATS FLOWN ON COSMOS 1887**

MAIJA I. MEDNIEKS (Chicago, University, IL), IRINA A. POPOVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), and RICHARD E. GRINDELAND (NASA, Ames Research Center, Moffett Field, CA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 947-952. Research supported by PHS. refs  
Copyright

The cellular compartmentalization of the cyclic AMP-receptor proteins in heart ventricular tissue obtained from rats flown on the Cosmos 1887 is determined. Photoaffinity labeling of soluble and particulate cell fractions with a (32P)-8-azido analog of cyclic AMP is followed by electrophoretic separation of the proteins and by autoradiographic identification of the labeled isoforms of cAPK R subunits. It is shown that RII in the particulate subcellular fraction was significantly decreased in heart cells from rats in the flight group when compared to controls. Protein banding patterns in both the cytoplasmic fraction and in a fraction enriched in chromatin-bound proteins exhibited some variability in tissues of individual animals, but showed no changes that could be directly attributed to flight conditions. No significant change was apparent in the distribution of RI or RII cyclic AMP binding in the soluble fractions. It is inferred that the cardiac cell integrity or its protein content is not compromised under flight conditions. P.D.

**A91-53891\*** San Jose State Univ., CA.

**PINEAL PHYSIOLOGY IN MICROGRAVITY - RELATION TO  
RAT GONADAL FUNCTION ABOARD COSMOS 1887**

DANIEL C. HOLLEY, CAROL L. MARKLEY (San Jose State University, CA), MAGDI R. I. SOLIMAN, FARIDA KADDIS (Florida Agricultural and Mechanical University, Tallahassee), and IGOR KRASNOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 953-958. refs (Contract NASA ORDER A-53751-C)  
Copyright

Results are reported from an analysis of pineal glands obtained for five male rats flown aboard an orbiting satellite for their melatonin, serotonin (5-HT), 5-hydroxyindole acetic acid (5-HIA), and calcium content. Plasma 5-HT and 5-HIAA were measured. These parameters were compared to indicators of gonadal function: plasma testosterone concentration and spermatogonia development. Plasma melatonin was found to be low at the time of euthanasia and was not different among the experimental groups. Pineal calcium of flight animals was not different from ground controls. Pineal 5-HT and 5-HIAA in the flight group were significantly higher than those in ground controls. These findings suggest a possible increase in pineal 5-HT turnover in flight animals which may result in increased melatonin secretion. It is argued that the alteration of pineal 5-HT turnover and its expected effects on melatonin secretion may partially explain the lower plasma testosterone levels and 4-11 percent fewer spermatogonia cells observed in flight animals. P.D.

**A91-53900\*** Texas Univ., Houston.

**DOPPLER DETECTION OF DECOMPRESSION BUBBLES WITH  
COMPUTER ASSISTED DIGITIZATION OF ULTRASONIC  
SIGNALS**

B. D. BUTLER, R. ROBINSON, C. FIFE, and T. SUTTON (Texas, University, Houston) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 997-1004. refs (Contract NAG9-215)  
Copyright

The use of an inexpensive, commercially available audio digitizer in conjunction with a PC to digitize Doppler bubble signals for visual and electronic evaluation is reported. This device can be operated simultaneously with Doppler audio monitoring. Precordial and arterial Doppler recordings of gas bubbles were obtained from anesthetized dogs after intravascular infusion or following decompression. Additional evaluations were conducted on Doppler bubble recordings obtained from human decompression studies. The device can be used in real-time or for later signal analysis. Accompanying menu-driven software provides for numerous signal modification options and visual displays. This device can provide a simultaneous visual display of Doppler signals normally available only for audio evaluation. P.D.

**A91-55283**

**BIOMEDICAL EFFECTS OF NATURAL UV RADIATION -  
GLOBAL CONSEQUENCES OF THE OZONE LAYER  
DESTRUCTION [MEDIKO-BIOLOGICHESKIE EFEKTY  
ESTESTVENNOGO UF-IZLUCHENIIA - GLOBAL'NYE  
POSLEDSTVIYA RAZRUSHENIIA OZONOVOGO SLOIA]**

A. D. STRZHIZHOVSKII, A. S. D'IAKONOV, and V. V. BELOUSOV Kosmicheskaja Biologiya i Aviakosmicheskaja

Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 4-10. In Russian. refs

Copyright

Effects of high-intensity irradiation by UV light in the B spectral range (280-320 nm) on terrestrial microorganisms, aqueous ecosystems, plants, and animals are discussed on the basis of experimental data reported in the literature, and quantitative estimates of the ozone layer destruction are presented. It is indicated that adverse effects of UV-B light accumulate continuously, leading to increasing rates of mutations in soil microorganisms and increases of cataracts, skin cancers, and other disorders in animals and humans. It is suggested that the use of UV-B irradiation as an agent for stimulating growth, improving hemodynamics, or increasing work capacity should be viewed with great caution. I.S.

**A91-55284**

**THE EFFECT OF UV RADIATION ON THE SENSORY AND NOCICEPTIVE SKIN SENSITIVITY IN NUDE MICE [VLIANIE UF-IZLUCHENIIA NA SENSORNUIU I NOTSITSEPTIVNUIU CHUVSTVITEL'NOST' KOZHI BEZVOLOS'YKH MYSHEI]**

A. O. LAZAREV Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 11-13. In Russian. refs

Copyright

The effects of irradiation by UV light (at intensities of 12.17 and 3.27 W/sq m, at a dose rate of 23.19 kJ/sq m) on the parameters of reactions reflecting the sensory and nociceptive skin sensitivities in nude mice were investigated in animals subjected to electrical pulse stimuli with stepwise-increasing current levels. It was found that the patterns of changes in the sensory and nociceptive skin sensitivity produced by electric stimuli were not correlated with the intensity levels of UV irradiation. However, the changes were more significant, appeared earlier, and disappeared later in mice irradiated with UV rays at 12.17 W/sq m intensity than corresponding changes in mice irradiated at 3.27 W/sq m. I.S.

**A91-55285**

**THE EFFECT OF A SINGLE IRRADIATION WITH SUPERERYTHEMA DOSES OF UV RADIATION ON THE GENERAL RESISTANCE OF NUDE MICE [VLIANIE ODNOKRATNYKH VOZDEISTVII SUPERERITEMNYKH DOZ UF-IZLUCHENIIA NA OBSHCHUIU REZISTENTNOST' ORGANIZMA BEZVOLOS'YKH MYSHEI]**

G. V. LOBACHEVA and A. D. STRZHIZHOVSKII Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 13-15. In Russian. refs

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The effects of irradiation with UV-B light at doses of 1.0 and 1.4 kJ/sq m and 0.11 and 0.59 W/sq m intensity levels on the general resistance of nude mice, as measured in terms of the amount of automicroflora on the exposed skin and the resistance to the *St. aureus* alpha-toxin (injected i.p. at LD50 doses), were investigated. Results indicate that administration of a single M.E.D. dose of UV-B light could lower the body resistance of an animal, with the effect increasing with radiation intensity. I.S.

**A91-55286**

**THE EFFECT OF CHRONIC IRRADIATION BY UV-B RADIATION ON THE NITROGEN-FIXING CAPACITY OF SOIL IN A FIELD STUDY [DEISTVIE KHONICHESKOGO UF-IZLUCHENIIA ZONY B NA AZOTFIKSIRUIUSHCHUIU SPOSOBNOST' POCHV V USLOVIAKH POLEVOGO EKSPERIMENTA]**

T. I. URALETS Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 15-17. In Russian. refs

Copyright

The effect of chronic irradiation by UV-B light on the nitrogen-fixing capacity of soil organisms was investigated in a field experiment in which LER-40 lamps were used as a source of above-background UV-B irradiation at intensity levels of 0.34,

0.49, and 0.77 W/sq m and nitrogen fixation was measured by gas chromatography. Results showed that, compared with nonirradiated soil samples, the nitrogen-fixing capacity of soil samples exposed to UV-B light at intensities of 0.34 and 0.49 W/sq m was increased by 17 and 9 percent, respectively; at 0.77 W/sq m, nitrogen fixation was inhibited by 13 percent. I.S.

**A91-55287**

**INVESTIGATION OF THE SENSITIVITY OF VARIOUS FARM CROPS TO SHORT-TERM UV STRESS [IZUCHENIE CHUVSTVITEL'NOSTI RAZLICHNYKH SEL'SKOKHOZIAISTVENNYKH RASTENII K NEPRODOLZHITEL'NOMU UF-STRESSU]**

E. V. KANASH and V. N. SAVIN Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 18-20. In Russian. refs

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The effect of a 7-hr exposure to UV-B light (280-380 nm), at doses of 100 to 250 kJ/sq m, on various farm crops (including cereals, legumes, vegetables, and forage plants) was investigated in experiments where plant sensitivity to UV light was measured in terms of changes produced in yields of these crops. It was found that, after irradiation, the yield of most crops, including potatoes, vetch, clover, peas, horse-beans, and barley was smaller than that of controls, while the productivity of cereals was not affected. I.S.

**A91-55288**

**BARLEY YIELD UNDER CONTINUOUS EXPOSURE TO INCREASED LEVELS OF UV RADIATION DURING GROWTH [FORMIROVANIE UROZHAIA RASTENII IACHMENIA PRI VEGETATSII V USLOVIAKH POSTOIANNOGO DEISTVIA UF-RADIATSII POVYSHENNYKH UROVNEI]**

E. V. KANASH, V. V. ARTEM'EVA, and O. V. NIKANDROVA Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 20-23. In Russian. refs

Copyright

The effect of irradiation by biologically effective UV light on the productivity of barley plants was investigated in field experiments where biologically effective UV light of 0.53, 0.103, and 0.260 W/sq m intensities was applied at various stages of plant development. Yield losses under these conditions were found to be 14.0, 31.6, and 45.8 percent, respectively. I.S.

**A91-55289**

**THE EFFECT OF CHRONIC IRRADIATION BY UV-B LIGHT ON THE GROWTH, DEVELOPMENT, AND PRODUCTIVITY OF FODDER BEET [VLIANIE KHONICHESKOGO UF-OBLUCHENIIA ZONY B NA ROST, RAZVITIE I PRODUKTIVNOST' KORMOVOI SVEKLY]**

E. IA. ZIABLITSKAIA, G. V. KOZ'MIN, E. D. SIMONENKOVA, A. A. ZEINALOV, and IU. V. TOLSTIKOV Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 23-25. In Russian. refs

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**A91-55290**

**THE EFFECT OF MEDIUM-WAVELENGTH-RANGE UV RADIATION ON THE PHOTOSYNTHETIC APPARATUS AND THE PRODUCTIVITY OF HIGHER PLANTS [O DEISTVII SREDNEVOLNOVOI UF-RADIATSII NA FOTOSINTETICHESKII APPARAT I PRODUKSIONNYI PROTSESS VYSSHIKH RASTENII]**

IU. E. GILLER, I. IU. SHCHERBAKOVA, B. I. LIPKIND, F. A. KARIEVA, and V. A. SHISHKIN Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 26-29. In Russian. refs

Copyright

The effect of irradiation with medium-wavelength-range (250-410 nm) UV light on the formation of photosynthetic pigments, growth, and productivity of higher plants was investigated in laboratory (pea and Triticale seedlings) and field (cotton and soy plants) experiments, in which plants were exposed to either single doses

or to continuous irradiation. It was found that exposures to doses of 12-13 kJ/sq m per day caused greater changes in the chlorophyll content of chloroplasts and inhibited plant growth to a greater extent in soy beans than in cotton plants. I.S.

A91-55291

**THE EFFECT OF NATURAL UV RADIATION ON THE GROWTH AND ACTIVITY OF ENDOGENOUS GROWTH REGULATORS IN BARLEY LEAVES [DEISTVIE ESTESTVENNOI UF-RADIATSII NA ROST I AKTIVNOST' ENDOGENNYKH REGULIATOROV ROSTA V LIST'IAKH IACHMENIA]**

O. A. AKNAZAROV and S. SH. SHOMANSUROV Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 29-31. In Russian. refs  
Copyright

A91-55292

**THE EFFECT OF INCREASED LEVELS OF CHRONIC IRRADIATION BY NATURAL UV-B LIGHT ON THE FUNCTIONAL STATUS OF THE SHEEP ORGANISM [VLIANIE POVYSHENNYKH UROVNEI UF-IZLUCHENIIA ZONY B NA FUNKSIONAL'NOE SOSTOIANIE ORGANIZMA OVETS PRI EGO KHRONICHESKOM DEISTVII]**

V. L. IVANOV, A. G. IPATOVA, V. V. DEMICHEV, N. V. EFIMENKO, V. A. KOZLOV, N. N. SUKHANOVA, T. S. SHEVCHENKO, and A. S. SHEVCHENKO Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 32-35. In Russian. refs  
Copyright

Effects of increased doses of continuous irradiation by UV-B light (1 hr daily with an intensity of 5.5 W/sq m, up to a total dose of 300 kJ/sq m for 15 days) on the cardiovascular functions and the biochemical, biophysical, and structural parameters of blood plasma and blood cells of sheep were investigated. It was found that exposures to increased doses of UV-B light caused increased occurrences of arrhythmia; diastole shortenings; increases in the systole-diastole index; decreases in the platelet count; shortenings in the blood-coagulation time; increases in plasma concentrations of Ca, Fe, and Cu, and decreases of Zn; and conformational changes in cytoplasmic membranes of platelets and lymphocytes. I.S.

A91-55293

**DISORDERS IN THE REGULATION OF ACTIVE OXYGEN FORMS AND OF LIPID PEROXIDATION IN THE SKIN AND LIVER OF RATS FOLLOWING IRRADIATION BY UV-B LIGHT [NARUSHENIE SISTEM REGULIATSII AKTIVNYKH FORM KISLORODA I LIPOPEROKSIDATSII V KOZHE I PECHENI KRYSA POSLE DEISTVIIA UF-IZLUCHENIIA ZONY B]**

A. G. PLATONOV, V. N. MAISURADZE, and I. U. B. KUDRIASHOV Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 35-38. In Russian. refs  
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A91-55294

**THE ELECTRORETINOGRAPHIC PARAMETERS AND THE STATE OF THE CORNEA IN THE RABBIT EYE AFTER AN ACUTE EXPOSURE OF THE EYE TO UV RADIATION OF VARIOUS INTENSITIES [PARAMETRY ELEKTRORETINOGRAMMY I SOSTOIANIE ROGOVITSY GLAZA KROLIKA POSLE OSTROGO VOZDEISTVIIA NA GLAZ UF-IZLUCHENIIA RAZLICHNOI INTENSIVNOSTI]**

V. V. BELOUSOV and A. E. GRAMENITSKII Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 38-40. In Russian. refs  
Copyright

The effects of irradiation of the rabbit eye by UV-B light at intensities of 1.62, 0.567, or 1.57 W/sq m, to a total dose of 1.3 kJ/sq m, on the state of the cornea and the electroretinographic (ERG) parameters were investigated by estimating the extent of photokeratitis (PKR) and photoconjunctivitis (PCN) of the corneas and the changes in the wave amplitudes and the latencies of the ERGs. It was found that, 7-20 days after the exposures, the a-waves

and b-waves of ERGs decreased significantly, while the latencies remained unchanged. The ERG amplitudes were found to be inversely correlated to the intensity of UV light. At 1.62 W/sq m (comparable to UV intensities encountered in space flights), the extents of PKR and PCN were considerably greater than at the two lower intensities. I.S.

A91-55295

**PARAMETERS OF THE OPTOKINETIC REACTION OF THE RABBIT AFTER AN ACUTE IRRADIATION OF THE EYES WITH UV RADIATION [PARAMETRY OPTOKINETICHESKOI REAKTSII KROLIKA POSLE OSTROGO VOZDEISTVIIA UF-IZLUCHENIIA NA GLAZ]**

A. D. STRZHIZHOVSKII Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 41-43. In Russian. refs  
Copyright

The effect of an acute exposure of the rabbit eye to UV-B light to a final dose of 1300 J/sq m on the animal's optokinetic reactions was investigated using a specially designed drum-shaped apparatus with a light source equipped with a cylindrical rotating grid. It was found that the exposure to UV rays inhibited the ability of animals to perceive the motion of light stimuli and to react to changes in its velocity. I.S.

A91-55334

**THE EFFECT OF APOMORPHINE ON OPERANT BEHAVIOR IN RATS UNDER NORMOXIC AND HYPOXIC CONDITIONS**

IZO SAKURAI (Japan Self-Defense Force, Central Hospital, Tokyo), TSUNEHISA SATO (Medical Clinic Toyoko Hospital, Saint Marianna University, Kawasaki, Japan), TOSHITADA YOSHIOKA (Saint Marianna University, Kawasaki, Japan), and AKIO NAKAMURA (Japan Air Self-Defense Force, Aeromedical Laboratory, Tokyo) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1050-1053. refs  
Copyright

The effect of apomorphine on the performance of rats, maintained on a free-operant shock-avoidance schedule under normoxic and hypoxic (12, 10, and 8 percent O<sub>2</sub>) environments was studied. In a normoxic environment, apomorphine (1, 2, 4, and 8 mg/kg, i.p.) produced stereotyped behaviors and dose-dependent increases in the rats' lever-pressing response rate. In a hypoxic environment, however, the increase of the response rate induced by apomorphine at 1 mg/kg was suppressed by the hypoxic conditions tested. At a dose of 8 mg/kg apomorphine, it was also suppressed by exposure to severe hypoxia (10 and 8 percent O<sub>2</sub>). These results suggest that the impairment of avoidance behavior in rats by hypoxia was not always improved by apomorphine, and that the degree of improvement depends on the combined effects of the dosage of the drug injected, the degree of hypoxia, and the type of behavior observed. Author

A91-55335

**ROLE OF HISTAMINE IN MOTION SICKNESS IN SUNCUS MURINUS**

TAKAHIDE KAJI, HIROSHI SAITO, SHINYA UENO, TADASHI YASUHARA, TERUMI NAKAJIMA, and NORIO MATSUKI (Tokyo, University, Japan) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1054-1058. Research supported by University of Tokyo. refs  
Copyright

The levels of histamine (HA) and tele-methylhistamine (t-MH) were determined in five brain regions of *Suncus murinus*, and the effects of motion stimulus or drugs influencing the turnover of these amines were studied to elucidate the role of histamine in motion sickness. Shaking the animals for 2 min increased HA contents in telencephalon and diencephalon without significantly changing the t-MH levels. Alpha-fluoromethylhistidine (alpha-FMH), which is presumed to deplete the neuronal HA, tended to raise the HA levels. Alpha-FMH slightly alleviated the vomiting response to motion stimulus and suppressed the HA increase in diencephalon caused by shaking. Compound 48/80, which releases HA from mast cells, did not alter the control HA levels, but effectively

## 51 LIFE SCIENCES (GENERAL)

prevented the motion sickness and completely suppressed the motion-induced rises in HA levels. These results provide further evidence that brain HA plays an important role in the development of motion sickness. Author

**N91-31755\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

### **BIOFILM MONITORING COUPON SYSTEM AND METHOD OF USE Patent**

RICHARD L. SAUER, inventor (to NASA) and DAVID T. FLANAGAN, inventor (to NASA) 17 Sep. 1991 10 p Filed 14 Mar. 1990 supersedes N91-13857 (29 - 5, p 693)

(NASA-CASE-MS-C-21585-1; US-PATENT-5,049,492; US-PATENT-APPL-SN-493529; US-PATENT-CLASS-435-30; US-PATENT-CLASS-73-863.85; US-PATENT-CLASS-73-863.86; US-PATENT-CLASS-73-863.41; US-PATENT-CLASS-73-863.22; US-PATENT-CLASS-422-99; US-PATENT-CLASS-422-101)

Avail: US Patent and Trademark Office CSCL 06C

An apparatus and method is disclosed for biofilm monitoring of a water distribution system which includes the mounting of at least one fitting in a wall port of a manifold in the water distribution system with a passage through the fitting in communication. The insertion of a biofilm sampling member is through the fitting with planar sampling surfaces of different surface treatment provided on linearly arrayed sample coupons of the sampling member disposed in the flow stream in edge-on parallel relation to the direction of the flow stream of the manifold under fluid-tight sealed conditions. The sampling member is adapted to be aseptically removed from or inserted in the fitting and manifold under a positive pressure condition and the fitting passage sealed immediately thereafter by appropriate closure means so as to preclude contamination of the water distribution system through the fitting. The apparatus includes means for clamping the sampling member and for establishing electrical continuity between the sampling surfaces and the system for minimizing electropotential effects. The apparatus may also include a plurality of fittings and sampling members mounted on the manifold to permit extraction of the sampling members in a timed sequence throughout the monitoring period. Official Gazette of the U.S. Patent and Trademark Office

### **N91-31756# Brookhaven National Lab., Upton, NY. PYRIMIDINE DIMER FORMATION BY UVA RADIATION: IMPLICATIONS FOR PHOTOREACTIVATION**

B. M. SUTHERLAND, H. HACHAM, J. C. SUTHERLAND, and R. W. GANGE (Harvard Medical School, Boston, MA.) 1991 12 p Presented at the 2nd International Conference on the Biological Effects of UVA Radiation, San Antonio, TX, 27-28 Jun. 1991 (Contract DE-AC02-76CH-00016) (DE91-015837; BNL-46391; CONF-9106254-1) Avail: NTIS HC/MF A03

The duality of biological and biochemical effects mediated by UVA radiation complicates evaluation of its biological role. On the one hand, UVA can drive photoreactivation and prevent inactivation of a UV-irradiated organism; on the other hand, UVA clearly kills cells. We have investigated the ability of UVA to induce pyrimidine dimers in human skin in situ. Results of these studies indicate that UVA induces easily quantifiable levels of pyrimidine dimers in the DNA of human skin exposed in situ; and significant levels of dimers are induced in skin exposed to biologically relevant UVA doses (e.g. 0-1 minimal erythral dose (MED)). Also, UVA doses appropriate for photorepair may induce sufficient dimer frequencies to mask photoreactivation in biological systems, including human skin. Therefore, careful design of photoreactivation experiments is essential. The UV lamp used must not reverse or convert photodamage, nor induce additional lesions in the DNA. DOE

**N91-31757#** Air Force Inst. of Tech., Wright-Patterson AFB, OH.

**THE EFFECT OF EXERCISE TRAINING ON SKELETAL MUSCLE GLUCOSE TRANSPORTER ISOFORM GLUT4 CONCENTRATION IN THE OBESE ZUCKER RAT M.S. Thesis** ERIC A. BANKS May 1991. 110 p

(AD-A239461; AFIT/CI/CIA-91-054) Avail: NTIS HC/MF A06 CSCL 06/1

Exercise training has been demonstrated to improve skeletal muscle insulin resistance. However, the mechanisms for this improvement have not been fully characterized. The effects of high (HT) and low (LT) intensity exercise training were therefore examined on insulin-stimulated 3-O-methyl-D-glucose (3-OMG) transport and the concentration of glucose transporter isoform GLUT4 in the red (fast-twitch oxidative) and white (fast-twitch glycolytic) quadriceps of the obese Zucker rat. Sedentary obese (SED) and lean (LN) rats served as controls. 3-OMG transport was determined during hindlimb HT and LT rats displayed greater red quadriceps 3-OMG transport rates and GLUT4 concentrations than SED rats. Citrate synthase activity, which is an oxidative enzyme marker for skeletal muscle exercise training, highly correlated with GLUT4 concentration. The 3-OMG transport rate of LN rats was two-fold greater than SED rats despite similar GLUT4 concentration. These results suggest muscle insulin resistance in the obese Zucker rat is not due to a reduced GLUT4 concentration. However, the improved insulin resistance seen with exercise training appears to be due in part to an increased GLUT4 concentration which is only observed in muscle fibers recruited during training. GRA

**N91-31758#** Case Western Reserve Univ., Cleveland, OH. Inst. of Pathology.

### **ELECTRON MICROSCOPY TO CORRELATE CELL STRUCTURES AND BIOCHEMICAL ACTIVITY Midterm Report, 15 Nov. 1989 - 14 May 1991**

MASAMICHI AIKAWA 15 Jun. 1991 27 p (Contract DAMD17-90-C-0010; DA PROJ. 3M1-61102-BS-13) (AD-A239640) Avail: NTIS HC/MF A03 CSCL 06/5

Electron microscopy showed that desferrioxamine (DFO) appears to act specifically during the late trophozoite and early schizont stages of *P. falciparum* by preventing nuclear division. This finding is consistent with inhibition of the iron-dependent enzyme ribonucleotide reductase induced by DFO. Inhibition of this enzyme appears to contribute to the antimalarial effect of iron chelate. Immuno-electron microscopy showed liposome-encapsulated malarial antigen that is phagocytosed by macrophages can enter an intracellular compartment in which some of the antigenic epitopes are not degraded by lysosomal enzymes. This indicates the possible existence of a pathway in which liposomal contents can bypass lysosomal degradation. PRBC sequestration and cytoadherence of knobs on PRBC to endothelial cells in cerebral vessels were shown in rhesus monkeys infected with *P. coatneyi*. This indicates that rhesus monkeys infected with *P. coatneyi* can be used as a primate model for human cerebral malaria. GRA

**N91-31776\*#** Utah State Univ., Logan.

### **EXPLORING THE LIMITS OF CROP PRODUCTIVITY: A MODEL TO EVALUATE PROGRESS**

BRUCE BUGBEE In NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 1-23 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

The goal was to determine the limits of crop productivity when all environmental constraints were removed. Researchers define productivity as food output per unit of input. Researchers evaluated cultivars of wheat with reduced leaf size and number to decrease the leaf area index at high plant densities. These cultivars may also have an improved harvest index. Hydroponic studies indicate that 1 mM nitrate in solution is adequate to support maximum growth in these systems, provided iron nutrition is adequate. Wheat does not accumulate nitrate in leaves even when the solution nitrate concentration is 15 mM. Long-term photosynthetic efficiency (g mol (exp -1) of photons) and harvest index were not altered by photoperiod (16, 20, or 24 hours). Wheat does not need, nor benefit from, a diurnal dark period. Author

**N91-31779\*#** Wisconsin Univ., Madison.

**ENVIRONMENTAL AND CULTURAL CONSIDERATIONS FOR GROWTH OF POTATOES IN CELSS**

THEODORE W. TIBBITTS, SUSAN M. BENNETT, and ROBERT C. MORROW /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 77-92 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 02/3

The white potato (*Solanum tuberosum*) was evaluated for use in the Closed Ecology Life Support System (CELSS) because of its high ratio of edible to inedible biomass and highly nutritious tuber that consists of readily digestible carbohydrates and proteins. Results are given for conditions that will produce the highest yields. The results, given in tabular form, indicate the optimum temperatures, irradiance, carbon dioxide concentration, root environment, plant spacing, root and stolen containment, and harvesting times. Author

**N91-32027#** Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Dept. of Environment Research.

**A SYSTEM TO DETERMINE WHOLE-PLANT EXCHANGE RATES OF OZONE, CARBON DIOXIDE AND WATER VAPOUR**

J. M. M. ABEN /in its KEMA Scientific Reports, Volume 8, Number 2, 1990 p 109-120 Apr. 1990

Avail: NTIS HC/MF A04

A whole plant gas exchange system was developed for the determination of ozone uptake, photosynthesis, respiration and transpiration. Performance studies showed that the boundary layer resistance was sufficiently low to allow accurate determination of the influence of environmental conditions on gas exchange. Ozone degradation at the inner surfaces of the chamber depended on air humidity but was always sufficiently low to enable accurate determination of the ozone flux to the plant and the influence on it of environmental factors. Both short term and long term stability were very good, facilitating the detection of small changes in gas exchange and favoring the performance of long experiments. Applications of the system in air pollutant research are illustrated. ESA

**N91-32748#** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Abt. Biophysik.

**PHOTOBIOLOGICAL INVESTIGATIONS ON SPORES OF STREPTOMYCES GRISEUS Ph.D. Thesis - Giessen Univ.**

BIRGIT KELLER Mar. 1991 111 p In GERMAN; ENGLISH summary Report will also be announced as translation ESA-TT-1269

(DLR-FB-91-14; ISSN-0939-2963; ETN-91-90044; ESA-TT-1269)

Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB PL DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 36.50 DM

On spores of *Streptomyces griseus* the UV action spectra of inactivation were compared between wet and dry state. In vacuum, the spores are more resistant to UV by a factor of two than under wet conditions. Their photoreactivity is reduced. The cross sections for induction of DNA double strand breaks and for inactivation show similar dependence on wavelength. ESA

**N91-32749#** California Univ., Berkeley. Lawrence Berkeley Lab.

**BIOPHYSICAL AND GENETIC ASPECTS OF LIGHT-POTENTIATED GRAVITROPIC CURVATURE IN THE MAIZE PRIMARY ROOT Ph.D. Thesis**

D. M. FANTIN Apr. 1991 190 p

(Contract DE-AC03-76SF-00098)

(DE91-016255; LBL-30682) Avail: NTIS HC/MF A09

This thesis explores issues related to light-induced gravitropic curvature in maize primary roots, such as the root cap as the potential photosensor, entrainment by light of curvature in the gravistimulated root, and the possibility of genetic control of bending response variation. Central to this thesis is a mathematical model, emphasizing physical forces and molecular flows, linking the stages of light-stimulated gravitropic curvature. The model assumes a growth inhibitor is produced in the root cap, transported by diffusion

to the extension zone, and transported by convection around the extension zone, where it retards growth at a rate proportional to its concentration. Model predictions were compared to experimental data to evaluate these assumptions. The root cap is shown to be the photosensor, and genetic crosses show that more than two genes must control the bending response. DOE

**N91-32750#** Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst.

**BIOPHYSICAL AND BIOMATHEMATICAL ADVENTURES IN RADIOBIOLOGY**

B. R. SCOTT 1991 30 p Presented at the 5th Annual Southern Univ. Coll. of Science Symposium on Versatility and Wonders Or Physics, Baton Rouge, LA, Mar. 1991 Submitted for publication

(Contract DE-AC04-76EV-01013)

(DE91-017484; CONF-9103198-1) Avail: NTIS HC/MF A03

Highlights of my biophysical and biomathematical adventures in radiobiology is presented. Early adventures involved developing state-vector models for specific harmful effects (cell killing, life shortening) of exposure to radiation. More recent adventures led to developing hazard-function models for predicting biological effects (e.g., cell killing, mutations, tumor induction) of combined exposure to different toxicants. Hazard-function models were also developed for predicting harm to man from exposure to large radiation doses. Major conclusions derived from the modeling adventures are as follows: (1) synergistic effects of different genotoxic agents should not occur at low doses; (2) for exposure of the lung or bone marrow to large doses of photon radiation, low rates of exposure should be better tolerated than high rates; and (3) for some types of radiation (e.g., alpha particles and fission neutrons), moderate doses delivered at a low rate may be more harmful than the same dose given at a high rate. DOE

**N91-32751#** Arizona State Univ., Tempe.

**PARTICULATE MODELS OF PHOTOSYNTHESIS**

G. R. SEELY Jun. 1991 23 p

(Contract DE-FG02-86ER-13620)

(DE91-016842; DOE/ER-13620/4) Avail: NTIS HC/MF A03

A chlorophyll model system for photochemical energy conversion has been developed. When irradiated with red light, reducing equivalents are transferred from hydrazobenzene in the hydrocarbon particles to 5,5'-dithiobis (2-nitrobenzoate) in the aqueous phase. The primary photochemical step is transfer of an electron from singlet excited chlorophyll to a primary oxidant ligated to it, or to another chlorophyll to a primary oxidant ligated to it, or to another chlorophyll molecule, depending on the composition of the system. Evidence for the mode of operation derives from analysis of kinetics and quantum yields of reaction, and of fluorescence spectra, quantum yields, and lifetimes. It was found that chlorophyll associates strongly with micelles of N-dodecyl pyridinium iodide in toluene, its hydrate is maintained in a dispersed state by dodecylpyridinium alkanooates, and that it reacts with 2,2'-dithiobis (5-nitropyridine) by photoaddition of a nitro pyridylthiyl group. Procedures for correcting fluorescence spectra and quantum yields in highly scattering media were worked out and applied to the characterization of the model system. DOE

**N91-32752#** Argonne National Lab., IL.

**THE ROLE OF SPIN CHEMISTRY IN THE PRIMARY EVENTS OF PHOTOSYNTHESIS**

G. KOTHE, S. WEBER, S. S. SNYDER, JAU TANG, M. C. THURNAUER, A. L. MORRIS, R. R. RUSTANDI, and ZHIYU WANG (Chicago Univ., IL.) 1991 15 p Presented at the OJI International Conference on Spin Chemistry, Tomakomai (Japan), 15-18 Jul. 1991

(Contract W-31-109-ENG-38)

(DE91-017301; ANL/CP-73656; CONF-9107163-1) Avail: NTIS HC/MF A03

We have developed theoretical treatments and have performed various transient experiments such as RYDMR (reaction yield detected magnetic resonance) and FT-CIDEP (Fourier transform-chemically induced dynamic electron spin polarization)

to understand the role that spin chemistry may play in photosynthesis. In this paper, we extend our vector model to include the Redfield density matrix formalism in order to accommodate explicitly the processes of sequential electron transfer, relaxation and coherence. The formal calculations will be illustrated using radical pairs occurring in photosynthetic reaction centers, including oscillations attributable to coherent spin dynamics. Quantum beats have been observed as predicted for radical pairs in fully deuterated algae using ultrahigh time resolution continuous wave electron paramagnetic resonance (EPR). Time domain simulations can provide information on T(sub 1), T(sub 2), and the lifetime of the radical pair. DOE

## 52

## AEROSPACE MEDICINE

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

**A91-53885**  
**TRANS-THORACIC FLUID SHIFTS AND ENDOCRINE RESPONSES TO 6-DEG HEAD-DOWN TILT**

D. GRUNDY, K. REID, F. J. MCARDLE, B. H. BROWN, D. C. BARBER, C. F. DEACON, and I. W. HENDERSON (Sheffield, University, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 923-929. refs  
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A tomographic method of measuring electrical impedance known as Applied Potential Tomography has been used to image the impedance changes within the thoraxes of 8 healthy volunteers (4 male, 4 female) during 4-h periods of 6 deg head-down tilt (HDT). A large decrease in impedance, reflecting an increase in thoracic fluid, was apparent within 1 min of tilting, peaked after 45 min, and was maintained throughout, although during the 4 h there was an 8 percent return toward baseline resistivity. Resistivity changes were most obvious in the region of the lungs. Simultaneous measurements of the key fluid regulating hormones revealed a significant increase in atrial natriuretic peptide and significant decrease in angiotensin II and aldosterone. There was no significant difference in plasma antidiuretic hormone level. These results illustrate the dynamic nature of fluid shifts during HDT, the spatial distribution of the fluid within the thorax, and the associated endocrine responses. Author

**A91-53886** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.  
**CAROTID BARORECEPTOR INFLUENCE ON FOREARM VASCULAR RESISTANCE DURING LOW LEVEL LOWER BODY NEGATIVE PRESSURE**

CYNTHIA A. THOMPSON (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL), DAVID A. LUDWIG (North Carolina, University, Greensboro), and VICTOR A. CONVERTINO (NASA, Kennedy Space Center, Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 930-933. refs  
 (Contract NAS10-10285; NGT-60002)  
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The degree of forearm vasoconstriction induced by low levels of lower body negative pressure (LBNP) provides a measure of the responsiveness of the cardiopulmonary baroreflex. The validity of this measurement is based on the assumption that this vasoconstriction response is not influenced by unloading of carotid baroreceptors. To test the hypothesis that arterial baroreceptor unloading does not alter the degree of forearm vascular resistance during low levels of LBNP, 12 subjects were exposed to -15 and -20 mm Hg LBNP with and without additional artificial (+ 10 mm Hg neck pressure) unloading of the carotid baroreceptors. There was no measurable influence of carotid unloading on forearm vascular resistance at either level of LBNP. It is concluded that

forearm vascular resistance measured during cardiopulmonary baroreceptor unloading is unaffected by carotid baroreceptor unloading within the magnitude encountered during low levels of LBNP. Author

**A91-53887\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**LOWER BODY NEGATIVE PRESSURE TO PROVIDE LOAD BEARING IN SPACE**

ALAN R. HARGENS, ROBERT T. WHALEN, DONALD E. WATENPAUGH, DOUGLAS F. SCHWANDT (NASA, Ames Research Center, Moffett Field, CA), and LARRY P. KROCK (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 934-937. refs

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Results are presented from an experiment to determine whether lower body negative pressure (LBNP) produces a footward force equal to the product of the pressure differential and body cross-sectional area at the waist seal. Twelve male volunteers were sealed at the superior iliac crest in upright and supine LBNP chambers. Each subject was exposed to 10 mm Hg increments of LBNP up to 70 mm HG (standing) or to 50-100 mm Hg (supine), depending upon individual tolerance. Static reaction force was measured at each LBNP level for about 1-2 min. The forces measured during LBNP agreed well with forces calculated from the cross-sectional areas of the subjects' waists. It is inferred from these results that exercise in microgravity against 100 mm Hg LBNP could produce static and inertial forces similar in magnitude to those occurring on earth. It is concluded that this gravity-independent technique can help maintain the musculoskeletal and cardiovascular systems of crew members during prolonged exposure to microgravity. P.D.

**A91-53888**  
**CARDIOPULMONARY BAROREFLEX CONTROL OF FOREARM VASCULAR RESISTANCE AFTER ACUTE BLOOD VOLUME EXPANSION**

G. W. MACK, T. NISHIYASU, X. SHI, E. R. NADEL (Yale University, New Haven, CT), and B. M. QUIGLEY (Queensland, University, Australia) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 938-943. refs  
 (Contract NIH-HL-20634; NIH-HL-39818)

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The stimulus-response characteristics of cardiopulmonary (CP) baroreflex control of forearm vascular resistance (FVR) in young adult male volunteers before and after volume expansion and a redistribution of blood volume toward the heart are reported. The relationship between reflex stimulus and response during unloading of CP mechanoreceptors with lower body negative pressure (0 to -20 mm Hg) were assessed. Changes in central venous pressure (CVP) were estimated from changes in venous pressure of a large peripheral vein of the dependent arm with the subject in the right lateral decubitus position. In all conditions, reflex forearm vasoconstriction occurred in response to a reduction in the estimated CVP. The reduced sensitivity of the CP baroreflex following volume expansion was manifested primarily as a smaller FVR response to LBNP. These data support the concept that reflexes involved in extracellular volume regulation interact with baroreflex control of vascular tone. P.D.

**A91-53892**  
**THE USE OF CARDIAC AND EYE BLINK MEASURES TO DETERMINE FLIGHT SEGMENT IN F4 CREWS**

GLENN F. WILSON and FRANK FISHER (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 959-962. refs

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Discriminant analysis techniques were used to classify eight flight segments for 19 F4 crewmembers and to classify pilots from Weapons systems Officers (WSOs). Heart rate and eye blink data were used as variables. Pilots and WSOs were correctly

classified 84 percent of the time, while 92 percent of the flight segments were correctly classified for pilots and 89 percent for WSOs. The percent correct classifications of flight segments using the jackknife procedure were 69 percent and 68 percent, respectively. The advantage of collecting multiple physiological signals was demonstrated. Combined cardiac and eye blink data produced better classifications than when each was used alone. Application of this technique to the flight environment is discussed. Author

**A91-53893**  
**MARKERS FOR DEVELOPMENT OF HYPERTENSION IN**  
**COMMERCIAL FLIGHT AVIATORS**

K. EKSTRAND, J. A. NILSSON, B. LILJA, P. A. BOSTROM, and M. ARBORELIUS, JR. (Lund University, Malmö, Sweden) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 963-968. refs

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In order to discover markers for the development of cardiovascular disease and hypertension, a study was made of systolic and diastolic blood pressure, ECG, and heart rate before, during and after exercise; body mass index (BMI); serum cholesterol; and smoking habits in 183 male aviators (mean age 41 years at commencement, and 55 at follow-up). Those developing cardiovascular disease had an overrepresentation of smokers but the disease could not be related to any other variable. By contrast, the following independent markers for prediction of future hypertension in normotensive aviators were found: increased BMI, increased diastolic blood pressure at 50 W, low heart rate at maximal exercise and smoking. Of these markers high diastolic blood pressure and low heart rate during exercise are new. Subjects with initially elevated blood pressure who did not develop hypertension decreased their diastolic blood pressure after exercise in contrast to those developing hypertension. Author

**A91-53896**  
**HEAT STRESS ON HELICOPTER PILOTS DURING GROUND**  
**STANDBY**

PAUL FROOM, IGAL SHOCHAT, LIORA STRICHMAN, ALEX COHEN (Israel Air Force, Aeromedical Center, Ramat Gan), and YORAM EPSTEIN (Heller Institute of Medical Research, Ramat Gan, Israel) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 978-981. refs

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Measurements of ambient thermal conditions are used to characterize and predict thermal conditions in the cockpit before takeoff and during an hour standby period of two helicopters with a crew of two and with the cockpit doors opened. Dry-bulb, wet-bulb, and globe temperatures were measured on 28 separate summer days. The wet bulb globe temperature index (WBGT) was used to estimate heat stress. Ambient WBGT at time 0 ranged from 13 to 31 C. There was a 2.9 + or - 3.7 deg difference in WBGT between ambient and cockpit conditions at time 0 which increased to 7.2 + or - 3.5 deg after 1 h. An inverse correlation was found between the cockpit WBGT at time 0 and the change in cockpit WBGT in the 1-h period. It is concluded that the greenhouse effect results in a cockpit which is significantly higher than ambient conditions. Subsequent changes in cockpit WBGT depend on the balance between heat transfer from the pilots' bodies to the cockpit and the loss of heat after the helicopter doors are opened. P.D.

**A91-53897**  
**UNEQUAL NARROWING OF THE VISUAL FIELD IN A +GZ**  
**ENVIRONMENT**

STEPHEN E. POPPER (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and LLOYD D. TRIPP, JR. (Systems Research Laboratories, Inc., Dayton, OH) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 986-988. refs

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The etiology of unequal loss of peripheral vision (left versus right) under sustained +Gz acceleration is examined. Two case

histories of unequal peripheral light loss (PLL) are discussed. The operational significance of unequal PLL is discussed. Consideration is given to pilot training to verify adequacy of the anti-G straining maneuver, expose each pilot to standard high-G profiles, and have each pilot experience as much PLL as possible (tunnel down to a center-mounted red light, or if only overall graying occurs, to use 60 percent of light intensity). Given the stereotypical pilot and the personal implications of an almost complete PLL, it is not possible to ensure all pilots experience the desired PLL. The implications of these observations are discussed. P.D.

**A91-53898**  
**TECHNIQUES TO ENHANCE SAFETY IN ACCELERATION**  
**RESEARCH AND FIGHTER AIRCREW TRAINING**

JAMES E. WHINNERY, RICHARD J. HAMILTON, and JOSEPH P. CAMMAROTA, JR. (U.S. Navy, Aerial Combat Maneuvering Enhancement Laboratory, Warminster, PA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 989-993. refs

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Techniques are presented that can be immediately employed by centrifuge medical personnel to reduce the potential for significant embarrassment and possible injury involving the central nervous system (CNS). These include techniques to reduce excessive parasympathetic tone that may result in marked bradycardia and transient asystole past +Gz stress, and manually controlled inflation and pulsation of the anti-G suit to enhance CNS perfusion past +Gz stress. Aircrew training profiles with electrocardiographic response are presented. An apparatus to maintain and pulsate anti-G suit (AGS) inflation manually from the centrifuge control room is described. The characteristics of an AGS deflation profile following single AGS inflation initiated by a flight surgeon upon recognition of G-LOC during aircrew centrifuge training are presented. P.D.

**A91-53899**  
**DECOMPRESSION SICKNESS - USN OPERATIONAL**  
**EXPERIENCE 1969-1989**

R. BASON, D. YACAVONE, and A. H. BELLENKES (U.S. Navy, Naval Safety Center, Norfolk, VA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 994-996. refs

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This report presents data on the U.S. Navy's experience in decompression sickness occurring in operational flight from January 1, 1969 to December 30, 1989. During these 21 years, decompression sickness was reported in 12 USN aircraft and involved 15 aircrew. The primary cause of decompression, as might be expected, was a loss of cabin or cockpit pressurization. The most common manifestation of decompression sickness was limb or joint pain although some crewmembers experienced various manifestations of neurological dysfunction. One crewmember experienced chokes. Of the 15 afflicted aircrew, 13 (87 percent) had complete remission of symptoms by the time they landed. Two crewmembers required compression therapy for resolution of symptoms. None of the reported symptoms were incapacitating and none of the aircraft involved crashed or received even minor damage. Author

**A91-54296**  
**NECK AND BODY LOADS - 'ALL THE DATA IS NEEDED'**

RICHARD P. WHITE, JR. and AILEEN M. BARTOL (Systems Research Laboratories, Inc., Dayton, OH) *SAFE Journal*, vol. 21, July-Aug. 1991, p. 26-33.

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Compact six-component balance systems to measure the dynamic forces and moments the head applies to the neck and those applied to the lumbar spine from the upper body segments have been developed. The systems are now being used in manikins to measure the dynamic loads applied to these critical body parts. The results presented demonstrate the difference in the measurements obtained by utilizing different calibration procedures

and the need to use the complete calibration matrix, if accurate multi-axis loading information is to be recorded. R.E.P.

**A91-55242**

**CLINICAL AND PHYSIOLOGICAL ASSESSMENT OF BASIC NOSOLOGICAL FORMS OF VISION-ORGAN PATHOLOGY IN PILOTS [KLINIKO-FIZIOLOGICHESKAIA OTSENKA OSNOVNYKH NOZOLOGICHESKIKH FORM PATOLOGII ORGANA ZRENIIA U LETCHIKOV]**

L. M. ASYEV, A. I. BUTURLIN, A. S. KONDRAT'EV, I. G. OVECHKIN, and V. V. CHUMAKOV *Voenno-Meditsinskii Zhurnal* (ISSN 0026-9050), May 1991, p. 58-60. In Russian. refs  
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Results are presented of an analysis of cases in which military flight personnel individuals were disqualified on the basis of vision disorders. Vision pathology was recorded in 17.1 percent of disqualified pilots and in 29 percent of individuals accepted for limited flight-related activity. Myopia and myopic astigmatism were found to be the dominant types of vision malfunction. Seventy-eight percent of the myopia cases were among the navigators of the 1st class, regardless of age and length of service. I.S.

**A91-55297**

**SKIN AND EYE INJURIES CAUSED BY SOLAR UV RADIATION [POVREZHDENIIA KOZHI I GLAZ UF-IZLUCHENIEM SOLNTSA]**

V. S. KRASNOVIDOV, V. F. LYSAK, and V. K. OSIPOVICH *Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina* (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 46-50. In Russian. refs  
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The types of skin and eye injuries induced by solar UV rays are discussed, with consideration given to the mechanisms of skin erythema, pigmentation, and burns. Data are presented on the spectral sensitivity of the skin to UV light of different wavelengths, as well as on injury-related irradiation thresholds. Special attention is given to the nature of UV-light-induced eye injuries and their clinical picture. Threshold doses of irradiation for injuries of the eye conjunctiva, cornea, and lens are indicated. I.S.

**A91-55298**

**EFFECT OF SUPERERYTHEMATOUS DOSES OF UV RADIATION ON THE GENERAL CONDITION OF HUMAN ORGANISM [VLIANIE SUPERERITEMNYKH DOZ UF-RADIATSII NA OBSHCHEE SOSTOIANIE ORGANIZMA CHELOVEKA]**

N. E. PANFEROVA, L. V. GUTOROVA, T. A. KABESHEVA, and V. I. PERVUSHIN *Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina* (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 50-54. In Russian. refs  
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The effect of exposures to supererythematous doses (2-4, 5-6, or 7-8 minimal erythematous dose, MED) of UV-B light on the various parameters of the physiological condition of the human body was investigated in experiments in which 20 or 50 percent of the skin of subjects was exposed to UV-B light at intensities from 0.25 W/sq m at wavelengths up to 280 nm, 9.9 W/sq m in the 280-320 nm range, and 12.5 W/sq m in the 320-400 nm range. Results collected 1 and 3 days after the exposures included observations of the skin condition and measurements of perspiration, body temperature, fluid consumption, diuresis, and ECG and occlusion-plethysmography parameters. It was found that a 7-8 MED dose was sufficient to cause signs of early injury after both 20 and 50 percent skin exposures, with the observed adverse changes being more severe after 50 percent skin exposures than they were at 20 percent. I.S.

**A91-55299**

**THE DURATION OF THE AFTEREFFECTS OF UV IRRADIATION UNDER CONDITIONS OF UV INSUFFICIENCY [O DLITEL'NOSTI POSLEDEISTVIA UF-OBLUCHENIIA CHELOVEKA V USLOVIAKH UF-NEDOSTATOCHESTI]**

N. E. PANFEROVA, V. I. PERVUSHIN, V. I. LEBEDEV, M. S. BELAKOVSKII, M. S. KHAIDAKOV, L. V. GUTOROVA, T. A.

KABESHEVA, I. N. KHODKEVICH, and M. P. RYKOVA *Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina* (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 54-56. In Russian. refs  
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The aftereffects of repeated exposures to UV-B light under conditions of UV-light insufficiency were investigated in experiments during autumn and winter, in which residents of the Moscow region were subjected to irradiation of the upper body by UV light in the ranges of 220-280, 280-320, or 320-400 nm, with intensities equal to 0.035, 1.75, and 0.65 W/sq m, respectively. Results indicate that, as a result of ten to twenty exposures (which varied in the total minimal erythematous dose), the skin sensitivity of the subjects decreased, the skin capillary resistance increased, the Ca metabolism normalized, and the blood 25(OH) D increased. However, twenty sessions of exposure were found to cause untoward long-term aftereffects. On the basis of these results, it is recommended that spacecraft personnel should be treated with UV light of moderate intensity on the ground before short-term (less than 4 months) flights and in space during longer flights. I.S.

**A91-55300**

**THE RESONANCE HYPOTHESIS OF MOTION SICKNESS ON THE GROUND [REZONANSNAIA GIPOTEZA NAZEMNOGO UKACHIVANIIA]**

D. V. LYCHAKOV *Kosmicheskaiia Biologiia i Aviakosmicheskaiia Meditsina* (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 57, 58. In Russian. refs  
Copyright

A hypothesis is presented according to which motion sickness is a result of a resonance between frequencies of accelerations inducing motion sickness and the zeta waves of 0.17-0.25 Hz frequencies, which are known to be related to the body's defence control against environmental stress. It is suggested that the vestibulatory system of the human body acts as both the transmitting link and the generator or a pacemaker of zeta waves. I.S.

**A91-55329\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ADAPTATION OF SLEEP AND CIRCADIAN RHYTHMS TO THE ANTARCTIC SUMMER - A QUESTION OF ZEITGEBER STRENGTH**

PHILIPPA H. GANDER (NASA, Ames Research Center; San Jose State University Foundation, Moffett Field, CA), JOHN A. MACDONALD, JOHN C. MONTGOMERY (Auckland, University, New Zealand), and MICHAEL G. PAULIN (University of Otago, Dunedin, New Zealand) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1019-1025. Research supported by Department of Scientific and Industrial Research of New Zealand. refs  
Copyright

Adaptation of sleep and circadian rhythms was examined in three temperate zone dwellers arriving in Antarctica during summer. Rectal temperature, wrist activity, and heart rate were monitored continuously, sleep timing and quality noted on awakening, and mood and fatigue rated every 2 h while awake. Sleep was poorer in 2/3 subjects in Antarctica, where all subjects reported more difficulty rising. Sleep occurred at the same clock times in New Zealand and Antarctica, however, the rhythms of temperature, activity, and heart rate underwent a delay of about of 2 h. The subject with the most Antarctic experience had the least difficulty adapting to sleeping during constant daylight. The subject with the most delayed circadian rhythms had the most difficulty. The delay in the circadian system with respect to sleep and clock time is hypothesized to be due to differences in zeitgeber strength and/or zeitgeber exposure between Antarctica and New Zealand. Author

**A91-55331**

**VISUAL CONTRAST SENSITIVITY OF U.S. NAVY JET PILOTS** LEONARD A. TEMME, EDWARD RICKS, AILENE MORRIS, and DAVID SHERRY (U.S. Navy, Naval Aerospace Medical Research

Laboratory, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1032-1036. Research supported by U.S. Navy. refs  
Copyright

Good visual contrast sensitivity (CS) is often described as a visual capability important for success as a military aviator and so has been suggested as a physical standard for personal selection and retention. To evaluate this idea, the CS of 135 U.S. Navy fighter pilots ranging in age from 24 to 44 years was measured, and the values were compared to the CS of nonaviators. In addition, the pilots' CS were correlated with their air-to-air target detection distances measured during air combat maneuver training and to their night carrier landing performance scores. The major findings were: (1) the mean CS of the aviators and the nonaviators were within  $\pm 1.0$  s.d. of each other in most instances, and those few instances where a greater difference was found were parsimoniously explained by methodological and procedural factors; (2) sensitivities to different spatial frequencies were highly correlated among themselves, indicating much redundancy among the measurements; and (3) there was no evidence of a relationship between CS and air-to-air target detection distances or night carrier landing performance. Author

#### A91-55332

##### MECHANISM OF POSTFLIGHT DECLINE IN OSMOTIC CONCENTRATION OF URINE IN COSMONAUTS

IU. V. NATOCHIN, R. G. PARNOVA, D. L. FIRSOV, E. I. SHAKHMATOVA (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR), A. I. GRIGOR'EV, V. B. NOSKOV, and IU. V. SUKHANOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1037-1043. refs  
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The ratio of reabsorption of osmotically free water to osmolal clearance in individual urine voids was about the same before and after short-term spaceflights. This ratio was reduced after long-term flights, so that the regression lines for pre- and postflight values have different slopes. This change in the function relating the two factors was accompanied by increased vasopressin in blood plasma and probably was caused by altered cellular reaction to vasopressin. The decrease in the effect of vasopressin may have been caused by the development of hypokalemia and hypercalcemia in the cosmonauts, and a decrease in cellular potassium in the outer renal medulla. It is established that, in addition to cAMP, cGMP and inositol trisphosphate participate in cellular reactions to vasopressin. Increases in the concentration of cGMP and decrease in the formation of inositol triphosphate in the presence of neomycin increase the hydroosmotic effect of vasopressin. It is hypothesized that modulation of the effect of vasopressin in cosmonauts is due to change in the functional state of their kidneys. Author

#### A91-55333

##### INCREASED PLASMA HYPOXANTHINE VALUES IN HUMANS DURING EXPOSURE TO SIMULATED ALTITUDE OF 7,620 METERS (25,000 FEET)

SVEIN DUELAND, KJELL MYHRE (Royal Norwegian Air Force, Institute of Aviation Medicine, Oslo, Norway), AUD N. DUELAND, and OLA D. SAUGSTAD (National Hospital, Oslo, Norway) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1044-1049. Research supported by Norwegian Cancer Society, NAF, Laerdal Foundation for Acute Medicine, et al. refs  
Copyright

In this study, the effect of severe and moderate hypoxemia on plasma hypoxanthine and lactate values was determined. Hypoxemia was induced in healthy humans in a low pressure chamber. The test subjects breathed atmospheric air at barometric pressures of 279 mm Hg and 385 mm Hg, representing a simulated altitude of about 7,620 and 5,334 m, respectively. Exposure to 279 mm Hg represents a severe hypoxemia, and all subjects exposed to this simulated altitude for 2 min showed symptoms related to hypoxia. After this exposure, plasma hypoxanthine

increased by an average of 2.4 times compared to preexposure values. Exposure to 385 mm Hg represents a moderate hypoxemia, and the persons tested at this simulated altitude for 45 min showed no or minor symptoms related to hypoxia and there was no change in plasma hypoxanthine values. In contrast to the unchanged plasma hypoxanthine values, there was a 50 percent increase in plasma lactate values after 30 min exposure. It is concluded that plasma hypoxanthine is a reliable marker for severe cellular hypoxia in humans and that enhanced plasma hypoxanthine levels are a rapid response to cellular hypoxia. Author

#### A91-55337

##### AIRLINE PILOT INCAPACITATION SURVEY

MELANIE JAMES and ROGER GREEN (RAF, Institute of Aviation Medicine, Farnborough, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1068-1072. refs  
Copyright

A survey, replicating one originally conducted by the International Federation of Airline Pilot's Associations (IFALPA) in 1967, was carried out to investigate the etiology of in-flight incapacitation on commercial flight decks. The questionnaire was constructed by IFALPA and distributed worldwide by its member associations. Since response to the questionnaire was voluntary, no control of the sample population was possible. The results indicate that 29 percent of the 4345 respondents had been incapacitated at least once. As in 1967, gastrointestinal symptoms accounted for the majority (58 percent) of incidents, other main causes being symptoms of nasal and sinus congestion ('blocked' ear and sinus pain), headaches, and faintness or general weakness. Of those who had experienced an incident of incapacitation, 48 percent claimed that safety was actually, or potentially, affected. However, when all respondents were asked whether they were concerned about safety in the event of incapacitation in-flight (excluding take-off and landing), only 25 percent expressed concern. Slightly more pilots operating in three-man crews (50.5 percent) thought incapacitation affected the safety of the flight than those operating in two-man crews (45.3 percent). Author

#### A91-55338

##### THE ADEQUACY OF CORRECTIVE LENSES WORN BY UNITED STATES AIR FORCE AVIATORS FOR ANNUAL FLIGHT MEDICAL EXAMINATIONS

PETER B. MAPE (USAF, 379th Strategic Hospital, Wurtsmith AFB, MI) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1073-1077. refs  
Copyright

Aviators presenting for annual flight medical examinations at the 379th Strategic Hospital at Wurtsmith Air Force Base were studied to determine the prevalence of substandard visual acuity. The prevalence of the use of outdated (superseded) corrective lenses was also studied. Three hundred and forty two examinations on different aviators were conducted and 92 (26.9 percent) of these aviators were found to require corrective lenses. There were 23 (6.7 percent) aviators who were found to have inadequate visual acuity and 14 of these were found to be wearing superseded lenses. The visual screening method prescribed by the United States Air Force did not identify four of the aviators who wore superseded lenses. Three aviators were found to be wearing lenses obtained from civil sources. The study suggests that improvements could be made in U.S. Air Force visual screening and care. Author

#### A91-55340

##### BURN INJURIES FROM SMALL AIRPLANE CRASHES

STANLEY J. MOYE, C. W. CRUSE, and GEORGE M. WATKINS (Tampa General Hospital; South Florida, University, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1081-1083. refs  
Copyright

Because a large amount of general aviation activity occurs in Central Florida, admissions for victims of small airplane crashes were reviewed. Thirteen burn victims of small aircraft accidents

over a 7-year period were identified. Of the 13, 12 survived their burn injuries, an overall survival rate of 92 percent. The extent of burn injury, Abbreviated Burn Severity Index, complications, other injuries, and rehabilitation potential are reviewed. Burn injury resulting from small airplane crashes is usually survivable if the patient arrives at the Burn Center alive. These burn victims generally are highly motivated individuals, are easily rehabilitated, and continue productive lives. Small airports and local hospitals should be aware of burn center availability because of the usual major extent of the burn injury. Author

**A91-55342****A COMPARISON OF THE ROUTINE MEDICAL EXAMINATION OF PILOTS IN 12 AIR FORCES**

JAN N. NIELSEN (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1090-1095. refs

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All air forces use routine medical examination to ensure the health of their pilots and flying safety. This paper compared pilot physicals in 12 air forces, and reviewed literature dealing mainly with routine medical examination of asymptomatic individuals. The discussion considers what should be done during the routine pilot examination to ensure flying safety, health and mission completion. General recommendations are given on ways to keep cost and effort within limits without failing to achieve the objective. Methods to achieve this include differentiating the intervals between examinations in different age groups and inclusion of procedures only beyond a certain age. Caution is advised when considering the inclusion of new procedures, and attention should be paid to whether such a test can be expected to produce unacceptable numbers of false positive results. Author

**A91-55343****THE EEG IN PILOT SELECTION**

B. D. MURDOCH (Human Sciences Research Council, Div. of Neuropsychology, Johannesburg, Republic of South Africa) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1096-1098. refs

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The literature dealing with the electroencephalogram EEG in pilot selection published since a review in 1976 is summarized and tabulated. The incidence of seizure development in healthy groups with epileptiform discharges in their EEGs was found to be very low. An alternative interpretation is offered of the significance of epileptiform discharges in these groups in the context of pilot selection, and a plea is made for international standardization of procedures in this area. Author

**A91-55344****SICKLE CELL ANEMIA TRAIT IN THE MILITARY AIRCREW POPULATION - A REPORT FROM THE MILITARY AVIATION SAFETY SUBCOMMITTEE OF THE AVIATION SAFETY COMMITTEE, ASMA**

V. M. VOGEL, N. R. ROSADO, and J. J. CONTIGUGLIA (Aerospace Medical Association, Alexandria, VA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1099-1102. refs

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The question of whether sickle cell trait (SCT) is potentially dangerous to military aircrew personnel who have it and, consequently, whether such individuals should be allowed to fly in military aircraft is a very emotional issue. This article traces the evolution of how the U.S. military has dealt with the problem, and the present status of individuals with SCT in the U.S. military aviation community. Extensive studies and means for subjectively evaluating the problem were instituted by the Department of Defense in 1981, after making the decision not to restrict aircrew with the trait from aviation duties. All research projects and educational programs were abruptly stopped in 1985. Today, there are no actual restrictions on individuals with SCT for duty in the aviation and diving communities. Author

**A91-55401****PREDICTING ADAPTATION POTENTIALS IN MILITARY PERSONNEL WITH DIFFERENT CONSTITUTIONAL TYPES [PROGNOZIROVANIE ADAPTATIONNYKH VOZMOZHNOSTEI VOENNOSLUZHASHCHIKH S RAZLICHNYM KONSTITUTIONAL'NYM TIPOM]**

A. V. ZAKHAROV, V. V. PASTUKHOV, M. P. MOROZ, and Z. K. SULIMO-SAMUILO Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), June 1991, p. 57-59. In Russian. refs

Copyright

The potential ability of military personnel to adapt to physical stress was investigated in two groups of individuals, one residing in the tropics and the other in high-altitude climate; all subjects were classified among three constitutional types (cardiac, vascular, and cardiovascular) according to physiological reactions to physical load, as described by Slonim (1949). It was found that the measurements of various cardiovascular indices such as the heart rate, vessel resistance, and heart rate/average pressure ratio can be used to predict the ability, or inability, of an individual to adapt to strenuous physical activity. I.S.

**N91-31759#** Chicago Univ., IL.**NUCLEAR MEDICINE AND IMAGING RESEARCH: QUANTITATIVE STUDIES IN RADIOPHARMACEUTICAL SCIENCE**

M. COPPER and R. N. BECK Jun. 1991 83 p

(Contract DE-FG02-86ER-60438)

(DE91-015447; DOE/ER-60438/T3) Avail: NTIS HC/MF A05

During the past three years, the program has undergone a substantial revitalization. There has been no significant change in the scientific direction of this grant, in which emphasis continues to be placed on developing new or improved methods of obtaining quantitative data from radiotracer imaging studies. However, considerable scientific progress has been made in the three areas of interest: radiochemistry, quantitative methodologies, and experimental methods and feasibility studies, resulting in a sharper focus of perspective and improved integration of the overall scientific effort. Changes in faculty and staff, including development of new collaborations, have contributed to this, as has acquisition of additional and new equipment and renovations and expansion of the core facilities. DOE

**N91-31760\*** National Aeronautics and Space Administration, Washington, DC.**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 353)**

Feb. 1989 84 p

(NASA-SP-7011(353); NAS 1.21:7011(353)) Avail: NTIS HC A03; NTIS standing order as PB91-912300, \$10.50 domestic, \$21.00 foreign CSCL 06/5

This bibliography lists 238 reports, articles, and other documents introduced into the NASA Scientific and Technical Information System in August 1991. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, biotechnology, human factors engineering, and flight crew behavior and performance. Author

**N91-31761#** Hopital d'Instruction des Armees, Versailles (France). Service de Medecine Aerospatiale.**CONTINUOUS 24 HOUR ECG STUDY, ON GROUND AND IN FLIGHT, OF 19 MIRAGE 2000 PILOTS STATIONED AT THE DIJON AIRBASE (FRANCE). COMPARISON WITH SIMILAR RECORDINGS TAKEN ON OTHER TYPES OF FIGHTER AIRCRAFT OR IN OPERATIONALLY DIFFERENT CONDITIONS [ETUDE DE L'ECG CONTINU DE 24 HEURES, AU SOL ET EN VOL CHEZ 19 PILOTES DE MIRAGE 2000 STATIONNES SUR LA B.A. DE DIJON. COMPARAISON AVEC LES ENREGISTREMENTS SIMILAIRES EFFECTUES SUR D'AUTRES TYPES D'AVIONS DE COMBAT OU DANS DES CONDITIONS OPERATIONNELLE]**

A. SEIGNEURIC and J. P. BURLATON 1990 26 p In

## FRENCH

(Contract DRET-87-1027)

(ETN-91-99973) Avail: NTIS HC/MF A03

Electrocardiograph (ECG) studies of fighter pilots in different Mirage types are presented and compared. Recordings covered several different types of operational missions, as well as the sleep phase and a diurnal activity which had not been standardized. The results relating to the diurnal, nocturnal and in-flight sinus frequency, the variations of auricular-ventricular conduction, supraventricular and ventricular excitability troubles, and repolarization modifications, were compared for Mirage 2000 and Mirage 3 and F1 pilots. ESA

**N91-31762#** Manchester Univ. (England). School of Management.

**DEVELOPMENTS IN MEDICAL AUDIT IN HOSPITALS IN THE NATIONAL HEALTH SERVICE M.S. Thesis**

M. DJUMIC 1990 214 p

(ETN-91-99984) Copyright Avail: NTIS HC/MF A10

The current work on establishing comprehensive medical audit, focusing in particular on the role of information systems in the development of medical audit, the problems with outcome measurement, the perceived implications of medical audit for clinical freedom and the relationship of the activity to other reforms affecting the NHS (National Health Service, United Kingdom), is reviewed. In addition to a comprehensive review of the literature on medical audit, the study involved interviews with clinicians and management staffs. ESA

**N91-31763#** Lawrence Livermore National Lab., CA.

**BIOLOGICAL DOSIMETRY AND MECHANISMS OF CARCINOGENESIS**

M. L. MENDELSON 14 Jun. 1991 13 p Presented at the Symposium on Chemical Carcinogenesis: the Relevance of Mechanistic Understanding in Toxicological Evaluation, Berlin, Federal Rep. of Germany, 29-30 Apr. 1991

(Contract W-7405-ENG-48)

(DE91-015689; UCRL-JC-107755; CONF-9104280-1) Avail: NTIS HC/MF A03

Biological dosimetry has been given new meaning in recent years by advancing methodologies which provide increasingly sensitive and detailed cellular and biochemical information on the exposed subject. One mode of dosimetry is the toxicological mode; this involves the study of cause and effect relationships across subjects, doses, agents and species. The primary purpose of this mode is to understand and generalize the underlying mechanisms of biological damage, and to help predict or prevent ultimate toxic effects. The other mode of dosimetry described is the epidemiological mode. The emphasis is on using the biological response to reconstruct the dose received by occupationally, environmentally or medically exposed populations. The use is described of these two modes of dosimetry in unraveling the mechanisms and risks of carcinogenesis in human populations. DOE

**N91-31764#** Tennessee Univ., Knoxville. Dept. of Chemistry.

**BORON IN NUCLEAR MEDICINE: NEW SYNTHETIC APPROACHES TO PET, SPECT, AND BNCT AGENTS**

G. W. KABALKA Sep. 1991 25 p

(Contract DE-FG05-86ER-60434)

(DE91-016488; DOE/ER-60434/6) Avail: NTIS HC/MF A03

The primary objective of the DOE Nuclear Medicine Program at The University of Tennessee is the creation of new methods for introducing short-lived isotopes into agents for use in computerized tomography. A portion of the research effort is directed toward the development of new synthetic methods for the preparation of boron-containing neutron therapy agents. The uniqueness of the UT program is its focus on the design of new chemistry and technology as opposed to the application of known reactions to the synthesis of specific radiopharmaceuticals. The versatile organic boron reagents are utilized in most of the new chemistry. This new technology is then used in nuclear medicine research at the UT Biomedical Imaging Center and in collaborative

research programs with colleagues at other DOE facilities. An important goal of the DOE Nuclear Medicine Program at UT is to provide training for students (predoctoral and postdoctoral) in the scientific aspects of nuclear medicine. DOE

**N91-31765#** Naval Medical Research and Development Command, Bethesda, MD.

**NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND Annual Report, 1990**

1990 55 p

(AD-A239393) Avail: NTIS HC/MF A04 CSCL 06/5

Cold-induced amnesia was initiated in the Naval Medical Research and Development Command's (NMRDC) FY90 Independent Research Program to elucidate the neurochemical and physiological mechanisms underlying the decrements to working memory that are induced by exposure to moderate or severe cold (here termed cold-induced amnesia). Such memory impairment has been reported by Navy personnel who are commonly exposed to cold temperatures, yet clearly must be able to function effectively in increasingly complex and high tech operational environments. Cold-induced amnesia proposed to determine the effects of temperature on specific neurotransmitters and neurohormones in vivo, in brain regions whose physiological integrity is known to be critical for normal memory function, and to relate observed neurophysiological changes to alterations in working memory and behavioral performance. The ultimate transition goal of this study is to provide advanced biomedical therapies for the prevention and treatment of cold-induced memory impairment in Navy personnel. GRA

**N91-31766#** Tennessee Univ., Memphis.

**MURAMYL PEPTIDE-ENHANCED SLEEP:****PHARMACOLOGICAL OPTIMIZATION OF PERFORMANCE**

Annual Report, 1 Jun. 1990 - 31 May 1991

JAMES M. KRUEGER 1 Jun. 1991 110 p

(Contract DAMD17-86-C-6194; DA PROJ. 3M1-61102-BS-15)

(AD-A239442) Avail: NTIS HC/MF A06 CSCL 06/5

It is now recognized that sleep results from neuronal activity which is regulated by the interactions of neurons with substances produced by neurons and other cellular components of the brain. Over the past 30 years, the technical abilities to identify and synthesize biochemicals has greatly improved; these advances have led to the identification of several endogenous sleep factors (SFs) (substances that promote sleep). Over the past five years, several new SFs were identified and analogs were synthesized which may be developed into new, more effective, and safer somnogenic agents. The broad goal of this work was to develop the information needed to determine if it is reasonable to propose either endogenous SFs or synthetic analogs as potential sleep inducing agents for military use. GRA

**N91-31767#** Army Research Inst. of Environmental Medicine, Natick, MA.

**COLD-INDUCED CHANGES IN ARTERIAL SENSITIVITY Final Report**

STEPHEN P. BRUTTIG and DONALD E. ROBERTS May 1991 33 p

(AD-A239493; USARIEM-T11-91) Avail: NTIS HC/MF A03

CSCL 06/10

We studied the effects of cold on rabbits and pigs: (1) to determine how cold affects the smooth muscle sensitivity to receptor-mediated (NEPI - Norepinephrine) or nonreceptor-mediated (KCL) (pigs only) agonist induction of in vitro vascular contraction; (2) to determine whether cold-induced vascular sensitivity to catecholamines exists in an intact hypothermic pig model; and (3) to determine the effect of cortisol on the arterial smooth muscle contraction. The in vitro exposure of femoral arteries from rabbits and pigs to cold resulted in a progressive loss of sensitivity to agonist. Femoral arteries isolated from hypothermic pigs (core temp = 25 C for 2 hours) were no more sensitive to NEPI in vitro than arteries from normothermic animals. However, the in situ hind limb arterial bed of the hypothermic pig was ten times more sensitive to arterial injection

of NEPI than the arterial bed of the normothermic pig. The sensitivity of porcine vascular smooth muscle to NEPI does not appear to be affected by cortisol. These data suggest that cold evokes an extravascular control (mechanisms not intrinsic to vascular tissue) over NEPI sensitivity. Moreover, these data suggest that the mechanism for control of cold-induced sensitivity to sympathetic neurotransmitter in the pig is different from the mechanism which operates in the rabbit. GRA

**N91-31768#** Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

**THE G-LOC SYNDROME Final Report**

JAMES E. WHINNERY 31 Oct. 1990 15 p  
(AD-A239561; NADC-91042-60) Avail: NTIS HC/MF A03  
CSCL 06/5

Acceleration (+GZ)-induced loss of consciousness (G LOC) is but one isolated symptom that results when central nervous system (CNS) function is altered by G-stress. Other symptoms and changes also result when reduction of oxygenated blood flow to the CNS occurs. The complex of symptoms and changes that result from G-stress occur in close temporal relationship and therefore form a G-LOC syndrome. Recognition of the G-LOC syndrome serves to include the associated symptoms as part of the normal response to CNS ischemia/hypoxia. This recognition is important in reducing the potential for unnecessary aeromedical evaluation or disqualification of normal aircrew who have an uncomplicated G-LOC episode. It also serves to ensure that abnormal responses can be more clearly identified. Recognition of the G-LOC syndrome also serves to enhance the understanding that G-LOC is a primary neurologic disturbance induced by G-stress. The existing situation is clarified by recognizing the G-LOC syndrome as including all of the +GZ-induced CNS symptoms, either alone or in combination, as a normal response to +GZ stress in normal human beings. GRA

**N91-31769#** Naval Medical Research Inst., Bethesda, MD.  
**BASIC OPERATION AND PRELIMINARY TRIALS OF A  
DETECTOR FOR STATIONARY GAS BUBBLES Technical  
Report, Sep. 1988 - May 1989**

GARY ALBIN, PAUL MASSELL, and EDWARD THALMANN Jul.  
1991 46 p  
(AD-A239710; NMRI-91-39) Avail: NTIS HC/MF A03 CSCL  
06/10

Symptoms of decompression sickness (DCS) typically are assumed to result from the formation of gas bubbles in blood or extravascular tissue. Information on extravascular bubbles has been severely limited by the lack of any nondestructive testing method of observing them. A system has been developed to detect stationary gas bubbles 1 to 20 microns in diameter by using ultrasonic interrogation. We describe the system and propose a protocol for using it to identify the sizes and numbers of bubbles. A mathematical model of a vibrating bubble in liquid has been coded into a computer program, and currently we are developing an analogous model to simulate a bubble in an elastic solid. A technique is described for preparing calibration standards by trapping bubbles in a transparent hydrogel, which can be assayed using light microscopy. Crude preliminary trials with the bubble detector demonstrate that it can detect sufficiently large populations of bubbles, although its signal/noise ratio appears too low for detecting individual bubbles. Quantitative assay of bubbles is not possible until the system has been modified to provide a way to capture and store the output signal. GRA

**N91-31770#** Naval Health Research Center, San Diego, CA.  
**SLEEP LOGS: MEASUREMENT OF INDIVIDUAL AND  
OPERATIONAL EFFICIENCY Interim Report, period ending  
Oct. 1988**

P. NAITOH, G. BANTA, T. KELLY, J. BOWER, and R. BURR  
May 1991 24 p Sponsored by Navy Medical Research and  
Development Command  
(AD-A239774; NHRC-90-29) Avail: NTIS HC/MF A03 CSCL  
06/10

Sleep logistics are based on scientific knowledge of how sleep

loss influences human performance, and provides techniques to assure that every member of a group receives sufficient sleep at appropriate times so that serious sleep loss does not interfere with mission completion. Sleep logistics require careful measurement of the amount and pattern of sleep each group member can obtain during a given mission scenario. There are many tools for measuring amounts and patterns of sleep. The most economical and preferred method to study sleep, especially in a large group of individuals, has been the sleep log (diary). Two to four days of sleep log data were collected from 39 Navy and Marine Corps personnel during an at-sea Naval operation in the Persian Gulf. For the overall group, the average sleep episode duration was 6.8 hours per 24-hours without serious sleep fragmentation. An exception was a group of four boiler technicians. These boiler technicians accumulated a sleep debt which might interfere with maintaining sustained attention and situational awareness. Various techniques for analyzing sleep log data are discussed. Advantages and disadvantages of sleep log techniques are compared to those of other methods of collecting sleep data. GRA

**N91-32621\*#** Wesley Hospital, Brisbane (Australia).  
**THE QT INTERVAL IN LIGHTNING INJURY WITH  
IMPLICATIONS FOR THE CESSATION OF METABOLISM  
HYPOTHESIS**

CHRISTOPHER J. ANDREWS, DAVID M. COLQUHOUN, and MAT  
DARVENIZA (Queensland Univ., Brisbane, Australia) In NASA.  
Kennedy Space Center, The 1991 International Aerospace and  
Ground Conference on Lightning and Static Electricity, Volume 1  
11 p Aug. 1991

Avail: NTIS HC/MF A99 CSCL 06/18

An hypothesis is presented to provide an alternative to the Cessation of Metabolism hypothesis often invoked in lightning injury. Cessation of Metabolism has been proposed to explain the observation of good recovery after a prolonged period in cardiac arrest in some lightning injured patients. Reevaluation of EEGs from lightning injured patients show a high incidence of QT prolongation. Reexamination of the cases used to support Cessation of Metabolism also reveals little evidence to justify the hypothesis. The finding of QT prolongation coupled with the hyperadrenergic state said to exist in lightning injury, may promote a state of episodic induction of and recovery from Torsade de Pointes Ventricular Tachycardia (VT). Histological examination of the myocardium supports the new hypothesis. This the first concerted description of lightning injury as one of the general causes of QT prolongation. It appears to occur frequently after lightning injury, is a prerequisite of and predisposes to episodes of Torsade de Pointes VT. These electrocardiographic abnormalities explain Cessation of Metabolism and recognition may change management and lead to greater survival. Author

**N91-32622\*#** Wesley Hospital, Brisbane (Australia).  
**FURTHER IDENTIFICATION AND TREATMENT MODALITIES  
IN TELEPHONE MEDIATED LIGHTNING STRIKE**

CHRISTOPHER J. ANDREWS and MAT DARVENIZA (Queensland  
Univ., Brisbane, Australia) In NASA. Kennedy Space Center,  
The 1991 International Aerospace and Ground Conference on  
Lightning and Static Electricity, Volume 1 8 p Aug. 1991.  
Avail: NTIS HC/MF A99 CSCL 06/18

The results are presented of a prospective survey of people injured by lightning impulses transmitted by the public telephone system. The results are compared with those of a previous retrospective survey. Various deficiencies in the methodology of the latter survey are addressed. A division into a population with severe injury and a population with mild injury is made based on medical history and examination taken immediately after a strike. The best predictors of severe injury were found to be the presence of symptoms beyond one week after the strike, and also the initial presence of musculoskeletal injuries. Psychological upset is also seen to be a significant factor in severe injury. The only physical parameter of strike which could be used as a predictor of severe injury was the presence of concomitant power system damage. The importance of earth bonding between power and telephone

system is thus supported in a protection strategy. One author draws on experience in treating patients with these injuries to propose a treatment regimen for those with ongoing symptoms. The importance of evaluating and treating psychological and physical aspects is stressed. Author

**N91-32623\*#** Aerospace Corp., Los Angeles, CA.  
**STEP VOLTAGE ANALYSIS FOR THE CATENOID LIGHTNING PROTECTION SYSTEM**

J. C. CHAI, R. BRIET, D. L. BARKER, and H. E. ELEY /n  
 NASA, Kennedy Space Center, The 1991 International Aerospace and Ground Conference on Lightning and Static Electricity, Volume 19 p Aug. 1991  
 Avail: NTIS HC/MF A99 CSCL 06/18

The main objective of the proposed overhead Catenoid Lightning Protection System (CLPS) is personnel safety. To ensure working personnel's safety in lightning situations, it is necessary that the potential difference developed across a distance equal to a person's pace (step voltage) does not exceed a separately established safe voltage in order to avoid electrocution (ventricular fibrillation) of humans. Therefore, the first stage of the analytical effort is to calculate the open circuit step voltage. An impedance model is developed for this purpose. It takes into consideration the earth's complex impedance behavior and the transient nature of the lightning phenomenon. In the low frequency limit, this impedance model is shown to reduce to results similar to those predicted by the conventional resistor model in a DC analysis. Author

**N91-32753** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Visuology Group.

**INTRODUCTION TO MULTIREOLUTION MORPHOLOGY Final Report**

A. TOET 6 Mar. 1991 32 p  
 (Contract A87/D/149)  
 (IZF-1991-A-10; TD-91-0038; ETN-91-99990) Copyright Avail:  
 Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG  
 Soesterberg, Kampweg, Netherlands

Some new multiresolution image representations are presented in which iterative morphological filters of many scales but identical shape serve as basis functions. The representations differ from established techniques in that the primitives have a well defined location and size. Structural pattern decompositions are obtained by subtracting successive layers in the multiresolution representations. The resulting image descriptions provide a useful basis for multiresolution shape analysis and synthesis and are well suited for parallel and VLSI (Very Large Scale Integration) implementation. Examples are provided which show that multiresolution morphology can also be used to fuse images originating from multiple sensors and/or different sensing modalities. An attempt was made to visualize the morphological operations as much as possible. ESA

**N91-32754#** School of Aerospace Medicine, Brooks AFB, TX.  
**PUBLICATIONS AND PRESENTATIONS OF THE OPHTHALMOLOGY BRANCH, USAF SCHOOL OF AEROSPACE MEDICINE, 1981-1990 Interim Report, Jan. 1981 - Dec. 1990**  
 THOMAS J. TREDICI and BERTHA B. SECORD Dec. 1990  
 56 p  
 (Contract AF PROJ. 7755)  
 (AD-A239458; USAFSAM-SR-90-6) Avail: NTIS HC/MF A04  
 CSCL 06/5

Aerospace ophthalmology combines the practice of Clinical Ophthalmology and Aerospace Medicine in attempting to solve the visual and ophthalmological problems of the aviator and astronaut. The Ophthalmology Branch of the USAF School of Aerospace Medicine has exclusively performed this task for nearly 75 years. The visual problems and solutions proposed are documented in the publications and invited presentations of Ophthalmology Branch personnel, listed in chronological order for the years 1981 through 1990. They deal primarily with applied visual and clinical topics, such as visual standards for flying, the

use of contact lenses in aviation, visual illusions and aircraft accidents, air-to-air target acquisition, management of glaucoma in flying personnel, etc. GRA

**N91-32755#** National Inst. for Occupational Safety and Health, Cincinnati, OH.

**SCIENTIFIC WORKSHOP ON THE HEALTH EFFECTS OF ELECTROMAGNETIC RADIATION ON WORKERS: BIBLIOGRAPHY**

30 Jan. 1991 280 p Presented at a Workshop in Cincinnati, OH, 30-31 Jan. 1991  
 (PB91-173351) Avail: NTIS HC/MF A13 CSCL 06/18

The bibliography contained references generated from a computer literature search of various data bases. The references were published prior to mid 1990. The terms included in the search were: power transmission, extremely low frequency, very low frequency, 50 Hz, 60 Hz, and magnetic and electromagnetic fields. Each citation contained the usual pertinent material plus the data base abstract of the reference, when available. The bibliography was divided into the following sections: in vitro studies; in vivo studies (including gross effects observations; reproductive effects; cardiovascular, serum, endocrine, organs; immune systems, tumors, leukemia, growth, enzymes; neurological, pineal, behavioral; chicks, eggs, embryos; birds, nesting, population density, collisions; Drosophila melanogaster; and botanical effects); epidemiologic studies; measurement and control; and transmission lines. Author

**N91-32756#** Pacific Northwest Lab., Richland, WA.  
**INTERACTION OF EXTREMELY-LOW-FREQUENCY ELECTROMAGNETIC FIELDS WITH HUMANS**

T. S. TENFORDE Jul. 1991 8 p Presented at the 9th International Congress of Radiation Research (ICRR) Conference, Toronto, Ontario, 7-12 Jul. 1991  
 (Contract DE-AC06-76RL-01830)  
 (DE91-015779; PNL-SA-19016; CONF-9107136-4) Avail: NTIS  
 HC/MF A02

At a macroscopic level, the effects of extremely low frequency (ELF) electromagnetic fields on humans are well understood based on fundamental physical principles, but far less is known about the nature of the interactions at a cellular or molecular level. Current evidence suggests the effects of ELF on cellular biochemistry are due to interactions with the cell membrane. Elucidation of the mechanism that underlies this transmembrane signaling is critical for a molecular-level understanding of ELF field effects. Further research is also required to clarify a possible link between ELF exposure and increased cancer risk, since estimated ELF exposure in occupational or residential settings is much lower than the levels used in laboratory studies. There is a clear need for additional epidemiological research in which qualitative dosimetry is used to characterize ELF exposure and careful attention is given to possible effects of confounding variables. DOE

**N91-32757#** Argonne National Lab., IL. Environmental Assessment and Information Sciences Div.

**ASSESSING THE RISK OF CHRONIC LUNG INJURY ATTRIBUTABLE TO LONG-TERM OZONE EXPOSURE**

R. G. WHITFIELD, T. S. WALLSTEN, and R. L. WINKLER (Duke Univ., Durham, NC.) Jul. 1991 108 p  
 (Contract W-31-109-ENG-38)  
 (DE91-016814; ANL/EAIS-2) Avail: NTIS HC/MF A06

The research described here is part of a larger risk assessment project sponsored by the U.S. Environmental Protection Agency. The purpose of this research is to characterize scientific judgment regarding the risk of chronic lung injury to children aged 8 through 16 and adult outdoor workers due to long term ozone exposure in areas with patterns of exposure similar to those found in southern California and the Northeast. The qualitative and quantitative judgments resulting from the work will not be used in the ongoing review of the ozone primary ambient air quality standard. They will instead be used to inform policymakers and the public about the possible health implications of long term exposure to ozone.

Our measure of injury is the incidence of mild or moderate lesions in the centriacinar region of the lung. The probabilities over population response rates were elicited from six health experts actively researching ozone-induced lung injury. We describe our approach and present the results in the form of judgmental probability distributions and associated qualitative comments over the population response rate for formation of lesions induced by exposure to ozone. DOE

**N91-32758#** Lawrence Livermore National Lab., CA.  
**THE EFFECT OF SHOWER/BATH FREQUENCY ON THE HEALTH AND OPERATIONAL EFFECTIVENESS OF SOLDIERS IN A FIELD SETTING**

L. C. HALL and J. I. DANIELS 1 Nov. 1990 12 p  
 (Contract W-7405-ENG-48)

(DE91-017545; UCRL-CR-105166-1) Avail: NTIS HC/MF A03

Dermal disease is a significant cause of morbidity among soldiers in a combat setting. For example, among American combat troops in Vietnam, disability from skin disease was one of the single most important medical causes of man-days lost from combat. Currently, the U.S. Army makes shower or bath facilities available to soldiers in the field on a weekly basis. U.S. Army after-action reports and anecdotal descriptions from the field indicate that this may not be an optimal regimen for the maintenance of personal hygiene, especially with respect to diseases of the skin. Determination of the optimal frequency of showering or bathing for soldiers in a combat setting is complicated by the fact that soldiers in the U.S. Army may be involved in field exercise or combat in many different areas of the world with a variety of climatic conditions. Although certain aspects of the role of environmental factors in the incidence and severity of dermal disease have been documented, the role of hygiene in the potential mitigation of these effects has not been evaluated. The present project entails a comprehensive review and analysis of available literature in order to determine the health impact of shower/bath frequency for soldiers in a combat setting. An integral component of this work is an evaluation of the impact of climate, and microclimate produced by clothing, on the type, frequency, and severity of skin disease. There is a relatively large body of information concerning the effectiveness of antimicrobial soaps in minimizing the incidence and severity of dermal disease. This data will be evaluated to determine whether use of these soaps, or an increase in the use of cleansing agents in general, will result in a decrease in the severity and incidence of diseases of the skin for soldiers in the field. DOE

**N91-32759#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

**MOTION SICKNESS: SIGNIFICANCE IN AEROSPACE OPERATIONS AND PROPHYLAXIS**

Sep. 1991 201 p In ENGLISH and FRENCH Lecture series held in Toronto, Ontario, 7-8 Oct. 1991, in Athens, Greece, 24-25 Oct. 1991, and in De Bilt, Netherlands, 28-29 Oct. 1991 (AGARD-LS-175; ISBN-92-835-0634-0) Copyright Avail: NTIS HC/MF A10; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In aerospace activities, motion sickness, specifically air sickness, continues to be a problem during flying training and in regular operations for aircrew and passengers. Simulator sickness can degrade the effectiveness of simulator training and space sickness reduces the efficiency of astronauts. Sea sickness is also of aeromedical concern in so far as it affects aircrew operating from ships and the survivability of ditched sailors. The presentation is proposed as an aid to flight surgeons in the performance of their primary care duties.

**N91-32760#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

**SIGNS AND SYMPTOMS OF MOTION SICKNESS AND ITS BASIC NATURE**

K. E. MONEY (Canadian Space Agency, Ottawa, Ontario) In AGARD, Motion Sickness: Significance in Aerospace Operations

and Prophylaxis 4 p Sep. 1991

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The cardinal signs and symptoms of motion sickness are malaise, pallor, (and/or flushing), cold sweating, abdominal discomfort, changes in gastric motility, and changes in levels of circulating hormones. Cardiovascular, respiratory, and other signs have also been reported, as have a variety of other sensations, feelings, and performance changes. It is reasonable to think that motion sickness is basically the activation, by motion, of a poison response mechanism. Author

**N91-32761#** Naval Aerospace Medical Inst., Pensacola, FL.  
**MOTION SICKNESS AND ITS RELATION TO SOME FORMS OF SPATIAL ORIENTATION: MECHANISMS AND THEORY**

FRED E. GUEDRY (University of West Florida, Pensacola.) In AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis 30 p Sep. 1991

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The mechanisms of motion sickness fall under three component topics, which separately involve distinctive subject matters and together challenge the entire scope of neuroscience disciplines. The components are as follows: (1) the process involved in the sensorimotor and perceptual motor adjustments to the sustained experience of unusual motion; (2) the neurochemical link whereby the neurochemical processes and byproducts of sensorimotor adjustment accumulate to a threshold level that when exceeded elicits the sickness syndrome; and (3) the sickness syndrome, which includes emesis and all of the autonomic and physiological accompaniments that degrade performance. These mechanisms are studied in detail. Author

**N91-32762#** Southampton Univ. (England). Human Factors Research Unit.

**PHYSICAL CHARACTERISTICS OF STIMULI PROVOKING MOTION SICKNESS**

MICHAEL J. GRIFFIN In AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis 32 p Sep. 1991  
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The physical characteristics of motion stimuli responsible for motion sickness are reviewed in two parts. The provocative stimuli are categorized and their nauseogenic properties discussed qualitatively in terms of the sensory conflict theory of motion sickness. Quantitative data available from experimental studies with specific types of motion is then summarized. The motions of the body considered include translational oscillation, swing motions, rotation about a vertical axis, rotation about an off-vertical axis, rotational oscillation, and cross coupled (i.e., Coriolis) stimulation. Conditions producing visually induced motion sickness are also summarized. Author

**N91-32763#** Naval Aerospace Medical Inst., Pensacola, FL.  
**FACTORS INFLUENCING SUSCEPTIBILITY: INDIVIDUAL DIFFERENCES AND HUMAN FACTORS**

FRED E. GUEDRY (University of West Florida, Pensacola.) In AGARD, Motion Sickness: Significance in Aerospace Operations and Prophylaxis 18 p Sep. 1991

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From a conceptual viewpoint, individual differences in susceptibility to motion sickness are determined by differences in the following: initial reactivity (receptivity), ability to adapt to the motion, ability to retain the adaptation during abstinence periods, and ability to reinstate adaptive responses upon reexposure to motion. From a theoretical viewpoint, the adaptive adjustment involves alteration of the timing, magnitude, and direction of sensorimotor reactions so as to increase the efficiency of postural control in the motion environment. However, the threshold linking the sensorimotor adaptive process to the processes that set-off the signs and symptoms of motion sickness may also be an individual characteristic. A conceptual model is presented to

organize the discussion of individual differences in motion sickness susceptibility. Factors that have been reported to influence incidence of motion sickness such as age, mental activity, anxiety and fear, perceptual style, physical fitness, active control of the inducing motion, concomitant visual stimulation, quality of the initial exposure to the motion environment, and conditioned motion sickness are discussed. Author

**N91-32764#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

#### SPACE SICKNESS

K. E. MONEY (Canadian Space Agency, Ottawa, Ontario) *In* AGARD, *Motion Sickness: Significance in Aerospace Operations and Prophylaxis* 5 p Sep. 1991  
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Motion sickness in spaceflight occurred only rarely in the earliest space flights in small capsules, but in the larger Space Shuttle the incidence is fully 70 pct. Apparently, in larger spacecraft the requirement to make head movements and body movements in weightlessness, increases the likelihood of space sickness. Typically, after its appearance in the first day of a spaceflight, space sickness is made worse by head movements and by disorientation, and it is ameliorated by remaining motionless. Antimotion sickness drugs have been useful in dealing with space sickness and biofeedback techniques might be useful, but attempts to predict susceptibility (except by assessing susceptibility on previous spaceflights) have not been successful. Author

**N91-32765#** Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

#### SIMULATOR SICKNESS

K. E. MONEY (Canadian Space Agency, Ottawa, Ontario) *In* AGARD, *Motion Sickness: Significance in Aerospace Operations and Prophylaxis* 4 p Sep. 1991  
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Sickness in a flight simulator can compromise training, and it can also give rise to effects that persist afterwards and create hazards for the trainee. Generally, simulator sickness involves more visual disturbances, more dizziness, and more aftereffects than in other kinds of motion sickness, and less gastrointestinal disturbance (although a few instances of frank vomiting have been reported, both in the simulator and after leaving it). Simulator sickness can interfere with, and discourage participation in, simulator training. Its aftereffects could cause accidents, and to avoid these accidents, the trainees are often grounded for a while after flying the simulators. Different incidences of simulator sickness, most between 10 and 60 pct., were found in different simulators and depend partly on the criteria for the sickness and on how the simulator is used. Procedures for minimizing the problem were developed. Author

**N91-32766#** Southampton Univ. (England). Human Factors Research Unit.

#### SEA SICKNESS

MICHAEL J. GRIFFIN *In* AGARD, *Motion Sickness: Significance in Aerospace Operations and Prophylaxis* 20 p Sep. 1991  
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A historical illustration of the prevalence of motion sickness at sea is followed by a review of experimental studies in which both ship motion and sickness were quantified. The motions responsible for sea sickness are identified and alternative methods of predicting sea sickness from measures of ship motion are defined. The influence of causal factors other than motion are also considered. Author

**N91-32767#** Institute of Aviation Medicine, Farnborough (England).

#### PREVENTION AND TREATMENT OF MOTION SICKNESS: NON-PHARMACOLOGICAL THERAPY

J. R. R. STOTT *In* AGARD, *Motion Sickness: Significance in*

*Aerospace Operations and Prophylaxis* 9 p Sep. 1991

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The concept that conflicting sensory patterns of motion constitute the stimulus that in susceptible subjects gives rise to motion sickness, allows rational measures to be taken aimed at minimizing sensory conflict and thereby reducing the incidence of symptoms. Such measures add to the effectiveness of prophylactic drugs and may alone be sufficient to prevent motion sickness. It is well known among sailors and astronauts that continued or repeated exposure to an initially nauseogenic motion stimulus leads to a state of increased resistance to its effect. This provides a spontaneous cure for some individuals and forms the basis of therapeutic programs to assist others. The strategies that individuals can adopt to minimize their exposure to nauseogenic stimuli are presented, as well as with adaptation and its application to the treatment of chronic airsickness in aircrew. Also considered are some of the nonpharmacological measures that have been used in the treatment of motion sickness. Author

**N91-32768#** Amsterdam Univ. (Netherlands). University Hospital.

#### ASSESSMENT OF DRUG EFFECTIVENESS

W. J. OOSTERVELD *In* AGARD, *Motion Sickness: Significance in Aerospace Operations and Prophylaxis* 8 p Sep. 1991

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The inhibitory effect was studied of Touristil, a combination of Cinnarizine 40 mg and Domperidone 30 mg, on the labyrinth. Each of these two compounds exerts a vestibular inhibition separately, albeit through different mechanisms. The activity of Cinnarizine (C) is rather slow at the onset, and reaches a maximum after 2 to 3 hours, while the peak effect of Domperidone (D) comes about more rapidly. It emerged from this study that the two separate compounds C and D, once in combination in Touristil (C+D), has a synergistic effect on the vestibular system in the form of an inhibition. The maximum reduction of about 60 pct. obtained is altogether exceptional and clearly underlines the potency of the new combination. Also, it is shown that Touristil is most effective in those subjects who are not affected by C, the most potent of the two, when given exclusively. As there is an obvious relationship between the inhibitory action of a drug on the labyrinth and its value as a medication against motion sickness, it may be concluded that Touristil is a very potent preparation against motion sickness. Author

**N91-32769#** Institute of Aviation Medicine, Farnborough (England).

#### MANAGEMENT OF ACUTE AND CHRONIC MOTION SICKNESS

J. R. R. STOTT *In* AGARD, *Motion Sickness: Significance in Aerospace Operations and Prophylaxis* 7 p Sep. 1991

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To the general physician, the problem of motion sickness typically is presented as a request for advice on how to avoid motion sickness when travelling, or during leisure activities such as gliding or sailing. More urgently, a doctor aboard ship in rough weather may be confronted with the need to treat individuals prostrated by repeated vomiting as a result of sea sickness. The military doctor may have to deal with the operational problem of air sickness in trainee aircrew, sea sickness in sailors, or motion sickness among troops transferred by air, in enclosed army personnel carriers, landing craft or tanks. Finally, because motion sickness may have financial implications by contributing to the failure rate in a costly training program, medical advice may be sought in order to minimize the economic problem of wastage in training. These and other factors are considered in the diagnosis and prophylactic treatment of motion sickness. Author

**N91-32770#** Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst. **THE RELEVANCE OF ANIMAL BIOASSAYS TO ASSESS HUMAN HEALTH HAZARDS TO INORGANIC FIBROUS MATERIALS**

N. F. JOHNSON 1990 11 p Presented at the NATO Advanced Research Workshop, Albuquerque, NM, 22-25 Oct. 1990 (Contract DE-AC04-76EV-01013) (DE91-017516; CONF-9010405-1) Avail: NTIS HC/MF A03

Animal inhalation experiments are relevant to assessing human health risks from inorganic fibers. Appropriately conducted inhalation experiments should be used to identify hazardous fibrous materials, because other animal bioassays can give false positive results. Injection and instillation bioassays can be used to screen and identify the most biologically active materials for subsequent inhalation experiments. DOE

**N91-32777\*#** Texas Univ. Health Science Center, San Antonio. **HEALTH MAINTENANCE FACILITY: DENTAL EQUIPMENT REQUIREMENTS**

JOHN YOUNG, JOHN GOSBEE, and ROGER BILLICA (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 1-4 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The objectives were to test the effectiveness of the Health Maintenance Facility (HMF) dental suction/particle containment system, which controls fluids and debris generated during simulated dental treatment, in microgravity; to test the effectiveness of fiber optic intraoral lighting systems in microgravity, while simulating dental treatment; and to evaluate the operation and function of off-the-shelf dental handheld instruments, namely a portable dental hand drill and temporary filling material, in microgravity. A description of test procedures, including test set-up, flight equipment, and the data acquisition system, is given. Author

**N91-32778\*#** Texas Univ. Health Science Center, San Antonio. **DENTAL EQUIPMENT TEST DURING ZERO-GRAVITY FLIGHT**

JOHN YOUNG, JOHN GOSBEE, and ROGER BILLICA (Krug International, Houston, TX.) *In* NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 5-19 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The overall objectives of this program were to establish performance criteria and develop prototype equipment for use in the Health Maintenance Facility (HMF) in meeting the needs of dental emergencies during space missions. The primary efforts during this flight test were to test patient-operator relationships, patent (manikin) restraint and positioning, task lighting systems, use and operation of dental rotary instruments, suction and particle containment system, dental hand instrument delivery and control procedures, and the use of dental treatment materials. The initial efforts during the flight focused on verification of the efficiency of the particle containment system. An absorptive barrier was also tested in lieu of the suction collector. To test the instrument delivery system, teeth in the manikin were prepared with the dental drill to receive restorations, some with temporary filling materials and another with definitive filling material (composite resin). The best particle containment came from the combination use of the laminar-air/suction collector in concert with immediate area suction from a surgical high-volume suction tip. Lighting in the treatment area was provided by a flexible fiberoptic probe. This system is quite effective for small areas, but for general tasks ambient illumination is required. The instrument containment system (elastic cord network) was extremely effective and easy to use. The most serious problem with instrument delivery and actual treatment was lack of time during the microgravity sequences. The restorative materials handled and finished well. Author

**N91-32780\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. **OPERATION AND PERFORMANCE OF THE CIBA-CORNING 512 COAGULATION MONITOR DURING PARABOLIC FLIGHT**

ROBYN GOCKE, CHARLES W. LLOYD, and NANCY K. GREENTHNER (Krug Life Sciences, Inc., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 41-58 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The goal was to assess the functionality and evaluate the procedures and operations required to operate the Ciba-Corning 512 Coagulation Monitor during parabolic flight. This monitor determines the clotting characteristics of blood. The analyzer operates by laser detection of the cessation of blood flow in a capillary channel within a test cartridge. Test simulator results were excellent for both pre-and post-flight. In-flight results were not obtained due to the warm-up time required for the simulator. Since this is an electronic function only, the expected results on the simulator would be the same in zero-g. Author

**N91-32781\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**APPLICATION AND USE OF SPINAL IMMOBILIZATION DEVICES IN ZERO-GRAVITY FLIGHT**

DEBRA T. KRUPA, JOHN GOSBEE, ROGER BILLICA (Krug International, Houston, TX.), and JOEY B. BOYCE *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 59-70 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

A KC-135 parabolic flight was performed for the purpose of evaluation of spinal immobilization techniques in microgravity. The flight followed the standard 40 parabola profile with four NASA/KRUG experimenters involved. One performed as coordinator/recorder, one as test subject, and two as the Crew Medical Officers (CMO). The flight was to evaluate the application of spinal immobilization devices and techniques in microgravity as are performed during initial stabilization or patient transport scenarios. The sequence of detail for examination of the following objectives included: attempted cervical spine immobilization with all free floating, the patient restrained to the floor, various hand positioning techniques; c-collar placement; Kendrick Extrication Device (KED) application with various restraints for patient and CMO; patient immobilization and transport using the KED; patient transported on KED and spine board. Observations for each task are included. Major conclusions and issues are also included. Author

**N91-32782\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**ATLS: CATHETER AND TUBE PLACEMENT**

JOHN GOSBEE, DEBRA T. KRUPA, L. PEPPER, and DEBRA ORSAK (McDonnell-Douglas Space Systems Co., Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 71-82 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The specific objectives of this experiment are: to evaluate the rack mounted equipment and medical supplies necessary for medical procedures; to evaluate the attachments, mounting points, and inner drawer assemblies for the medical supplies; and to evaluate the procedures for performing medical scenarios. The resources available in the HMF miniracks to accomplish medical scenarios and/or procedures include: medical equipment mounted in the racks; a patch panel with places to attach tubing and catheters; self contained drawers full of critical care medical supplies; and an ALS 'backpack' for deploying supplies. The attachment lines, tubing and associated medical supplies will be deployed and used with the equipment and a patient mannequin. Data collection is provided by direct observations by the inflight experimenters, and analysis of still and video photography. Author

**N91-32783\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**EVALUATION OF AEROSOLIZED MEDICATIONS DURING PARABOLIC FLIGHT MANEUVERS**

CHARLES W. LLOYD, WILLIAM J. MARTIN, and JOHN GOSBEE

(Krug International, Houston, TX.) *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 83-96 Sep. 1991  
 Avail: NTIS HC/MF A11 CSCL 06/5

The goal was to visually evaluate the effect gravity has on delivery of medications by the use of various aerosol devices. During parabolic flight the same four aerosols were retested as performed in studio ground tests. It appears that the Cetacaine spray and the Ventolin inhaler function without failure during all test. The pump spray (Nostril) appeared to function normally when the container was full, however it appeared to begin to fail to deliver a full mist with larger droplet size when the container was nearly empty. The simple hand spray bottle appeared to work when the container was full and performed progressively worse as the container was emptied. During Apollo flights, it was reported that standard spray bottles did not work well, however, they did not indicate why. It appears that we would also conclude that standard spray bottles do not function as well in zero gravity by failing to produce a normal mist spray. The standard spray bottle allowed the fluid to come out in a narrow fluid stream when held with the nozzle either level or slightly tilted upward. Author

**N91-32786\*#** Krug International, Houston, TX.

#### **MINOR SURGERY IN MICROGRAVITY**

ROGER BILLICA, DEBRA T. KRUPA, ROBERT STONESTREET, and VICTOR D. KIZZEE *In* NASA, Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 121-130 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The purpose is to investigate and demonstrate equipment and techniques proposed for minor surgery on Space Station Freedom (SSF). The objectives are: (1) to test and evaluate methods of surgical instrument packaging and deployment; (2) to test and evaluate methods of surgical site preparation and draping; (3) to evaluate techniques of sterile procedure and maintaining sterile field; (4) to evaluate methods of trash management during medical/surgical procedures; and (4) to gain experience in techniques for performing surgery in microgravity. A KC-135 parabolic flight test was performed on March 30, 1990 with the goal of investigating and demonstrating surgical equipment and techniques under consideration for use on SSF. The flight followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. Author

**N91-32788\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

#### **VENIPUNCTURE AND INTRAVENOUS INFUSION ACCESS DURING ZERO-GRAVITY FLIGHT**

DEBRA T. KRUPA, JOHN GOSBEE, ROGER BILLICA, PERRY BECHTLE, GERALD J. CREAGER (Krug International, Houston, TX.), and JOEY B. BOYCE *In its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 145-162 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The purpose of this experiment is to establish the difficulty associated with securing an intravenous (IV) catheter in place in microgravity flight and the techniques applicable in training the Crew Medical Officer (CMO) for Space Station Freedom, as well as aiding in the selection of appropriate hardware and supplies for the Health Maintenance Facility (HMF). The objectives are the following: (1) to determine the difficulties associated with venipuncture in a microgravity environment; (2) to evaluate the various methods of securing an IV catheter and attached tubing for infusion with regard to the unique environment; (3) to evaluate the various materials available for securing an intravenous catheter in place; and (4) to evaluate the fluid therapy administration system when functioning in a complete system. The inflight test procedures and other aspects of the KC-135 parabolic flight test to simulate microgravity are presented. Author

**N91-32789\*#** Krug International, Houston, TX.

#### **EVALUATION OF CARDIOPULMONARY RESUSCITATION TECHNIQUES IN MICROGRAVITY**

ROGER BILLICA, JOHN GOSBEE, and DEBRA T. KRUPA *In*

NASA, Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 163-183 Sep. 1991  
 Avail: NTIS HC/MF A11 CSCL 06/5

Cardiopulmonary resuscitation (CPR) techniques were investigated in microgravity with specific application to planned medical capabilities for Space Station Freedom (SSF). A KC-135 parabolic flight test was performed with the goal of evaluating and quantifying the efficacy of different types of microgravity CPR techniques. The flight followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. Three experiments were involved chosen for their clinical background, certification, and practical experience in prior KC-135 parabolic flight. The CPR evaluation was performed using a standard training mannequin (recording resusci-Annie) which was used in practice prior to the actual flight. Aboard the KC-135, the prototype medical restraint system (MRS) for the SSF Health Maintenance Facility (HMF) was used for part of the study. Standard patient and crew restraints were used for interface with the MRS. During the portion of study where CPR was performed without MRS, a set of straps for crew restraint similar to those currently employed for the Space Shuttle program were used. The entire study was recorded via still camera and video. Author

**N91-32790\*#** Krug International, Houston, TX.

#### **FLUID HANDLING 2: SURGICAL APPLICATIONS**

ROGER BILLICA, JOHN YOUNG (Texas Univ. Health Science Center, San Antonio.), DOUG RUSHING, and VICTOR D. KIZZEE *In* NASA, Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 185-192 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 06/5

The methods proposed for managing fluids and particulate debris during minor surgery on Space Station Freedom (SSF) were investigated and demonstrated. A KC-135 parabolic flight test was performed, in which the flight followed the standard 40 parabola profile with 20 to 25 seconds in near-zero gravity in each parabola. The equipment (suction and laminar flow device) was evaluated. While this equipment performed satisfactorily previously in the dental simulation, the purpose of the current flight was to reconfigure the equipment in support of a minor surgical situation in order to evaluate its efficacy and establish clear requirements for the actual flight hardware. To accomplish the study the Health Maintenance Facility medical restraint system was deployed as for surgical use and mannequin suture arm was restrained to its surface. The surgical area was established as for performing minor surgery with standard tray and suture instruments employed. Author

## 53

### BEHAVIORAL SCIENCES

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

**A91-53894\*** Texas Univ., Galveston.

#### **PSYCHIATRIC DIAGNOSES IN A GROUP OF ASTRONAUT APPLICANTS**

PATRICIA A. SANTY, DEAN M. FAULK (Texas, University, Galveston), and AL W. HOLLAND (NASA, Johnson Space Center, Houston, TX) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Oct. 1991, p. 969-973. refs  
 Copyright

Between 1959 and 1987, the psychiatric evaluation of astronaut candidates evolved from a 30-h intensive examination evaluating applicants for psychopathology, and studying their performance under stress, to a 2-h clinical interview whose structure and contents were determined by the individual examiner. Evaluations done during these years applied both psychiatric (or, 'select-out') criteria and psychological (or, 'select-in') criteria. In an attempt to

more rigorously define the psychiatric, 'select-out' component, a standardized, semistructured clinical interview was developed to identify the presence or history of psychiatric disorders listed in the Diagnostic and Statistical Manual of Mental Disorders, 3rd Ed. ('DSM-III'). A total of 117 astronaut applicants underwent this clinical interview as part of a comprehensive medical evaluation during a recent astronaut selection. Of the 117 applicants, 9 (7.7 percent) met DSM-III criteria for a variety of Axis I and Axis II diagnoses, including V-code diagnoses. Author

A91-53895

**EXTENT AND ETIOLOGY OF AEROMEDICAL DUTY RESTRICTIONS AT A U.S. COAST GUARD AIR STATION**

TIMOTHY J. UNGS (USCG, Kodiak, AK) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Oct. 1991, p. 974-977. refs  
Copyright

A91-54143

**SCIENTIFIC RESULTS FROM THE ISEMSI EXPERIMENT**

J. COLLET (ESA, Long-Term Programme Office, Paris, France), CL. GHARIB (Lyon I, Universite, Villeurbanne, France), K. KIRSCH (Berlin, Freie Universitaet, Federal Republic of Germany), and R. J. VAERNES (Norwegian Underwater Technology Centre, Diving Div., Bergen, Norway) ESA Bulletin (ISSN 0376-4265), no. 67, Aug. 1991, p. 58-64.  
Copyright

The results of a long-term isolation experiment conducted by ESA are presented in the form of an overview to determine how to address the human problems related to isolation and autonomy. The scientific program and the experiment are outlined, and general results are given for the psychological experiments and physiological tests. The tasks related to the testing are reported to be almost complete, no severe social conflicts are reported, and the level of stress and workload are found to be in the middle range. No indication is found regarding sleep disturbances, performance impairment, or other major difficulties. Significant physiological parameters include a stress-hormone peak in the second week, modified blood-volume-regulating hormone levels, and a circaseptan rhythm of water intake. The results indicate that more complex studies in other analogous environments are required to advance the goal of autonomy. C.C.S.

A91-54162

**TOWARD A MOVEMENT DYNAMICS PERSPECTIVE ON DUAL-TASK PERFORMANCE**

STEPHAN P. SWINNEN (Louvain, Catholic University, Belgium) and CHARLES B. WALTER (Illinois, University, Chicago) Human Factors (ISSN 0018-7208), vol. 33, Aug. 1991, p. 367-387. Research supported by Catholic University of Louvain. refs  
(Contract NATO-732/86)  
Copyright

In the present investigation of the effect of practice on the parallel organization and control of discrete, asymmetric bimanual movements, subjects simultaneously performed a flexion movement in the left limb and a flexion-extension-flexion movement in the right. Two groups, one of which received kinematic information feedback, were instructed to produce the different patterns simultaneously, a third performed each movement in isolation to furnish the baseline condition. Bimanual groups tended to synchronize the pattern of motor output, leading to mutual interference; the provision of feedback led to better metrical and structural dissociation of limb actions. O.C.

A91-55339

**BRIEF COGNITIVE BEHAVIOR THERAPY IN AN UNDERGRADUATE PILOT STUDENT - A CASE REPORT**

JOSEPH A. BANKEN (USAF, Mental Health Clinic, Reese AFB, TX) and CHARLES H. MAHONE (Texas Tech University, Lubbock) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1078-1080. refs  
Copyright

This is a case report of a male undergraduate pilot student

referred from the aerospace medicine service because of difficulty coping with stresses associated with undergraduate pilot training (UPT). Two phases of a short-term cognitive-behavioral treatment program were undertaken. The initial phase of treatment involved assisting the student to become aware of cognitive, behavioral, and physiological cues that were associated with increased levels of stress, and relaxation training. The second treatment phase involved stress inoculation strategies and coping procedures that were competency based, rather than mastery based. The latter had previously been unsuccessfully used by the student. Results indicated increases in self-reported stress management skills and in objective reports of training performance. Although generalizability of this study is limited, short-term cognitive behavioral therapy procedures are felt to be an important tool for improving the performance of UPT students, and may also reduce the probability of self-initiated elimination due to subjective stress complaints. Author

A91-55341

**SITUATIONAL AWARENESS IS MORE THAN EXCEPTIONAL VISION**

BRYCE O. HARTMAN (USAF, School of Aerospace Medicine, Brooks AFB, TX) and GRANT E. SECRIST (Human Performance Research Associates, San Antonio, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1084-1089. refs  
Copyright

Superior situational awareness, an extraordinary awareness of the total flight environment and aerial combat situation, is a significant contributor to success in aerial engagement. Review of over 1000 published sources has led to the formulation of situational awareness as being principally in the cognitive domain. Superior awareness involves exceptional sensitivity to performance-critical cues in the operational environment, an exceptional capacity to anticipate changes in system states and operational conditions, and the ability to act on those changes in a proactive mode. Three important constructs are described: (1) automatic information processing; (2) near-threshold processing; and (3) skilled memory. In combination, they constitute a pilot attribute which uniquely facilitates the full armamentarium of skills and abilities of the superior tactical pilot. Author

N91-31771# Illinois Univ., Chicago. State Psychiatric Inst.

**FULL-INFORMATION ITEM BI-FACTOR ANALYSIS Report, 31 Jul. 1989 - 31 Jul. 1990**

ROBERT D. GIBBONS, DONALD R. HEDEKER, and R. D. BOCK Jul. 1990 20 p  
(Contract N00014-89-J-1104; NR PROJ. RR0-42046)  
(AD-A229346) Avail: NTIS HC/MF A03 CSCL 05/8

A plausible s-factor solution for many types of psychological and educational tests is one in which there is one general factor and s-1 group or method related factors. The bi-factor solution results from the constraint that each item has a non-zero loading on the primary dimension  $\alpha_j$  and at most one of the s-1 group factors. This structure has been termed the bi-factor solution by Holzinger & Swineford but it also appears in the work of Tucker and Joreskog. All attempts at estimating the parameters of this model have been restricted to continuously measured variables; it has not been previously considered in the context of item-response theory (IRT). It is conceivable, however, that the bi-factor structure might arise in IRT related problems. The purpose of this paper is to derive a bi-factor item-response model for binary response data, and to develop a corresponding method of parameter estimation. This restriction leads to a major simplification of the likelihood equations that (1) permits the statistical evaluation of problems of unlimited dimensionality; (2) permits conditional dependence among discrete and previously identified subsets of items, and (3) in some cases provides more parsimonious factor solutions than an unrestricted full-information item factor analysis might provide (e.g. Bock and Aitkin, 1981). GRA

**N91-31772#** Colorado Univ., Boulder. Center for Research on Judgment and Policy.  
**EFFECTS OF STRESS ON JUDGMENT AND DECISION MAKING IN DYNAMIC TASKS Interim Report, 1 Sep. 1988 - 31 Dec. 1989**

KENNETH R. HAMMOND and CYNTHIA M. LUSK. Jun. 1991 183 p  
 (Contract MDA903-86-C-0142)  
 (AD-A239452; ARI-RN-91-82) Avail: NTIS HC/MF A09 C SCL 05/8

Three empirical studies on judgment and decision making in dynamic tasks were carried out during the period 1 September 1988 to 31 December 1989. Subjects were expert research meteorologists. Topics were forecasting (a) hail, (b) microbursts, and (c) convection initiation (thunderstorms) at an airport approach. Primary findings were as follows: in the hail study, meteorologists' forecasts were closely approximated by a weighted-sum model; in the microburst study, experts who worked together for years, when tested in work conditions, did not agree on the judgments of principal cues; in the convection study, more accurate forecasts were made on high stress than low stress days, thus contradicting the conventional wisdom. Two annotated bibliographies were produced: the effects of stress on judgment and decision making, and the effects of variation of display formats on judgment and decision making. GRA

**N91-31773#** Colorado Univ., Boulder.  
**OPTIMIZING THE LONG-TERM RETENTION OF SKILLS: STRUCTURAL AND ANALYTIC APPROACHES TO SKILL MAINTENANCE 3 Interim Report, Aug. 1988 - Aug. 1989**  
 ALICE F. HEALY, K. A. ERICSSON, and LYLE E. BOURNE, JR. Jun. 1991 13 p  
 (Contract MDA903-86-K-0155)  
 (AD-A239574; CU-153-0638; ARI-RN-91-81) Avail: NTIS HC/MF A03 C SCL 05/8

This research program identifies the characteristics of knowledge and skill most resistant to decay because of disuse. The program is divided into analytic and structural approaches. Two lines of research are used to investigate skill retention and maintenance using the analytic approach. The first investigates different laboratory analogues of component military skills, and the second investigates parallel natural skills learned by the college population during prior education. We have developed five laboratory methodologies and completed experimental studies involving each of them, and have identified four natural skills and gathered long-term retention data for each of these skills. For the structural approach, we designed an experimental paradigm to assess the detailed encoding of new knowledge at presentation and at delay using verbal report techniques and chronometric measurement of retrieval components. We completed several studies of retention of vocabulary items with this paradigm. In addition, we formulated a theoretical framework, on the notion of procedural reinstatement, and have used this framework to account for findings from many different facets of our research program, both analytic and structural. GRA

**N91-31774#** Decision Science Consortium, Inc., Reston, VA.  
**EXAMINING THE EFFECT OF INFORMATION ORDER ON EXPERT JUDGMENT Interim Report, May 1989 - May 1990**  
 LEONARD ADELMAN, MARTIN A. TOLCOTT, and TERRY A. BRESNICK Jun. 1991 27 p  
 (Contract MDA903-89-C-0134)  
 (AD-A239708; REPT-90-6; ARI-RN-91-78) Avail: NTIS HC/MF A03 C SCL 05/8

Research indicates that humans use heuristics to make inferences and that, depending on task characteristics, these heuristics can lead to inconsistencies and errors in judgment - that is, cognitive biases. Most of this research has been performed with university students performing tasks, requiring logical thinking but not expertise in a particular substantive area. Our concern is in determining whether heuristics can lead to cognitive biases among experienced personnel performing their substantive task. In particular, we examined whether information order and response

mode could affect the judgements of Army air defense operators. A within-subject factorial experiment was performed in December, 1989, with 63 Army air defense operators. Information order and response mode interacted to affect the Army air defense operators' judgments. When information was presented sequentially and a probability estimate was obtained after each piece of information, participants gave different probability estimates of whether an unknown aircraft was friendly or hostile, depending on the order with which the same information was presented. These results support the predictions of the Hogarth-Einhorn belief updating model. GRA

**N91-32771** Maryland Univ., College Park.  
**COGNITIVE CYBERNETICS AND HUMAN COMMUNICATION: THE REGULATORY EFFECTS OF PRIOR KNOWLEDGE Ph.D. Thesis**

WALTON BURRELL BISHOP 1990 368 p  
 Avail: Univ. Microfilms Order No. DA9110273

The theory behind a way to measure the effectiveness of human communication and an experiment designed to test the theory are described. The theory says that we must measure a message recipient's prior knowledge and use this information to improve messages in a cognitive cybernetic manner, that is, in a way that permits the prior knowledge of intended message recipients to control the complexity and redundancy of messages. Thus, the theory suggests that information theory should be modified to consider the effects of message interpretation by message recipients. The experiment, conducted over a three-year period at the University of Maryland, involved 398 undergraduate students. Interviews conducted in 1987 provided information needed for the pilot tests of 1988. The pilot tests showed how to design a two-phase experiment in which information from Phase 1 would provide data that could be analyzed by the Galileo multidimensional scaling system. The Galileo system's results were expected to show how a science article could be modified to make it either easier or more difficult for Phase 2 students to understand. The experiment's results indicate that students who read an improved article, in which all improvements were based upon Galileo results, scored significantly higher on a discipline test than those who read a degraded article were not consistent enough to produce any conclusive results. In general, the experiment's findings support the theory that a multidimensional scaling system can be used to determine some of the effects of subjects' prior knowledge, and information concerning these effects can be used to improve the comprehensibility of messages to specific audiences. The ability to measure effects of relevant prior knowledge may be used to help explain why different people often get different meanings from the same message. To test the theory further, the study recommends using the Galileo multidimensional scaling system to measure the effectiveness of science textbooks. Dissert. Abstr.

**N91-32772#** Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.

**AN INVESTIGATION INTO THE POTENTIAL USE OF PSYCHOMETRIC INSTRUMENTS FOR THE SELECTION OF FIREARMS OFFICERS**

SUSAN GLEAVE, JOHN HARRIS, and ANDREW GUPPY Apr. 1991 21 p  
 (CRANFIELD-AERO-9108; ISBN-1-871564-29-8; ETN-91-99897)  
 Avail: NTIS HC/MF A03; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 0AL, England, HC 8 sterling pounds

The aim of this study was to identify a way of assisting the development of the psychological aspects of the current selection procedure for firearms applicants. It was decided that this would be best satisfied with the development of a job performance criterion measure that would reliably differentiate between officers. A reliable criterion method was not achieved at the macro level, as no one method (behavior versus traits) was seen to be more reliable than the other. The aim may be satisfied in that the clusters of the behaviors and traits yielded three very respectable inter

judge reliabilities; therefore a combination of these three clusters may satisfy the aim and offer a reliable criterion on which to improve selection. ESA

**N91-32773#** Air Force Human Resources Lab., Williams AFB, AZ. Aircrew Training Research Div.

**AIRCREW PART-TASK TRAINING RESEARCH AND DEVELOPMENT IN THE 1980S: LESSONS LEARNED Final Technical Report, Jan. 1982 - Mar. 1991**

THOMAS H. GRAY and BERNELL J. EDWARDS Jun. 1991 26 p

(Contract AF PROJ. 1123)  
(AD-A239456; AL-TR-1991-0005) Avail: NTIS HC/MF A03  
CSCL 05/9

Throughout the 1980s the Aircrew Training Research Division of the Human Resources Directorate, Armstrong Laboratory sponsored various research and development (R and D) activities involving part-task training concepts. The R and D accomplished during this period was fueled by training device cost considerations, unit-level training needs, applications of new approaches in cognitive science, and the explosive development of the microprocessor. In total, seven part-task training devices were developed by this division. This report describes these devices and the research performed using them. In addition, the 'lessons learned' from research, as well as suggestions for future research in part-task training, are discussed. GRA

**N91-32774#** Oak Ridge National Lab., TN.

**MODELS OF HUMAN OPERATORS: THEIR NEED AND USEFULNESS FOR IMPROVEMENT OF ADVANCED CONTROL SYSTEMS AND CONTROL ROOMS**

H. E. KNEE and J. C. SCHRYVER 1991 11 p Presented at the International Conference on Fast Reactor Systems and Fuel Cycles, Kyoto (Japan), 27-31 Oct. 1991

(Contract DE-AC05-84OR-21400)  
(DE91-017245; CONF-911001-2) Avail: NTIS HC/MF A03

Models of human behavior and cognition (HB&C) are necessary for understanding the total response of complex systems. Many such models have become available over the past thirty years for various applications. Many potential model users remain skeptical about their practicality, acceptability, and usefulness. Such hesitancy stems in part from disbelief in the ability to model complex cognitive processes, and a belief that relevant human behavior can be adequately accounted for through the use of common-sense heuristics. This paper will highlight several models of HB&C and identify existing and potential applications in attempt to dispel such notions. DOE

## 54

**MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

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

**A91-53597**

**FLIGHT DECK AUTOMATION - STRATEGIES FOR USE NOW AND IN THE FUTURE**

WILLIAM W. WILSON and DELMAR M. FADDEN (Boeing Commercial Airplane Group, Seattle, WA) SAE, Aerospace Atlantic Conference, Dayton, OH, Apr. 22-26, 1991. 11 p. refs  
(SAE PAPER 911197) Copyright

The effectiveness of employing automated flight-deck equipment is considered by viewing the pilot as the foundation of increasingly automated systems. Accident rates are discussed in terms of automation, and the benefits and costs of automated systems are set forth. The benefits are related to pilot preference, and the costs relate primarily to training, procedures, and design considerations. Key issues for the use of automation are the quality

of implementation of the automation technologies, the pilot's role as monitor of the systems, and the graceful degradation of the automatic system with sufficient trend information. The operational hierarchy view of automated systems is presented with the pilot at the base, followed by operational controls, all-weather operation controls, basic automatics, simple integration, and complex integration. C.C.S.

**A91-53986**

**CONTAMINATION CONTROL PROGRAM FOR THE SPACE STATION HABITABLE MODULES**

NIKKI M. ABRAMOV (Boeing Aerospace and Electronics, Huntsville, AL) IN: Institute of Environmental Sciences, Annual Technical Meeting, 36th, New Orleans, LA, Apr. 23-27, 1990, Proceedings. Mount Prospect, IL, Institute of Environmental Sciences, 1990, p. 206-211. refs

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The goals and the challenges of the contamination control program for the Space Shuttle Freedom habitable modules are briefly reviewed. The program includes rigorous screening of designs and materials, analytical modeling of the internal and external contamination sources and effects, assembly and testing in clean room facilities, cleaning processes, on-orbit maintenance operations, and potentially contaminating contingency operations. Some of the technologies required are routine cleaning and disinfection techniques and materials that are safe for use in microgravity and in a closed environment, rapid automated contaminant detection methods, and crew and hardware decontamination techniques that are effective in microgravity. V.L.

**A91-54018#**

**HUMAN FACTORS ENGINEERING - AN INTEGRAL PART OF THE FLIGHT DECK DESIGN PROCESS**

ROLF J. BRAUNE, R. C. GRAEBER, and DELMAR M. FADDEN (Boeing Commercial Airplane Group, Seattle, WA) AIAA, AHS, and ASEE, Aircraft Design Systems and Operations Meeting, Baltimore, MD, Sept. 23-25, 1991. 5 p. refs  
(AIAA PAPER 91-3089) Copyright

The philosophy of 'human-centered' design is discussed to identify the inherent requirements flight-deck design and automation. The priorities of simplification, redundancy, and automation are reviewed for several design teams and other groups. Important objectives are culled from the work of the groups such as enhancing human abilities, overcoming human limitations, and fostering human acceptance. A human-centered design team is defined as one that can address the geometry of the flight crew's workspace, determine human input, information requirements, and output characteristics, as well as assess human environmental tolerances and measure human performance. It is concluded that technologies resulting from the human-centered work are key for successful implementation of aerospace programs. C.C.S.

**A91-54141**

**MAN IN SPACE - A EUROPEAN CHALLENGE IN BIOLOGICAL LIFE SUPPORT**

C. TAMPONNET, R. BINOT, C. LASSEUR, and C. SAVAGE (ESTEC, Thermal Control and Life Support Div., Noordwijk, Netherlands) ESA Bulletin (ISSN 0376-4265), no. 67, Aug. 1991, p. 39-49.

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The requirements and potential applications of life-support technologies are reviewed in terms of the objectives and capacities of the ESA. Basic concepts of human life support and the regeneration of life-support materials are discussed with reference given to specific space-program logistics. Biological life-support techniques developed by ESA programs include the Biological Air Filter (BAF) and the Micro-Ecological Life-Support System Alternative (MELISSA). Principles of the BAF are at a high level of development, and the MELISSA concept is being examined theoretically to model the mass balance of the loop and identify potential technological difficulties. The report concludes that the

ESA plans to continue development of the two programs and initiate programs regarding plant cultivation in space and biological waste and water treatment. C.C.S.

A91-54163

**AURALLY AIDED VISUAL SEARCH IN THE CENTRAL VISUAL FIELD - EFFECTS OF VISUAL LOAD AND VISUAL ENHANCEMENT OF THE TARGET**

DAVID R. PERROTT, TOKTAM SADRALODABAI, KOUROSH SABERI (California State University, Los Angeles), and THOMAS Z. STRYBEL (California State University, Long Beach) Human Factors (ISSN 0018-7208), vol. 33, Aug. 1991, p. 389-400. refs Copyright

A two-alternative, forced-choice paradigm task involving the location and identification of which of two visual targets is present on a given trial has been examined. The visual targets were presented either concurrently with a sound located at the same position as the visual target or in silence. Aurally-guided search was especially improved when the visual target was located in the peripheral regions of the central visual field, and when a larger number of distractor images were present. In view of these results, spatially-correlated sounds may have considerable utility in such high-information environments as aircraft cockpits. O.C.

A91-54164

**EXPLICIT AND IMPLICIT HORIZONS FOR SIMULATED LANDING APPROACHES**

GAVAN LINTERN and YEOU-TEH LIU (Illinois, University, Savoy) Human Factors (ISSN 0018-7208), vol. 33, Aug. 1991, p. 401-417. refs

(Contract MDA903-86-C-0169)

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In a flight simulator experienced pilots flew landing approaches to a representation of an airport scene in which various sources of information had been distorted or removed. Reasonably accurate approaches could be made to a scene that contained only an aimpoint and a horizon. The addition of a runway outline did not enhance accuracy or stability, which lent credence to the hypothesis that the invariant angle between horizon and aimpoint can support glide slope control. Explicit distortion of this angle by simulation of up-sloping or down-sloping terrain beyond the runway had predictable effects on glide slope control. Implicit specification of a veridical horizon with texture lines parallel to the runway centerline weakened the effect of distortions in the explicit horizon. Thus both explicit and implicit specifications of the horizon contribute to perception of the glide slope angle. Implications of these results for the design of visual scenes for flight simulation are discussed. Author

A91-54165\* Lowell Univ., MA.

**AN ELLIPSOIDAL REPRESENTATION OF HUMAN HAND ANTHROPOMETRY**

BRYAN BUCHHOLZ (Lowell, University, MA) and THOMAS J. ARMSTRONG (Michigan, University, Ann Arbor) Human Factors (ISSN 0018-7208), vol. 33, Aug. 1991, p. 429-441. refs

(Contract NGT-23-005-802)

Copyright

Anthropometric data concerning the geometry of the hand's surface are presently modeled as a function of gross external hand measurements; an effort is made to evaluate the accuracy with which ellipsoids describe the geometry of the hand segments. Graphical comparisons indicate that differences between the ellipsoidal approximations and the breadth and depth measurements were greatest near the joints. On the bases of the present data, a set of overlapping ellipsoids could furnish a more accurate representation of hand geometry for adaptation to ellipsoid segment-geometry employing biomechanical models. O.C.

A91-54166

**VISUAL MONITORING WITH SPATIALLY VERSUS TEMPORALLY DISTRIBUTED DISPLAYS**

DAVID G. PAYNE and VIRGINIA A. LANG (New York, State

University, Binghamton) Human Factors (ISSN 0018-7208), vol. 33, Aug. 1991, p. 443-458. Research supported by USAF. refs Copyright

Recent research has examined performance levels using rapid communication ('RAPCOM') visual displays. This research is presently extended in three experiments using a task in which subjects monitored visual displays representing dynamically varying system parameters and responded whenever an indicator value went beyond a specified range. In the spatial condition the indicator values were simultaneously presented in different locations on the CRT; in the RAPCOM condition each indicator was presented in successive frames in a central location on the CRT. Results indicated that RAPCOM displays yielded shorter response latencies than did spatial displays, and that RAPCOM displays produced significantly higher error rates. These findings indicate that RAPCOM displays may not increase overall system performance, given the elevated error rates obtained with these displays. These error rate data indicate that it may not be possible to implement RAPCOM displays in real-world systems. Possible reasons for the high error rate obtained with the RAPCOM displays are discussed. Author

A91-54297

**BREATHING EQUIPMENT DYNAMIC REQUIREMENTS**

JOHN E. HOLLINGSWORTH (U.S. Navy, Naval Air Development Center, Warminster, PA) SAFE Journal, vol. 21, July-Aug. 1991, p. 34-38.

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A study to define the dynamic characteristics of aircraft breathing equipment and systems is presented. Specification changes are offered to permit optimizing performance of breathing systems. The proposed process for defining equipment requirements involves treating components as dynamic transfer functions being driven by aircrew dynamic requirements. One benefit of dynamic analysis is that it can be employed to distinguish minor differences between equipment samples to improve reliability. R.E.P.

A91-54298

**USE OF COMPOSITE MATERIALS TO DEVELOP A TEST MANIKIN WITH IMPROVED INERTIAL PROPERTIES**

CAROLINE VANINGEN-DUNN (Simula, Inc., Phoenix, AZ) and INTS KALEPS (USAF, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) SAFE Journal, vol. 21, July-Aug. 1991, p. 39-42. refs

Copyright

A program is described that demonstrated the highly successful use of composite materials for manikin skeletal segments to achieve better mass and mass moment of inertia properties. The results of this program have been implemented into a follow-up program to improve the kinematics of the Advanced Dynamic Anthropomorphic Manikin (ADAM). The program used composite materials to achieve the desired weight and inertial properties of the ADAM limb segments without reducing strength. The design of the limb segments began with a detailed analysis of the loads imposed on the joints during severe dynamic-load conditions such as 600-knots equivalent air speed windblast and 45-G acceleration during ejection. The Articulated Total Body (ATB) Model Program was used to predict these loads. A parallel effort was conducted to establish the baseline design of the ADAM limb segments using ANVIL 5000, a CAD software package. The baseline CAD configuration was modified and the materials were selected to provide inertial properties that represented those of human limb segments. The strength of the limb segments was then analyzed by using NISA II, a Finite Element Modeling Program, while applying the loads that were predicted with the ATB Model Program. Author

A91-54300\* Florida Univ., Gainesville.

**A KINEMATIC ANALYSIS OF THE SPACE STATION REMOTE MANIPULATOR SYSTEM (SSRMS)**

CARL D. CRANE, III, JOSEPH DUFFY (Florida, University, Gainesville), and TIM CARNAHAN (NASA, Goddard Space Flight

Center, Greenbelt, MD) Journal of Robotic Systems (ISSN 0741-2223), vol. 8, Oct. 1991, p. 637-658. refs  
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An efficient reverse analysis of three 6-degree-of-freedom (dof) subchains of the 7-dof SSRMS is presented. The first subchain is formed by locking the seventh joint. The second subchain is formed by locking the second joint, while the third subchain is formed by locking the first joint (the grounded joint is counted as the first joint in the chain). There are a maximum of eight different arm configurations in each of the three subchains, and these were determined by employing a computer-efficient algorithm, which required the rooting of only at most quadratic polynomials. The algorithms were implemented, and the SSRMS was employed in an animated environment to perform and practice a number of useful tasks for Space Station servicing. The locking of the second joint has the advantage in that an operator can choose the orientation of the plane that contains the two longest links so as to avoid collisions with obstacles. However, it has the disadvantage that when the second joint angle equals 0 deg or 180 deg, the manipulator is in a singularity configuration. This plane can also be oriented by specifying the first joint angle, so that the plane can be oriented arbitrarily and, in this, the singularity is avoided.

Author

**A91-54511**  
**INFLUENCE OF TISSUE INHOMOGENEITIES ON**  
**NONINVASIVE MUSCLE FIBER CONDUCTION VELOCITY**  
**MEASUREMENTS - INVESTIGATED BY PHYSICAL AND**  
**NUMERICAL MODELING**

JOCHEN SCHNEIDER, JIRI SILNY, and GUENTER RAU (Aachen, Rheinisch-Westfaelische Technische Hochschule, Federal Republic of Germany) IEEE Transactions on Biomedical Engineering (ISSN 0018-9294), vol. 38, Sept. 1991, p. 851-860. refs  
Copyright

The hypothesis that the observed fluctuations in propagation velocity are caused by electrically inhomogeneous tissue, regions of different electrical conductivity which are located between the excited muscle fibers and the recording electrodes and which cause a deformation of the extracellular electric current field, was examined. The investigation was performed by means of a physical model as well as by finite element model calculations. In both models single, simple shaped (cylindrical) inhomogeneity regions with a conductivity of 0.1 to 10 times that of the surrounding medium and diameters ranging between 1.6 and 2.7 mm were placed between excitation sources and recording site. The results indicate that the observed conduction velocity fluctuations of up to some 10 percent can be attributed to inhomogeneity effects of the tissue conductivity. I.E.

**A91-54640**  
**AN ANALYSIS OF THE CREW'S ROLE IN A HIGHLY**  
**AUTOMATED SPACE STATION CREW REENTRY VEHICLE**

VICTOR RILEY and LEILA JOHANNESSEN (Honeywell Systems and Research Center, Minneapolis, MN) IN: IEEE/AIAA/NASA Digital Avionics Systems Conference, 9th, Virginia Beach, VA, Oct. 15-18, 1990, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 415-418. refs  
Copyright

An analysis of potential crew involvement in a highly automated vehicle for returning crew members from an orbiting space station is presented. The purpose of the analysis is to define a systematic process by which the various constraints of crew deconditioning, crew training, and operational environment could be balanced in designing the crew's response to automation failures. The results of the analysis include an automation taxonomy in which crew involvement in a given situation is bounded at one end by mission requirements and level of automation failure and at the other by crew capabilities, and a list of crew functions at each level of potential crew involvement. I.E.

**A91-54647**  
**CREW INTERFACE DESIGN FOR A FLIGHT DECK**  
**ELECTRONIC LIBRARY SYSTEM**

FRANK E. GOMER (Honeywell, Inc., Air Transport Systems Div., Phoenix, AZ) IN: IEEE/AIAA/NASA Digital Avionics Systems Conference, 9th, Virginia Beach, VA, Oct. 15-18, 1990, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 453-457.  
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The design and evaluation of a Honeywell, Inc. stand-alone electronic library system (ELS) for flight operations applications are discussed. The major components of this ELS include an optical disk mass storage device, an active matrix liquid crystal display (LCD) with touch-screen user interface, and an ARINC 744 printer. A workstation-based, rapid-prototyping environment was developed to support iterative definition of ELS concepts, especially viable crew interface techniques and display screen formats. The results of Phase 1 evaluation are presented, to assess the effectiveness of the crew interface design. The only features of the user interface to receive marginal ratings were response times for printing text pages and charts. All other features were deemed to be acceptable or excellent. I.E.

**A91-54662**  
**ADVANCED CREW STATION INTEGRATION COCKPIT**

PAUL PENCIKOWSKI (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: IEEE/AIAA/NASA Digital Avionics Systems Conference, 9th, Virginia Beach, VA, Oct. 15-18, 1990, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1990, p. 545-548.  
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The advanced crew station integration cockpit (ACIC), which introduces an avionics suite comprising state-of-the-art, flight-qualified display hardware in conjunction with a comprehensive aerodynamic, sensor, threat, and weapons simulation capability, is described. The system is capable of displaying raster and calligraphic data in orthographic and perspective views. The controls are reprogrammable, relocatable, and reconfigurable in their size, type of action, and graphical attributes. The system easily interfaces to generic simulation systems. The ability to design and simulate head-up displays is also incorporated. The next-generation design tool ensures the utility of new cockpit designs by allowing head-to-head competition of proposed vendor hardware and supports the evaluation of all crew station, sensor fusion, and artificial-intelligence development programs. This stand-alone system operating in real-time is unique in its ability to perform high-fidelity simulation at low cost. I.E.

**A91-54874**  
**DYNAMICS AND CONTROL OF ROBOTIC SYSTEMS WORN**  
**BY HUMANS**

H. KAZEROONI (California, University, Berkeley) and S. L. MAHONEY (Minnesota, University, Minneapolis) ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control (ISSN 0022-0434), vol. 113, Sept. 1991, p. 379-387. refs  
Copyright

This article describes the dynamics, control, and stability of extenders, robotic systems worn by humans for material handling tasks. Extenders are defined as robot manipulators which extend (i.e., increase) the strength of the human arm in load maneuvering tasks, while the human maintains control of the task. Part of the extender motion is caused by physical power from the human; the rest of the extender motion results from force signals measured at the physical interfaces between the human and the extender, and the load and the extender. Therefore, the human wearing the extender exchanges both power and information signals with the extender. The control technique described here lets the designer define an arbitrary relationship between the human force and the load force. A set of experiments on a two-dimensional non-direct-drive extender were done to verify the control theory.

Author

A91-55296

**THE PROTECTION OF THE HUMAN EYE AND SKIN FROM SOLAR UV RADIATION [ZASHCHITA KOZHI I GLAZ CHELOVEKA OT UF-IZLUCHENIIA SOLNTSA]**

V. S. KRASNOVIDOV, V. F. LYSAK, and V. K. OSIPOVICH  
Kosmicheskaja Biologija i Aviakosmicheskaja Meditsina (ISSN 0321-5044), vol. 25, July-Aug. 1991, p. 43-46. In Russian. refs  
Copyright

The effects of solar UV radiation on the skin and the eye tissues of humans are discussed together with methods used to protect the skin and the eyes from the UV-induced damage. Data are presented on the UV absorptive capacity of different types of clothing and of various protective skin ointments and filters used as sun glasses. Special consideration is given to the means of eye protection for pilots and astronauts. I.S.

A91-55330

**TRACKING WITH A RESTRICTED FIELD OF VIEW - PERFORMANCE AND EYE-HEAD COORDINATION ASPECTS**

PATRICK B. SANDOR and ALAIN LEGER (Centre d'Essais en Vol, Bretigny-sur-Orge, France) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1026-1031. refs

(Contract DRET-87-1361)

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Vision through a restricted field of view (RFOV) is becoming increasingly common in aviation with the use of helmet mounted displays. The first experiment investigated the influence of a narrow (20-deg) binocular RFOV on performance during head-free visuomanual tracking of a wide range (+/- 85 deg) horizontally moving target. Second, the effects of two levels of RFOV (20-deg, 70-deg) on a similar tracking task presented with various eccentricities were compared to full field of view (FOV). Eye and head movement around the yaw axis were recorded and analyzed versus head-free visual pursuit alone. Tracking performance appeared moderately impaired when RFOV was set to 20-deg, but did not improve with a 70-deg field. Discomfort due to unusually large head movements was ruled out as a causal factor. Visuomanual tracking apparently implies a need for head stability. RFOV degrades this basic requirement which, in turn, could explain performance impairment. Analysis of eye-head coordination characteristics following FOV task conditions supports this hypothesis. Author.

A91-55336

**THE CHARACTERISTICS AND THEORETICAL BASIS OF THE QIGONG MANEUVER**

HONG-ZHANG GUO, SHU-XIA ZHANG, and BAI-SHENG JING (Air Force PR China, Institute of Aviation Medicine, Beijing, People's Republic of China) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Nov. 1991, p. 1059-1062. refs  
Copyright

A systematic experimental study was made since the Qigong (Q-G) maneuver was proposed in 1986. The purpose of this article is to summarize the 5-year research project. It describes the theoretical problems of the Q-G maneuver, including the mechanism of blood pressure elevation induced by the Q-G maneuver, analysis of the maneuver elements and their respective contribution, the theory and method of muscular contraction in the Q-G maneuver, and the theory and practice of seated posture in the anti-G maneuver. Also described are the characteristics of the Q-G maneuver in five aspects. Author

A91-55824

**STUDY OF MAN-SYSTEM FOR JAPANESE EXPERIMENT MODULE (JEM)**

HIDETAKA TANAKA (Mitsubishi Heavy Industries, Ltd., Nagoya Aerospace Systems Work, Tobishima, Japan), TAKANOBU SHIMODA, and TAKAO YAMAGUCHI (NASDA, Tokyo, Japan) IN: Space utilization and applications in the Pacific; Proceedings of the 3rd Pacific Basin International Symposium on Advances in Space Science Technology and its Applications, Los Angeles, CA,

Nov. 6-8, 1989. San Diego, CA, Univelt, Inc., 1990, p. 273-282. (AAS PAPER 89-627) Copyright

The JEM Man-Systems design concept is presented with particular attention given to major man-machine interface equipment configurations. The JEM Man System is aimed at supporting distributed system and element design, operations and training, flight crew, project management, and product assurance in the enforcement of human engineering and architectural continuity. It is based upon the SSF Man-Systems Integration standards. Specific functions of the system include mock-up production and test, study of accessibility and equipment layout, O-G simulator test, task analysis, and computer simulation. O.G.

A91-55826

**DEXTEROUS MANIPULATOR SYSTEM FOR SPACE STATION AND ITS FUTURE EXTENSION**

J. OTAO, K. SHIRAKI, K. KURAOKA (NASDA, Space Station Project Office, Tokyo, Japan), H. IHARA, S. TOMITA, K. KUMAMOTO, N. EZAWA, N. NOGUUCHI, and S. TAKARADA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan) IN: Space utilization and applications in the Pacific; Proceedings of the 3rd Pacific Basin International Symposium on Advances in Space Science Technology and its Applications, Los Angeles, CA, Nov. 6-8, 1989. San Diego, CA, Univelt, Inc., 1990, p. 301-315. refs  
(AAS PAPER 89-629) Copyright

A dexterous manipulator system called Small Fine Arm (SFA) is being developed for supporting the operation of the Japanese Experimental Module (JEM). The system comprises a single hand controller with force/moment feedback capability and a requisite control capability. SFA is aimed at fulfilling the following functions: soft handling of objects, precise operation (push, pull, and twist), compliant motion, precise pointing, and handling of special-purpose tools. O.G.

A91-55839\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**NASA'S TELEROBOTIC TESTBED**

J. F. STOCKY (JPL, Pasadena, CA) IN: Space utilization and applications in the Pacific; Proceedings of the 3rd Pacific Basin International Symposium on Advances in Space Science Technology and its Applications, Los Angeles, CA, Nov. 6-8, 1989. San Diego, CA, Univelt, Inc., 1990, p. 487-494. refs  
(AAS PAPER 89-649) Copyright

As part of the Advanced Technology Program in Telerobotics Technology conducted by NASA's Office of Aeronautics and Space Technology, a Telerobotics Testbed has been placed into use at the Jet Propulsion Laboratory. The Telerobotics Testbed represents an integration of the discipline technologies represented by its subsystems: (1) Operator Control Station, (2) Planning and Reasoning, (3) Run Time Control, (4) Sensing and Perception, and (5) Manipulation and Control Mechanization. The features provided initially by the Telerobotics Testbed are described both at the subsystem level and at the level of a fully integrated, end-to-end system. The capabilities of the total system as displayed experimentally are discussed, and the capabilities of which the Telerobotics Testbed will be capable are described. The experimental program to define the performance of the Telerobotics Testbed is discussed. Author

A91-56821

**MSS COLLISION DETECTION**

TERRY NG, R. RAVINDRAN, and H. SAKATA (Spar Aerospace, Ltd., Mississauga, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 37, March 1991, p. 4-8. refs

The Mobile Servicing System (MSS) currently under development in Canada to be capable of avoiding collisions with other objects on the Space Station is presented. The MSS is a robotic system that will perform a variety of functions that include Space Station construction and assembly, payload handling, and EVA support. Attention is given to the collision detection system, its implementation and prototype development, and preliminary test results. R.E.P.

**N91-31775\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS:**

**CELSS '89 WORKSHOP**

ROBERT D. MACELROY, ed. Mar. 1990 433 p Workshop held in Orlando, FL, Feb. 1989

(NASA-TM-102277; A-90059; NAS 1.15:102277) Avail: NTIS HC/MF A19 CSCL 06/11

Topics discussed at NASA's Controlled Ecological Life Support Systems (CELSS) workshop concerned the production of edible biomass. Specific areas of interest ranged from the efficiency of plant growth, to the conversion of inedible plant material to edible food, to the use of plant culture techniques. Models of plant growth and whole CELSS systems are included. The use of algae to supplement and improve dietary requirements is addressed. Flight experimentation is covered in topics ranging from a Salad Machine for use on the Space Station Freedom to conceptual designs for a lunar base CELSS.

**N91-31777\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ENVIRONMENTAL MODIFICATION OF YIELD AND FOOD COMPOSITION OF COWPEA AND LEAF LETTUCE**

CARY A. MITCHELL, SUZANNE S. NIELSEN (Purdue Univ., West Lafayette, IN.), and DAVID L. BUBENHEIM *In its* Controlled Ecological Life Support Systems: CELSS '89 Workshop p 25-53 Mar. 1990

(Contract NCC2-100)

Avail: NTIS HC/MF A19 CSCL 06/11

Cowpea (*Vigna unguiculata* (L.) Walp.) and leaf lettuce (*Lactuca sativa* L.) are candidate species to provide ligume protein and starch or serve as a salad base for a nutritionally balanced and psychologically satisfying vegetarian diet in the Controlled Ecology Life Support System (CELSS). Various nutritional parameters are reported. Hydroponic leaf lettuce grew best under CO<sub>2</sub> enrichment and photosynthetic photon flux (PPF) enhancement. Leaf protein content reached 36 percent with NH<sub>4</sub>(+) + NO<sub>3</sub> nutrition; starch and free sugar content was as high as 7 or 8.4 percent of DW, respectively, for high PPF/CO<sub>2</sub> enriched environments. Author

**N91-31778\*#** California Univ., Davis.

**EFFICIENCY OF N USE BY WHEAT AS A FUNCTION OF INFLUX AND EFFLUX OF NO<sub>3</sub>**

R. C. HUFFAKER, M. ASLAM, and M. R. WARD *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 55-76 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Since N assimilation is one of the most costly functions of a plant, its efflux before assimilation results in a serious energy cost and loss in efficiency which could decrease yields. Efficient crop production is critical to the Closed Ecology Life Support System (CELSS). The objective is to determine the extent of efflux of the N species NO<sub>3</sub>(-), NH<sub>4</sub>(+), NO<sub>2</sub>(-), and urea after uptake, and possible means of regulation. Researchers found that NO<sub>3</sub> efflux became serious as its substrate level increased. Efflux/Influx (E/I) of NO<sub>3</sub>(-) was greater in darkness (35 percent) than in light (14 percent), and the ratio greatly increased with substrate NO<sub>3</sub>(-), (up to 45 percent at 10 mM). It seems advantageous to use the lowest possible nutrient concentration of NO<sub>3</sub>(-). The feasibility of using ClO<sub>3</sub>(-) was assessed and its toxicity determined.

Author

**N91-31780\*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

**EFFECTS OF ATMOSPHERIC CO<sub>2</sub> ON PHOTOSYNTHETIC CHARACTERISTICS OF SOYBEAN LEAVES**

R. M. WHEELER, C. L. MACKOWIAK (Bionetics Corp., Cocoa Beach, FL.), J. C. SAGER, and W. M. KNOTT *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 93-105 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Soybean (Glycine max. cv. McCall) plants were grown at 500, 1000, and 2000 umol mol (exp -1) CO<sub>2</sub> for 35 days with a

photosynthetic photon flux of 300 umol m (exp -2) s (-1). Individual leaves were exposed to step changes of photosynthetic photon flux to study CO<sub>2</sub> assimilation rates (CAR), i.e., leaf net photosynthesis. In general, CAR increased when CO<sub>2</sub> increased from 500 to 1000 umol mol (exp -1), but not from 1000 to 2000 umol mol (exp -1). Regardless of the CO<sub>2</sub> level, all leaves showed similar CAR at similar CO<sub>2</sub> and PPF. This observation contrasts with reports that plants tend to become 'lazy' at elevated CO<sub>2</sub> levels over time. Although leaf stomatal conductance (to water vapor) showed diurnal rhythms entrained to the photoperiod, leaf CAR did not show these rhythms and remained constant across the light period, indicating that stomatal conductance had little effect on CAR. Such measurements suggest that short-term changes in CO<sub>2</sub> exchange dynamics for a controlled ecological life support system can be closely predicted for an actively growing soybean crop.

Author

**N91-31781\*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

**EFFECTS OF ELEVATED ATMOSPHERIC CARBON DIOXIDE CONCENTRATIONS ON WATER AND ACID REQUIREMENTS OF SOYBEANS GROWN IN A RECIRCULATING HYDROPONIC SYSTEM**

C. L. MACKOWIAK, R. M. WHEELER, W. LOWERY (Bionetics Corp., Cocoa Beach, FL.), and J. C. SAGER *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 107-118 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Establishing mass budgets of various crop needs, i.e. water and nutrients, in different environments is essential for the Controlled Ecological Life Support System (CELSS). The effects of CO<sub>2</sub> (500 and 1000 umol mol (exp -1)) on water and acid use (for pH control) by soybeans in a recirculating hydroponic system were examined. Plants of cvs. McCall and Pixie were grown for 90 days using the nutrient film technique (NFT) and a nitrate based nutrient solution. System acid use for both CO<sub>2</sub> levels peaked near 4 weeks during a phase of rapid vegetative growth, but acid use decreased more rapidly under 500 compared to 1000 umol mol (exp GR) CO<sub>2</sub>. Total system water use by 500 and 1000 umol mol (exp -1) plants was similar, leaving off at 5 weeks and declining as plants senesced (ca. 9 weeks). However, single leaf transpiration rates were consistently lower at 1000 umol mol (exp -1). The data suggest that high CO<sub>2</sub> concentrations increase system acid (and nutrient) use because of increased vegetative growth, which in turn negates the benefit of reduced water use (lower transpiration rates) per unit leaf area.

Author

**N91-31782\*#** Tuskegee Inst., AL. Agricultural Experiment Station.

**SWEET POTATO FOR CLOSED ECOLOGICAL LIFE SUPPORT SYSTEMS USING THE NUTRIENT FILM TECHNIQUE**

P. A. LORETAN, W. A. HILL, C. K. BONSI, C. E. MORRIS, J. Y. LU, C. R. A. OGBUEHI, and D. G. MORTLEY *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 119-126 Mar. 1990

Sponsored in part by Department of Agriculture

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Avail: NTIS HC/MF A19 CSCL 06/11

Sweet potatoes were grown hydroponically using the nutrient film technique (NFT) in support of the Closed Ecological Life Support System (CELSS) program. Experiments in the greenhouse with the TI-155 sweet potato cultivar produced up to 1790 g/plant of fresh storage roots. Studies with both TI-155 and Georgia Jet cultivars resulted in an edible biomass index of approximately 60 percent, with edible biomass linear growth rates of 12.1 to 66.0 g m(exp -2)d(exp -1) in 0.05 to 0.13 sq meters in 105 to 130 days. Additional experimental results are given. All studies indicate good potential for sweet potatoes in CELSS.

Author

**N91-31783\*#** Utah State Univ., Logan. Dept. of Plant Science. **CLONING CROPS IN A CELSS VIA TISSUE CULTURE: PROSPECTS AND PROBLEMS**

JOHN G. CARMAN and J. RICHARD HESS *In* NASA. Ames

Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 127-146 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

Micropropagation is currently used to clone fruits, nuts, and vegetables and involves controlling the outgrowth in vitro of basal, axillary, or adventitious buds. Following clonal multiplication, shoots are divided and rooted. This process has greatly reduced space and energy requirements in greenhouses and field nurseries and has increased multiplication rates by greater than 20 fold for some vegetatively propagated crops and breeding lines. Cereal and legume crops can also be cloned by tissue culture through somatic embryogenesis. Somatic embryos can be used to produce 'synthetic seed', which can tolerate desiccation and germinate upon rehydration. Synthetic seed of hybrid wheat, rice, soybean and other crops could be produced in a controlled ecological life support system. Thus, yield advantages of hybrids over inbreds (10 to 20 percent) could be exploited without having to provide additional facilities and energy for parental-line and hybrid seed nurseries. Author

**N91-31784\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**THE CONVERSION OF LIGNOCELLULOSES TO FERMENTABLE SUGARS: A SURVEY OF CURRENT RESEARCH AND APPLICATION TO CELSS**

GENE R. PETERSEN and LARRY BARESI /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 147-183 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

An overview of the options for converting lignocellulosics into fermentable sugars as applied to the Closed Ecological Life Support System (CELSS) is given. A requirement for pretreatment is shown as well as the many available options. At present, physical/chemical methods are the simplest and best characterized options, but enzymatic processes will likely be the method of choice in the future. The use of pentose sugars by microorganisms to produce edibles at levels comparable to conventional plants is shown. The possible use of mycelial food production on pretreated but not hydrolyzed lignocellulosics is also presented. Simple tradeoff analysis among some of the many possible biological pathways to regeneration of waste lignocellulosics was undertaken. Comparisons with complete oxidation processes were made. It is suggested that the NASA Life Sciences CELSS program maintain relationships with other government agencies involved in lignocellulosic conversions and use their expertise when the actual need for such conversion technology arises rather than develop this expertise within NASA. Author

**N91-31785\*#** Bionetics Corp., Cocoa Beach, FL.  
**USE OF INEDIBLE WHEAT RESIDUES FROM THE KSC-CELSS BREADBOARD FACILITY FOR PRODUCTION OF FUNGAL CELLULOSE**

R. F. STRAYER, M. A. BRANNON, and J. L. GARLAND /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 185-202 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

Cellulose and xylan (a hemicellulose) comprise 50 percent of inedible wheat residue (which is 60 percent of total wheat biomass) produced in the Kennedy Space Center Closed Ecological Life Support System (CELSS) Breadboard Biomass Production Chamber (BPC). These polysaccharides can be converted by enzymatic hydrolysis into useful monosaccharides, thus maximizing the use of BPC volume and energy, and minimizing waste material to be treated. The evaluation of CELSS-derived wheat residues for production for cellulase enzyme complex by *Trichoderma reesei* and supplemental beta-glucosidase by *Aspergillus phoenicis* is in progress. Results to date are given. Author

**N91-31786\*#** California Univ., Berkeley. Lawrence Berkeley Lab.

**CYANOBACTERIA IN CELSS: GROWTH STRATEGIES FOR NUTRITIONAL VARIATION AND NITROGEN CYCLING**

I. V. FRY and L. PACKER /in NASA. Ames Research Center,

Controlled Ecological Life Support Systems: CELSS '89 Workshop p 203-216 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

Cyanobacteria (blue-green algae) are versatile organisms which are capable of adjusting their cellular levels of carbohydrate, protein, and lipid in response to changes in the environment. Under stress conditions there is an imbalance between nitrogen metabolism and carbohydrate/lipid synthesis. The lesion in nitrogen assimilation is at the level of transport: the stress condition diverts energy from the active accumulation of nitrate to the extrusion of salt, and probably inhibits a cold-labile ATPase in the case of cold shock. Both situations affect the bioenergetic status of the cell such that the nitrogenous precursors for protein synthesis are depleted. Despite the inhibition of protein synthesis and growth, photosynthetic reductant generation is relatively unaffected. The high O<sub>2</sub> reductant would normally lead to photo-oxidative damage of cellular components; however, the organism copes by channeling the 'excess' reductant into carbon storage products. The increase in glycogen (28 to 35 percent dry weight increase) and the elongation of lipid fatty acid side chains (2 to 5 percent dry weight increase) at the expense of protein synthesis (25 to 34 percent dry weight decrease) results in carbohydrate, lipid and protein ratios that are closer to those required in the human diet. In addition, the selection of nitrogen fixing mutants which excrete ammonium ions present an opportunity to tailor these micro-organisms to meet the specific need for a sub-system to reverse potential loss of fixed nitrogen material. Author

**N91-31787\*#** Alabama A & M Univ., Normal. Dept. of Biology.  
**ALGAE FOR CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM DIET CHARACTERIZATION OF CYANOBACTERIA 'SPIRULINA' IN BATCH CULTURES**

M. G. TADROS /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 217-243 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

*Spirulina* sp. is a bioregenerative photosynthetic and edible alga for space craft crews in a Closed Ecological Life Support System (CELSS). It was characterized for growth rate and biomass yield in batch cultures, under various environmental conditions. The cell characteristics were identified for one strain of *Spirulina*: *S. maxima*. Fast growth rate and high yield were obtained. The partitioning of the assimilatory products (proteins, carbohydrates, lipids) were manipulated by varying the environmental conditions. Experiments with *Spirulina* demonstrated that under stress conditions carbohydrate increased at the expense of protein. In other experiments, where the growth media were sufficient in nutrients and incubated under optimum growth conditions, the total proteins were increased up to almost 70 percent of the organic weight. In other words, the nutritional quality of the alga could be manipulated by growth conditions. These results support the feasibility of considering *Spirulina* as a subsystem in CELSS because of the ease with which its nutrient content can be manipulated. Author

**N91-31788\*#** New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.

**PRELIMINARY EVALUATION OF WASTE PROCESSING IN A CELSS**

RICARDO B. JACQUEZ /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 245-263 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

Physical/chemical, biological, and hybrid methods can be used in a space environment for processing wastes generated by a Closed Ecological Life Support System (CELSS). Two recycling scenarios are presented. They reflect differing emphases on and responses to the waste system formation rates and their composition, as well as indicate the required products from waste treatment that are needed in a life support system. Author

**N91-31789\*#** Bionetics Corp., Cocoa Beach, FL.  
**BIOMASS PRODUCTION AND NITROGEN DYNAMICS IN AN INTEGRATED AQUACULTURE/AGRICULTURE SYSTEM**  
 L. P. OWENS and C. R. HALL *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 265-277 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

A combined aquaculture/agriculture system that brings together the three major components of a Controlled Ecological Life Support System (CELSS) - biomass production, biomass processing, and waste recycling - was developed to evaluate ecological processes and hardware requirements necessary to assess the feasibility of and define design criteria for integration into the Kennedy Space Center (KSC) Breadboard Project. The system consists of a 1 square meter plant growth area, a 500 liter fish culture tank, and computerized monitoring and control hardware. Nutrients in the hydroponic solution were derived from fish metabolites and fish food leachate. In five months of continuous operation, 27.0 kg of lettuce tops, 39.9 kg of roots and biofilm, and 6.6 kg of fish (wet weights) were produced with 12.7 kg of fish food input. Based on dry weights, a biomass conversion index of 0.52 was achieved. A nitrogen budget was derived to determine partitioning of nitrogen within various compartments of the system. Accumulating nitrogen in the hydroponic solution indicated a need to enlarge the plant growth area, potentially increasing the biomass production and improving the biomass conversion index. Author

**N91-31790\*#** Colorado Univ., Boulder. Bioserve Space Technologies.

**SEED SPROUT PRODUCTION: CONSUMABLES AND A FOUNDATION FOR HIGHER PLANT GROWTH IN SPACE**  
 MICHELLE DAY, TERRI THOMAS, STEVE JOHNSON, and MARVIN LUTTGES *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 279-293 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

Seed sprouts can be produced as a source of fresh vegetable materials and as higher plant seedlings in space. Sprout production was undertaken to evaluate the mass accumulations possible, the technologies needed, and the reliability of the overall process. Baseline experiments corroborated the utility of sprout production protocols for a variety of seed types. The automated delivery of saturated humidity effectively supplants labor intensive manual soaking techniques. Automated humidification also lend itself to modest centrifugal sprout growth environments. A small amount of ultraviolet radiation effectively suppressed bacterial and fungal contamination, and the sprouts were suitable for consumption. Author

**N91-31791\*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.  
**CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM BREADBOARD PROJECT, 1988**

W. M. KNOTT *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 295-302 Mar. 1990 Previously announced in IAA as A90-24803  
 Avail: NTIS HC/MF A19 CSCL 06/11

The Closed Ecological Life Support System (CELSS) Breadboard Project, NASA's effort to develop the technology required to produce a functioning bioregenerative system, is discussed. The different phases of the project and its current status are described. The relationship between the project components are shown, and major project activities for fiscal years 1989 to 1993 are listed. The Biomass Production Chamber (BPC) became operational and tests of wheat as a single crop are nearing completion. Author

**N91-31792\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**THE CROP GROWTH RESEARCH CHAMBER: A GROUND-BASED FACILITY FOR CELSS RESEARCH**  
 DAVID L. BUBENHEIM *In its* Controlled Ecological Life Support

Systems: CELSS '89 Workshop p 303-317 Mar. 1990  
 Avail: NTIS HC/MF A19 CSCL 06/11

A ground based facility for the study of plant growth and development under stringently controlled environments is being developed by the Closed Ecological Life Support System (CELSS) program at the Ames Research Center. Several Crop Growth Research Chambers (CGRC) and laboratory support equipment provide the core of this facility. The CGRC is a closed (sealed) system with a separate recirculating atmosphere and nutrient delivery systems. The atmospheric environment, hydroponic environment, systems controls, and data acquisition are discussed. Author

**N91-31793\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**DEVELOPMENT OF THE CELSS EMULATOR AT NASA.**

**JOHNSON SPACE CENTER**

HATICE S. CULLINGFORD *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 319-325 Mar. 1990 Previously announced in IAA as A90-27445 Prepared in cooperation with Lockheed Engineering and Sciences Co., Houston, TX  
 (Contract NAS9-17900)

Avail: NTIS HC/MF A19 CSCL 06/11

The Closed Ecological Life Support System (CELSS) Emulator is under development. It will be used to investigate computer simulations of integrated CELSS operations involving humans, plants, and process machinery. Described here is Version 1.0 of the CELSS Emulator that was initiated in 1988 on the Johnson Space Center (JSC) Multi Purpose Applications Console Test Bed as the simulation framework. The run model of the simulation system now contains a CELSS model called BLSS. The CELSS simulator empowers us to generate model data sets, store libraries of results for further analysis, and also display plots of model variables as a function of time. The progress of the project is presented with sample test runs and simulation display pages. Author

**N91-31794\*#** Texas Univ., Arlington. Center for Dynamic Systems Control Studies.

**A PERSPECTIVE ON CELSS CONTROL ISSUES**

ANN L. BLACKWELL *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 327-353 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Some issues of Closed Ecological Life Support System (CELSS) analysis and design are effectively addressed from a systems control perspective. CELSS system properties that may be elucidated using control theory in conjunction with mathematical and simulation modeling are enumerated. The approach that is being taken to the design of a control strategy for the Crop Growth Research Chamber (CGRC) and the relationship of that approach to CELSS plant growth unit subsystems control is described. Author

**N91-31795\*#** National Aeronautics and Space Administration, Washington, DC.

**TRANSPIRATION DURING LIFE CYCLE IN CONTROLLED WHEAT GROWTH**

TYLER VOLK (New York Univ., New York) and JOHN D. RUMMEL *In* NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 355-358 Mar. 1990 Previously announced in IAA as A90-15432  
 (Contract NCA2-101)

Avail: NTIS HC/MF A19 CSCL 06/11

A previously developed model of wheat growth, designed for convenient incorporation into system level models of advanced space life support systems is described. The model is applied to data from an experiment that grew wheat under controlled conditions and measured fresh biomass and cumulated transpiration as a function of time. The adequacy of modeling the transpiration as proportional to the inedible biomass and an age factor that varies during the life cycle are discussed. Author

**N91-31796\*#** Utah State Univ., Logan. Dept. of Plant Science.  
**PREPARATORY SPACE EXPERIMENTS FOR DEVELOPMENT OF A CELSS**

FRANK B. SALISBURY /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 359-372 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

The goal of Closed Ecological Life Support System (CELSS) studies is to examine the effects of microgravity on yield and quality of plant products and on the interactions between irradiance and crop area. Measuring yield and quality of crops as a function of irradiance in microgravity is virtually unique to the CELSS program, as is the emphasis on canopies rather than individual plants. The first step for space experiments is to develop a relatively stress free environment for plant growth, something that has so far never been achieved. High light levels are essential, and there must be time enough to complete a significant portion of the life cycle. Optimal atmosphere and nutrients must be provided. Such responses as germination, orientation of roots and shoots, photosynthesis and respiration, floral initiation and development, and seed maturation and viability will be studied. Author

**N91-31797\*#** National Aeronautics and Space Administration.  
 John F. Kennedy Space Center, Cocoa Beach, FL.

**FACTORS AFFECTING PLANT GROWTH IN MEMBRANE NUTRIENT DELIVERY**

T. W. DRESCHER, R. M. WHEELER (Bionetics Corp., Cocoa Beach, FL.), J. C. SAGER, and W. M. KNOTT /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 373-382 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

The development of the tubular membrane plant growth unit for the delivery of water and nutrients to roots in microgravity has recently focused on measuring the effects of changes in physical variables controlling solution availability to the plants. Significant effects of membrane pore size and the negative pressure used to contain the solution were demonstrated. Generally, wheat grew better in units with a larger pore size but equal negative pressure and in units with the same pore size but less negative pressure. Lettuce also exhibited better plant growth at less negative pressure. Author

**N91-31798\*#** National Aeronautics and Space Administration.  
 Lyndon B. Johnson Space Center, Houston, TX.

**CONCEPTUAL DESIGN OF A CLOSED LOOP NUTRIENT SOLUTION DELIVERY SYSTEM FOR CELSS IMPLEMENTATION IN A MICRO-GRAVITY ENVIRONMENT**

STEVEN H. SCHWARTZKOPF, MEL W. OLESON (Boeing Aerospace Co., Seattle, WA.), and HATICE S. CULLINGFORD /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 383-390 Mar. 1990

Previously announced in IAA as A90-27545

(Contract NAS9-17981)

Avail: NTIS HC/MF A19 CSCL 06/11

Described here are the results of a study to develop a conceptual design for an experimental closed loop fluid handling system capable of monitoring, controlling, and supplying nutrient solution to higher plants. The Plant Feeder Experiment (PFE) is designed to be flight tested in a microgravity environment. When flown, the PFE will provide information on both the generic problems of microgravity fluid handling and the specific problems associated with the delivery of the nutrient solution in a microgravity environment. The experimental hardware is designed to fit into two middeck lockers on the Space Shuttle, and incorporates several components that have previously been flight tested. Author

**N91-31799\*#** Wisconsin Univ., Madison.

**TECHNOLOGY FOR SUBSYSTEMS OF SPACE-BASED PLANT GROWTH FACILITIES**

R. J. BULA, R. C. MORROW, T. W. TIBBITTS, and R. B. COREY /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 391-408 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Technologies for different subsystems of space-based plant growth facilities are being developed at the Wisconsin Center for Space Automation and Robotics, a NASA Center for the Commercial Development of Space. The technologies include concepts for water and nutrient delivery, for nutrient composition control, and for irradiation. Effort is being concentrated on these subsystems because available technologies cannot be effectively utilized for space applications. Author

**N91-31800\*#** National Aeronautics and Space Administration.  
 Lyndon B. Johnson Space Center, Houston, TX.

**SOLID-SUPPORT SUBSTRATES FOR PLANT GROWTH AT A LUNAR BASE**

D. W. MING and C. GALINDO (Lockheed Engineering and Sciences Co., Houston, TX.) /in NASA. Ames Research Center, Controlled Ecological Life Support Systems: CELSS '89 Workshop p 409-437 Mar. 1990

Avail: NTIS HC/MF A19 CSCL 06/11

Zeoponics is only in its developmental stages at the Johnson Space Center and is defined as the cultivation of plants in zeolite substrates that contain several essential plant growth cations on their exchange sites, and have minor amounts of mineral phases and/or anion-exchange resins that supply essential plant growth anions. Zeolites are hydrated aluminosilicates of alkali and alkaline earth cations with the ability to exchange most of their constituent exchange cations as well as hydrate/dehydrate without change to their structural framework. Because zeolites have extremely high cation exchange capabilities, they are very attractive media for plant growth. It is possible to partially or fully saturate plant-essential cations on zeolites. Zeoponic systems will probably have their greatest applications at planetary bases (e.g., lunar bases). Lunar raw materials will have to be located that are suited for the synthesis of zeolites and other exchange resins. Lunar 'soil' simulants have been or are being prepared for zeolite/smectite synthesis and 'soil' dissolution studies. Author

**N91-31801** Defence and Civil Inst. of Environmental Medicine,  
 Downsview (Ontario).

**FEMALE AIRCREW: THE CANADIAN FORCES EXPERIENCE, 1979-1989**

R. J. HICKS Apr. 1990 15 p Previously announced as N91-11367

(DCIEM-90-P-14; CTN-91-60197) Avail: NTIS HC A03

Data collected since females first started aircrew training in Canada in 1979 is reviewed. Selection test data over a 10 year period indicates that females score significantly lower in quantitative and spatial / psychomotor skills; as long as the pilot job task emphasizes these skills, proportionately fewer females will be selected for training. Medical assessment data does indicate that a greater number of females will fail to meet the medical standard for pilot. The only reason for the difference is in the area of anthropometry. Again, as long as military cockpits are designed primarily with male indices, a greater number of females will continue to be excluded. Experience over the period has demonstrated that appropriately selected female aircrew, that is, using the same standards as for males, can perform equally with their male peers during training and in operational flying in the Air Force. CISTI

**N91-31802#** Sandia National Labs., Albuquerque, NM.  
**HUMAN FACTORS ENGINEERING DESIGN GUIDELINES FOR THE SOFTWARE USER INTERFACE**

H. W. ALLEN and D. L. CAMPBELL Jul. 1991 57 p

(Contract DE-AC04-76DP-00789)

(DE91-016061; SAND-91-0872) Avail: NTIS HC/MF A04

This report provides system designers with basic human factors information and guidelines for designing and developing the software user interface. A brief discussion of the user interface design philosophy is presented, followed by an overview of the user interface options available (such as color and highlighting), candidate approaches, and discussion of general display concepts and user interface features. We have presented information to facilitate discussions of user interface options, to aid in making

final user interface design decisions, and to further the refinement of the user interface. We provide a candidate questionnaire for evaluating your software user interface. DOE

**N91-31803\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**METHOD AND APPARATUS FOR BIO-REGENERATIVE LIFE SUPPORT SYSTEM Patent**

HATICE S. CULLINGFORD, inventor (to NASA) 9 Apr. 1991 13 p Filed 11 Jul. 1989 Supersedes N89-29027 (27 - 23, p 3335)

(NASA-CASE-MS-C-21629-1; US-PATENT-5,005,787; US-PATENT-APPL-SN-378548; US-PATENT-CLASS-244-163; US-PATENT-CLASS-244-159; US-PATENT-CLASS-47-1.4; US-PATENT-CLASS-47-62; US-PATENT-CLASS-55-75; US-PATENT-CLASS-210-748; INT-PATENT-CLASS-B64G-1/46) Avail: US Patent and Trademark Office CSCL 06/11

A life support system is disclosed for human habitation (cabin) which has a bioregenerative capability through the use of a plant habitat (greenhouse) whereby oxygen-rich air from the greenhouse is processed and used in the cabin and carbon dioxide-rich air from the cabin is used in the greenhouse. Moisture from the air of both cabin and greenhouse is processed and reused in both. Wash water from the cabin is processed and reused in the cabin as hygiene water, and urine from the cabin is processed and used in the greenhouse. Spent water from the greenhouse is processed and reused in the greenhouse. Portions of the processing cycles are separated between cabin and greenhouse in order to reduce to a minimum cross contamination of the two habitat systems. Other portions of the processing cycles are common to both cabin and greenhouse. The use of bioregenerative techniques permits a substantial reduction of the total consumables used by the life support system.

Official Gazette of the U.S. Patent and Trademark Office

**N91-31804#** Air Force Inst. of Tech., Wright-Patterson AFB, OH.

**COCKPIT RESOURCE MANAGEMENT: EFFECTS ON BEHAVIORAL INTERACTIONS ACROSS AIRLINES AND AIRCRAFT TYPES M.S. Thesis**

CATHY C. CLOTHIER May 1991 111 p (AD-A239467; AFIT/CI/CIA-91-028) Avail: NTIS HC/MF A06 CSCL 05/9

Due to the growing concern over human errors playing an instrumental role in aircraft accidents, the Federal Aviation Administration encouraged airlines to develop Cockpit Resource Management (CRM) training programs to address that issue. Baseline data measured crew interaction before pilots were exposed to seminars and simulators. Longitudinal data described behavioral changes wrought by the intervention. Within airline and within fleet data clearly showed that crews were more effective after CRM training. Within airline and across fleet data verified fleet differences discovered by the first method. Technology level seemed to be a cause of the fleet differences for crews performing in simulators. Crew size affected performance both on the line and in the simulator. Finally, the across airline and across fleet data, in addition to describing fleet differences, highlighted differences between the behavioral effectiveness of crews in different airlines. GRA

**N91-31805#** Aerospace Corp., El Segundo, CA. Lab. Operations.

**GARMENT SELECTION FOR CLEANROOMS AND CONTROLLED ENVIRONMENTS FOR SPACECRAFT**

ETHEL J. WATT'S 1 Apr. 1991 44 p (Contract F04701-88-C-0089) (AD-A239512; TR-0090(5530-02)-1; SSD-TR-91-26) Avail: NTIS HC/MF A03 CSCL 06/11

Strict contamination control practices are exercised throughout the lifetime of a spacecraft in order to satisfy the performance requirements of the system. Spacecraft materials are carefully selected to have low outgassing values and particulate deposition. Parts are cleaned, and the vehicle is assembled in cleanrooms

and work stations having controlled environments. Specifications are examined which govern the selection of special items of clothing designed to protect spacecraft from contaminants released by personnel and by garments. Special clothing includes coveralls, footwear, and head/face covers. Garments appropriate for both hazardous (meltproof as well as flame resistant), and nonhazardous operations are described. GRA

**N91-31806#** Naval Submarine Medical Research Lab., Groton, CT.

**THE MEDICAL HAZARDS OF FLAME-SUPPRESSANT ATMOSPHERES**

DOUGLAS R. KNIGHT 19 Apr. 1991 24 p (AD-A239618; NSMRL-1167) Avail: NTIS HC/MF A03 CSCL 06/5

Flames are a potential hazard to the occupants of sealed chambers. Four modifications of air are described that will suppress or extinguish flames. They are: (1) SUPPLEMENTATION - the addition of an appropriate foreign gas to air; (2) N2 PRESSURIZATION - the addition of compressed N2 to air; (3) DEPRESSURIZATION - the partial evacuation of air from the chamber; and (4) N2 DILUTION - the exchange of N2 for O2. The primary medical hazards of flame suppressant atmospheres are barotrauma, N2 narcosis, decompression sickness, hypoxia and inhalation toxicity. Experimental evidence supports the use of N2 DILUTION to suppress flames aboard patrolling submarines. One or more of the following adjuncts may enhance the use of N2 DILUTION without impairing human health: Physiological adaptation to hypoxia, addition of CO2 to the atmosphere and N2 PRESSURIZATION. GRA

**N91-31807#** School of Aerospace Medicine, Brooks AFB, TX. **TESTING AND EVALUATION OF THE CATALYST RESEARCH MINIOX 3 OXYGEN MONITOR Final Report, Oct. 1988 - Mar. 1989**

THOMAS E. PHILBECK, JR., REBECCA B. SCHULTZ, and ERNEST G. ROY Dec. 1990 24 p (Contract AF PROJ. 7930) (AD-A239665; USAFSAM-TR-90-25) Avail: NTIS HC/MF A03 CSCL 15/6

The Military Airlift Command (MAC) directs and controls aeromedical evacuation missions for the United States Air Force (USAF) and most of the Department of Defense (DOD). There is often a need to monitor and control the percentage of therapeutic oxygen being administered to patients. The Catalyst Research MiniOX III oxygen monitor was selected by MAC as its primary oxygen monitoring device. The Aeromedical Research Function tested and evaluated the MiniOX III, and found it to be a safe and reliable device and acceptable for worldwide aeromedical evacuation use. GRA

**N91-31808#** Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

**ADAPTIVE FUNCTION ALLOCATION FOR INTELLIGENT COCKPITS Final Report, Oct. 1989 - Oct. 1991**

JEFFREY MORRISON, JONATHAN GLUCKMAN, and JOHN DEATON 1 Jan. 1991 67 p (Contract NADC PROJ. RS-3-4-H20) (AD-A239714; NADC-91028-60) Avail: NTIS HC/MF A04 CSCL 23/2

The demands associated with flying modern tactical, strategic and commercial aircraft have made the cockpit a prime arena for the development of technology designed to aid human operators. The development of ever more powerful computers, expert systems, and artificial intelligence technology has led researchers and system designers to propose that decision making be aided dynamically using this technology. The implementation of this technology may modify the tasks normally performed by pilots in any of a number of ways, in order to facilitate the best performance of man machine systems. A series of Cockpit Automation Studies are being performed as part of the Adaptive Function Allocation for Intelligent Cockpits program. The goal of the program is to develop a prospective set of human performance based principles

and guidelines for the application of adaptive automation technology. As the first study this research developed a basic set of tasks in which automation concepts could later be applied. Derivatives of two common laboratory tasks were used: one task was a pursuit tracking task while the other task was a tactical assessment task (TAT). Subject's response time and accuracy were measured on the TAT while root mean square errors were obtained on the tracking task. Simple and complex task performance was measured as a function of task difficulty. Simple task results generally supported a resource view of human performance. GRA

**N91-31809#** Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

**AIRCREW CRITIQUE OF HIGH-G CENTRIFUGE TRAINING. PART 1: WHAT WAS THE BEST PART OF THE PROGRAM?**

**Final Report, Oct. 1988 - May 1991**

JAMES E. WHINNERY and RICHARD J. HAMILTON 1 May 1991 55 p  
(AD-A239781; NADC-91054-60-PT-1) Avail: NTIS HC/MF A04 CSDL 15/1

A fighter attack aviator high-G centrifuge training program was initiated at NADC. The critiques are review of 515 of 525 aircrew who participated in the centrifuge training. No negative overall critiques were received from USN, USMC, or USAF aircrew. Of particular note was the favorable aircrew attitude toward the 'HOOK maneuver' as the preferred method for teaching and performing the anti-G straining maneuver, and aircrew agreement that a G-LOC exposure would be a very beneficial part of the training program. A multitude of additional suggestions by the fighter aircrews offer the potential for further enhancement of successful program. The centrifuge training program has the potential for making the most significant enhancement of the interface between the fighter aviation medicine/aerospace physiology programs and fighter-attack operations that has yet to exist. The centrifuge training program not only enhances flight safety it also can immediately improve the combat readiness and capability of fighter-attack aircrew. GRA

**N91-32775#** Army Natick Research and Development Command, MA.

**HUMAN ANALOGUE MODELS FOR COMPUTER-AIDED DESIGN AND ENGINEERING APPLICATIONS Final Report, Nov. 1988 - Jul. 1990**

STEVEN P. PAQUETTE Nov. 1990 42 p  
(Contract DA PROJ. 161-62786-AH-98)  
(AD-A229520; NATICK/TR/90/054) Avail: NTIS HC/MF A03 CSDL 23/2

A review of six computerized human analogue models (SAMMIE, COMBIMAN, CREW CHIEF, CAR, JACK, and SAFEWORK) was conducted to identify the state-of-the-art in ergonomic modeling software. All of the models included here demonstrate some utility as ergonomic design tools and were developed so that material designers and engineers can conduct preliminary human factors analysis prior to prototype construction. These human figure models vary widely with respect to primary function and analytical capabilities. However, they essentially fall within one or more of the following categories: anthropometric accommodation analysis, biomechanical/strength modeling, or human-machine interface analysis. This report includes the developmental background of each model, the hardware requirements, and the major functions provided by each system, e.g., reach/clearance analysis, vision analysis, strength modeling, and computer simulation. The underlying anthropometric databases that support model generation are also reviewed. In addition, the techniques used to construct the human figures in terms of skeletal link structure and geometric representation of body segment shape and volume are discussed. Finally, some challenges are presented that confront future refinement of human figure models. GRA

**N91-32776\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**MEDICAL EVALUATIONS ON THE KC-135 1990 FLIGHT REPORT SUMMARY**

CHARLES W. LLOYD, TERRELL M. GUESS, CHARLES W. WHITING, and CHARLES R. DOARN (Krug Life Sciences, Inc., Houston, TX.) Sep. 1991 243 p  
(Contract NAS9-18492)  
(NASA-TM-104740; S-646; NAS 1.15:104740) Avail: NTIS HC/MF A11 CSDL 05/8

The medical investigations completed on the KC-135 during FY 1990 in support of the development of the Health Maintenance Facility and Medical Operations are discussed. The experiments are comprised of engineering evaluations of medical hardware and medical procedures. The investigating teams are made up of both medical and engineering personnel responsible for the development of medical hardware and medical operations. The hardware evaluated includes dental equipment, a coagulation analyzer, selected pharmaceutical aerosol devices, a prototype air/fluid separator, a prototype packaging and stowage system for medical supplies, a microliter metering system, and a workstation for minor surgical procedures. The results of these engineering evaluations will be used in the design of fleet hardware as well as to identify hardware specific training requirements.

**N91-32779\*#** Krug International, Houston, TX.

**MINI-RACK TESTBED EVALUATION**

JOHN GOSBEE, BARBARA STEGMANN, and TERRELL M. GUESS (Krug Life Sciences, Inc., Houston, TX.) In NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 21-40 Sep. 1991  
Avail: NTIS HC/MF A11 CSDL 05/8

The goal was to characterize the Health Maintenance Facility (HMF)-like mini-racks and drawers onboard the KC-135 as a test bed for the Space Station Freedom HMF racks. An additional goal was to evaluate the attachments, mounting points, and inner drawer assemblies of the mini-racks for various medical equipment and supplies. Results and recommendations are given. Author

**N91-32784\*#** Krug International, Houston, TX.

**TRANSPORT SUCTION APPARATUS AND ABSORPTION MATERIALS EVALUATION**

DEBRA T. KRUPA and JOHN GOSBEE In NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 97-108 Sep. 1991  
Avail: NTIS HC/MF A11 CSDL 05/8

The specific objectives were as follows. The effectiveness and function was evaluated of the hand held, manually powered v-vac for suction during microgravity. The function was evaluated of the battery powered lateral suction unit in microgravity. The two units in control of various types of simulated bodily fluids were compared. Various types of tubing and attachments were evaluated which are required to control the collection of bodily fluids during transport. Various materials were evaluated for absorption of simulated bodily fluids. And potential problems were identified for waste management and containment of secretions and fluids during transport. Test procedures, results, and conclusions are briefly discussed. Author

**N91-32785\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**ATLS-STOWAGE AND DEPLOYMENT TESTING OF MEDICAL SUPPLIES AND PHARMACEUTICALS**

JOHN GOSBEE, DARREN BENZ, CHARLES W. LLOYD, RICHARD BUEKER, and DEBRA ORSAK (McDonnell-Douglas Space Systems Co., Houston, TX.) In its Medical Evaluations on the KC-135 1990 Flight Report Summary p 109-119 Sep. 1991  
Avail: NTIS HC/MF A11 CSDL 05/8

The objective is to evaluate stowage and deployment methods for the Health Maintenance Facility (HMF) during microgravity. The specific objectives of this experiment are: (1) to evaluate the stowage and deployment mechanisms for the medical supplies; and (2) to evaluate the procedures for performing medical

## 54. MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

scenarios. To accomplish these objectives, the HMF test mini-racks will contain medical equipment mounted in the racks; and self-contained drawers with various mechanisms for stowing and deploying items. The medical supplies and pharmaceuticals will be destowed, handled, and restowed. The in-flight test procedures and other aspects of the KC-135 parabolic flight test to simulate weightlessness are presented. Author

**N91-32787\*#** Krug International, Houston, TX.  
**EVALUATION OF PROTOTYPE ADVANCED LIFE SUPPORT (ALS) PACK FOR USE BY THE HEALTH MAINTENANCE FACILITY (HMF) ON SPACE STATION FREEDOM (SSF)**  
DEBRA T. KRUPA, JOHN GOSBEE, LINDA MURPHY, and VICTOR D. KIZZEE /n NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 131-143 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 05/8

The purpose is to evaluate the prototype Advanced Life Support (ALS) Pack which was developed for the Health Maintenance Facility (HMF). This pack will enable the Crew Medical Officer (CMO) to have ready access to advanced life support supplies and equipment for time critical responses to any situation within the Space Station Freedom. The objectives are: (1) to evaluate the design of the pack; and (2) to collect comments for revision to the design of the pack. The in-flight test procedures and other aspects of the KC-135 parabolic test flight to simulate weightlessness are presented. Author

**N91-32791\*#** Krug International, Houston, TX.  
**EVALUATION OF PROTOTYPE AIR/FLUID SEPARATOR FOR SPACE STATION FREEDOM HEALTH MAINTENANCE FACILITY**

ROGER BILLICA, MAUREEN SMITH, LINDA MURPHY, and VICTOR D. KIZZEE /n NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 193-203 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 05/8

A prototype air/fluid separator suction apparatus proposed as a possible design for use with the Health Maintenance Facility aboard Space Station Freedom (SSF) was evaluated. A KC-135 parabolic flight test was performed for this purpose. The flights followed the standard 40 parabola profile with 20 to 25 seconds of near-zero gravity in each parabola. A protocol was prepared to evaluate the prototype device in several regulator modes (or suction force), using three fluids of varying viscosity, and using either continuous or intermittent suction. It was felt that a matrixed approach would best approximate the range of utilization anticipated for medical suction on SSF. The protocols were performed in one-gravity in a lab setting to familiarize the team with procedures and techniques. Identical steps were performed aboard the KC-135 during parabolic flight. Author

**N91-32792\*#** Eastman Kodak Co., Rochester, NY.  
**PRECISION METERING OF MICROLITER VOLUMES OF BIOLOGICAL FLUIDS IN MICRO-GRAVITY**  
RICHARD L. COLUMBUS, HARVEY J. PALMER, B. A. MCKINLEY, WILLIAM T. NORFLEET, and VICTOR D. KIZZEE (Krug Life Sciences, Inc., Houston, TX.) /n NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 205-211 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 05/8

Concepts were demonstrated and investigated for transferring accurately known and reproducible microliter volumes of biological fluids from sample container onto dry chemistry slides in microgravity environment. Specific liquid transfer tip designs were compared. Information was obtained for design of a liquid sample handling system to enable clinical chemical analysis in microgravity. Disposable pipet tips and pipet devices that were designed to transfer microliter volumes of biological fluid from a (test tube) sample container in 1-G environment were used during microgravity periods of parabolic trajectories of the KC-135 aircraft. The transfer process was recorded using charge coupled device camera and video cassette equipment. Metering behavior of water, a synthetic

aqueous protein solution, and anticoagulated human blood was compared. Transfer of these liquids to 2 substrate materials representative of rapidly wettable and slowly wettable dry chemistry slide surface was compared. Author

**N91-32793\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

### **SHUTTLE ORBITER MEDICAL SYSTEM EQUIPMENT/SUPPLIES EVALUATION**

KRISTIN MAIDLOW, JOHN M. SCHULZ, CHARLES W. LLOYD, and TIFFANY BREEDING (Krug International, Houston, TX.) /n *its* Medical Evaluations on the KC-135 1990 Flight Report Summary p 213-236 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 05/8

The effectivity was evaluated in zero gravity of several medical equipment and supply items flown in the Shuttle Orbiter Medical System (SOMS). Several procedures listed in Medical Operations Medical Checklist, JSC 1732 were also evaluated. Several items were drawn out of the kits and tested on the KC-135. In two different flights, the following elements were examined: (1) measuring IV flow (drip chamber, one way flow valve, and air/fluid-separator); (2) chemstrip protocol for urine analysis in zero-gravity; and (3) tamper resistant seals for injectable medications. Author

**N91-32794\*#** Georgetown Univ., Washington, DC.  
**DEPLOYMENT AND TESTING OF A SECOND PROTOTYPE EXPANDABLE SURGICAL CHAMBER IN MICROGRAVITY**

SANFORD M. MARKHAM and JOHN A. ROCK (Johns Hopkins Univ., Baltimore, MD.) /n NASA. Lyndon B. Johnson Space Center, Medical Evaluations on the KC-135 1990 Flight Report Summary p 237-239 Sep. 1991

Avail: NTIS HC/MF A11 CSCL 05/8

During microgravity exposure, two separate expandable surgical chambers were tested. Both chambers had been modified to fit the microgravity work station without extending over the sides of the table. Both chambers were attached to a portable laminar flow generator which served two purposes: to keep the chambers expanded during use; and to provide an operative area environment free of contamination. During the tests, the chambers were placed on various parts of a total body moulage to simulate management of several types of trauma. The tests consisted of cleansing contusions, debridement of burns, and suturing of lacerations. Also, indigo carmine dye was deliberately injected into the chamber during the tests to determine the ease of cleansing the chamber walls after contamination by escaping fluids. Upon completion of the tests, the expandable surgical chambers were deflated, folded, and placed in a flattened state back into their original containers for storage and later disposal. Results are briefly discussed. Author

**N91-32795\*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

### **ROTATIONALLY ACTUATED PROSTHETIC HELPING HAND Patent**

WILLIAM E. NORTON, inventor (to NASA), JEWELL G. BELCHER, JR., inventor (to NASA), JAMES R. CARDEN, inventor (to NASA), and THOMAS W. WEST, inventor (to NASA) 4 Jun. 1991 10 p Filed 12 Apr. 1990 Supersedes N90-27261 (28 - 21, p 3036)

(NASA-CASE-MFS-28426-1; US-PATENT-5,021,065;

US-PATENT-APPL-SN-508154; US-PATENT-CLASS-623-63;

US-PATENT-CLASS-623-62; INT-PATENT-CLASS-A61F-2/58;

INT-PATENT-CLASS-A61F-2/68) Avail: US Patent and

Trademark Office CSCL 06/11

A prosthetic device has been developed for below-the-elbow amputees. The device consists of a cuff, a stem, a housing, two hook-like fingers, an elastic band for holding the fingers together, and a brace. The fingers are pivotally mounted on a housing that is secured to the amputee's upper arm with the brace. The stem, which also contains a cam, is rotationally mounted within the housing and is secured to the cuff, which fits over the amputee's stump. By rotating the cammed stem between the fingers with

the lower arm, the amputee can open and close the fingers.  
Official Gazette of the U.S. Patent and Trademark Office

55

## SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

**A91-53951\*** Cornell Univ., Ithaca, NY.  
**ELECTRICAL ENERGY SOURCES FOR ORGANIC SYNTHESIS ON THE EARLY EARTH**

CHRISTOPHER CHYBA and CARL SAGAN (Cornell University, Ithaca, NY) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 1, 1991, p. 3-17. Research supported by Kenneth T. and Eileen L. Norris Foundation. refs  
(Contract NGT-50302)

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It is pointed out that much of the contemporary origin-of-life research uses the original estimates of Miller and Urey (1959) for terrestrial energy dissipation by lightning and coronal discharges being equal to  $2 \times 10$  to the 19th J/yr and  $6 \times 10$  to the 19th J/yr, respectively. However, data from experiments that provide analogues to naturally-occurring lightning and coronal discharges indicate that lightning energy yields for organic synthesis (nmole/J) are about one order of magnitude higher than the coronal discharge yields. This suggests that, on early earth, organic production by lightning may have dominated that due to coronal emission. New values are recommended for lightning and coronal discharge dissipation rates on the early earth,  $1 \times 10$  to the 18th J/yr and  $5 \times 10$  to the 17th J/yr, respectively. I.S.

**A91-53952\*** California Univ., Los Angeles.  
**A NOTE ON THE PREBIOTIC SYNTHESIS OF ORGANIC ACIDS IN CARBONACEOUS METEORITES**

JOHN F. KERRIDGE (California, University, Los Angeles) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 1, 1991, p. 19-29. Research supported by NASA. refs

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Strong similarities between monocarboxylic and hydrocarboxylic acids in the Murchison meteorite suggest corresponding similarities in their origins. However, various lines of evidence apparently implicate quite different precursor compounds in the synthesis of the different acids. These seeming inconsistencies can be resolved by postulating that the apparent precursors also share a related origin. Pervasive D enrichment indicates that this origin was in a presolar molecular cloud. The organic acids themselves were probably synthesized in an aqueous environment on an asteroidal parent body, the hydroxy (and amino) acids by means of the Strecker cyanohydrin reaction. Author

**A91-53953**  
**PROTEINOID MICROSPHERES AND THE PROCESS OF PREBIOLOGICAL PHOTOPHOSPHORYLATION**

M. P. KOLESNIKOV (AN SSSR, Institut Biokhimii, Moscow, USSR) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 1, 1991, p. 31-37. refs

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A chemical model of prebiological photophosphorylation with participation of hemoproteinoid microspheres, mixed microspheres containing bonded riboflavin and microspheres obtained from glycine rich proteinoids was studied. The illumination of aqueous solutions containing microspheres,  $K_2HPO_4$ , ADP and electron acceptor leads to an increase of ATP concentration and to a decrease of concentration of inorganic phosphate. Initial photochemical reactions with participations of proteinoid microspheres could have evolved in the course of chemical evolution and led to the emergence of the photophosphorylation in its modern biochemical form. Author

**A91-53954**

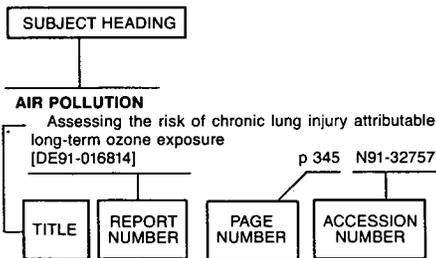
**EXPERIMENTAL AND COMPUTATIONAL STUDY OF THE RADIATION-INDUCED DECOMPOSITION OF FORMALDEHYDE - IMPLICATIONS TO COMETARY NUCLEI**

RAFAEL NAVARRO-GONZALEZ, SUSANA CASTILLO-ROJAS, and ALICIA NEGRON-MENDOZA (Universidad Nacional Autonoma de Mexico, Coyoacan, Mexico) *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149), vol. 21, no. 1, 1991, p. 39-49. refs

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The radiation-induced decomposition of aqueous solutions of formaldehyde was studied at 298 and 77 K in order to obtain an insight into the possible role of ionizing radiation on cometary chemistry. Aqueous solutions of 1.0 mol/cu dm formaldehyde were exposed to gamma-radiation in the dose range from 0.01 to 1.2 MGy. The radiation chemical yield of decomposition of formaldehyde was determined to be:  $26.3 \pm 1.2$  at 298 K and G equal to or less than 0.48 at 77 K. Based on previous estimates of the total dose of ionizing radiation that comets have accumulated over 4.6 billion years, a radiation-induced depletion of formaldehyde is predicted as a function of depth in comet nuclei: 100 percent destruction in the outer layers (0-20 m) and about 10 percent destruction in the interior layers. Author

### 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, a title extension is added, separated from the title by three hyphens. The 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.

## A

- AIR POLLUTION**  
Assessing the risk of chronic lung injury attributable long-term ozone exposure [DE91-016814] p 345 N91-32757
- ABILITIES**  
Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401  
Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773
- ABSORPTION**  
Fluid handling 2: Surgical applications p 349 N91-32790
- ACCELERATION STRESSES (PHYSIOLOGY)**  
Techniques to enhance safety in acceleration research and fighter aircrew training p 339 A91-53898  
Neck and body loads - 'All the data is needed' p 339 A91-54296  
The resonance hypothesis of motion sickness on the ground p 340 A91-55300  
The G-LOC syndrome [AD-A239561] p 344 N91-31768
- ACCELERATION TOLERANCE**  
Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809
- ACTIVATION (BIOLOGY)**  
Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748
- ACTIVITY (BIOLOGY)**  
Electron microscopy to correlate cell structures and biochemical activity [AD-A239640] p 336 N91-31758
- ADAPTATION**  
Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401
- ADAPTIVE CONTROL**  
Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808
- AEROSOLS**  
Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783
- AEROSPACE MEDICINE**  
A comparison of the routine medical examination of pilots in 12 air forces p 342 A91-55342  
Aerospace medicine and biology: A continuing bibliography with indexes (supplement 353) [NASA-SP-7011(353)] p 342 N91-31760  
Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754  
Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759  
Signs and symptoms of motion sickness and its basic nature p 346 N91-32760  
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761  
Physical characteristics of stimuli provoking motion sickness p 346 N91-32762  
Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763  
Simulator sickness p 347 N91-32765  
Sea sickness p 347 N91-32766  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767  
Assessment of drug effectiveness p 347 N91-32768  
Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Dental equipment test during zero-gravity flight p 348 N91-32778  
Mini-rack testbed evaluation p 361 N91-32779  
ATLS: Catheter and tube placement p 348 N91-32782  
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785  
Minor surgery in microgravity p 349 N91-32786  
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788  
Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794
- AGRICULTURE**  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- AIR POLLUTION**  
Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] p 345 N91-32757
- AIRBORNE/SPACEBORNE COMPUTERS**  
Crew interface design for a flight deck electronic library system p 354 A91-54647
- AIRCRAFT ACCIDENTS**  
Burn injuries from small airplane crashes p 341 A91-55340  
Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804
- AIRCRAFT INSTRUMENTS**  
Advanced Crew Station Integration Cockpit p 354 A91-54662
- AIRCRAFT MANEUVERS**  
The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336
- AIRCRAFT PILOTS**  
Markers for development of hypertension in commercial flight aviators p 339 A91-53893  
Heat stress on helicopter pilots during ground standby p 339 A91-53896  
Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897
- Neck and body loads - 'All the data is needed' p 339 A91-54296  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331  
Airline pilot incapacitation survey p 341 A91-55337  
A comparison of the routine medical examination of pilots in 12 air forces p 342 A91-55342  
The EEG in pilot selection p 342 A91-55343  
Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809  
Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754
- AIRLINE OPERATIONS**  
Airline pilot incapacitation survey p 341 A91-55337
- AIRPORTS**  
Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772
- ALGAE**  
Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787
- ALUMINUM SILICATES**  
Solid-support substrates for plant growth at a lunar base p 359 N91-31800
- AMBIENT TEMPERATURE**  
Heat stress on helicopter pilots during ground standby p 339 A91-53896
- ANALOG TO DIGITAL CONVERTERS**  
Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900
- ANALOGS**  
Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775
- ANEMIAS**  
Sickle cell anemia trait in the military aircrew population - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, ASMA p 342 A91-55344
- ANIMALS**  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770
- ANTHROPOMETRY**  
An ellipsoidal representation of human hand anthropometry p 353 A91-54165  
Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801  
Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775
- ANTIGRAVITY**  
The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336
- APPROACH CONTROL**  
Explicit and implicit horizons for simulated landing approaches p 353 A91-54164
- AQUICULTURE**  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- ARM (ANATOMY)**  
Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795
- ARTERIES**  
Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767
- ARTIFICIAL INTELLIGENCE**  
Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808
- ASBESTOS**  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770

SUBJECT

**ASPERGILLUS**

Use of inedible wheat residues from the KSC-CELSS  
breadboard facility for production of fungal cellulase  
p 357 N91-31785

**ASSIMILATION**

Efficiency of N use by wheat as a function of influx and  
efflux of NO<sub>3</sub> p 356 N91-31778

**ASTRONAUTS**

Psychiatric diagnoses in a group of astronaut  
applicants p 349 A91-53894  
Publications and presentations of the Ophthalmology  
Branch, USAF School of Aerospace Medicine,  
1981-1990  
[AD-A239458] p 345 N91-32754

**ATOMIC STRUCTURE**

The role of spin chemistry in the primary events of  
photosynthesis  
[DE91-017301] p 337 N91-32752

**AUTOMATIC CONTROL**

Adaptive function allocation for intelligent cockpits  
[AD-A239714] p 360 N91-31808

**AUTOMATIC FLIGHT CONTROL**

Human factors engineering - An integral part of the flight  
deck design process  
[AIAA PAPER 91-3089] p 352 A91-54018

**AUTONOMOUS NAVIGATION**

An analysis of the crew's role in a highly automated  
space station crew reentry vehicle p 354 A91-54640

**AVIONICS**

Crew interface design for a flight deck electronic library  
system p 354 A91-54647  
Advanced Crew Station Integration Cockpit  
p 354 A91-54662

**B****BACTERIA**

Cyanobacteria in CELSS: Growth strategies for  
nutritional variation and nitrogen cycling  
p 357 N91-31786

Algae for controlled ecological life support system diet  
characterization of cyanobacteria 'spirulina' in batch  
cultures p 357 N91-31787

**BARLEY**

Barley yield under continuous exposure to increased  
levels of UV radiation during growth p 334 A91-55288

The effect of natural UV radiation on the growth and  
activity of endogenous growth regulators in barley  
leaves p 335 A91-55291

**BARORECEPTORS**

Carotid baroreceptor influence on forearm vascular  
resistance during low level lower body negative pressure  
p 338 A91-53886

Cardiopulmonary baroreflex control of forearm vascular  
resistance after acute blood volume expansion  
p 338 A91-53888

**BAROTRAUMA**

Decompression sickness - USN operational experience  
1969-1989 p 339 A91-53899

The medical hazards of flame-suppressant  
atmospheres  
[AD-A239618] p 360 N91-31806

**BIBLIOGRAPHIES**

Aerospace medicine and biology: A continuing  
bibliography with indexes (supplement 353)  
[NASA-SP-7011(353)] p 342 N91-31760

Scientific workshop on the Health Effects of  
Electromagnetic Radiation on Workers: Bibliography  
[PB91-173351] p 345 N91-32755

**BINARY DIGITS**

Full-information item bi-factor analysis  
[AD-A229346] p 350 N91-31771

**BIOASSAY**

The relevance of animal bioassays to assess human  
health hazards to inorganic fibrous materials  
[DE91-017516] p 348 N91-32770

**BIOASTRONAUTICS**

Aerospace medicine and biology: A continuing  
bibliography with indexes (supplement 353)  
[NASA-SP-7011(353)] p 342 N91-31760

ATLS-stowage and deployment testing of medical  
supplies and pharmaceuticals p 361 N91-32785

Minor surgery in microgravity p 349 N91-32786

Evaluation of prototype Advanced Life Support (ALS)  
pack for use by the Health Maintenance Facility (HMF)  
on Space Station Freedom (SSF) p 362 N91-32787

Venipuncture and intravenous infusion access during  
zero-gravity flight p 349 N91-32788

**BIOCHEMISTRY**

Proteinoid microspheres and the process of  
prebiological photophosphorylation p 363 A91-53953

Pyrimidine dimer formation by UVA radiation:  
Implications for photoreactivation  
[DE91-015837] p 336 N91-31756

Electron microscopy to correlate cell structures and  
biochemical activity  
[AD-A239640] p 336 N91-31758

**BIOCONVERSION**

Biomass production and nitrogen dynamics in an  
integrated aquaculture/agriculture system  
p 358 N91-31789

**BIODYNAMICS**

An ellipsoidal representation of human hand  
anthropometry p 353 A91-54165

Neck and body loads - 'All the data is needed'  
p 339 A91-54296

Use of composite materials to develop a test manikin  
with improved inertial properties p 353 A91-54298

Rotationally actuated prosthetic helping hand  
[NASA-CASE-MFS-28426-1] p 362 N91-32795

**BIOLOGICAL EFFECTS**

Biomedical effects of natural UV radiation - Global  
consequences of the ozone layer destruction  
p 333 A91-55283

The effect of UV radiation on the sensory and nociceptive  
skin sensitivity in nude mice p 334 A91-55284

The effect of a single irradiation with supererythema  
doses of UV radiation on the general resistance of nude  
mice p 334 A91-55285

Barley yield under continuous exposure to increased  
levels of UV radiation during growth p 334 A91-55288

The effect of chronic irradiation by UV-B light on the  
growth, development, and productivity of fodder beet  
p 334 A91-55289

The effect of natural UV radiation on the growth and  
activity of endogenous growth regulators in barley  
leaves p 335 A91-55291

The effect of increased levels of chronic irradiation by  
natural UV-B light on the functional status of the sheep  
organism p 335 A91-55292

Disorders in the regulation of active oxygen forms and  
of lipid peroxidation in the skin and liver of rats following  
irradiation by UV-B light p 335 A91-55293

The electroretinographic parameters and the state of  
the cornea in the rabbit eye after an acute exposure of  
the eye to UV radiation of various intensities  
p 335 A91-55294

Parameters of the optokinetic reaction of the rabbit after  
an acute irradiation of the eyes with UV radiation  
p 335 A91-55295

Pyrimidine dimer formation by UVA radiation:  
Implications for photoreactivation  
[DE91-015837] p 336 N91-31756

Aerospace medicine and biology: A continuing  
bibliography with indexes (supplement 353)  
[NASA-SP-7011(353)] p 342 N91-31760

Biophysical and biomathematical adventures in  
radiobiology  
[DE91-017484] p 337 N91-32750

Interaction of extremely-low-frequency electromagnetic  
fields with humans  
[DE91-015779] p 345 N91-32756

Simulator sickness p 347 N91-32765

**BIOLOGICAL EVOLUTION**

Electrical energy sources for organic synthesis on the  
early earth p 363 A91-53951

A note on the prebiotic synthesis of organic acids in  
carbonaceous meteorites p 363 A91-53952

Proteinoid microspheres and the process of  
prebiological photophosphorylation p 363 A91-53953

**BIOLOGICAL MODELS (MATHEMATICS)**

An ellipsoidal representation of human hand  
anthropometry p 353 A91-54165

Biophysical and biomathematical adventures in  
radiobiology  
[DE91-017484] p 337 N91-32750

**BIOMASS**

Controlled Ecological Life Support Systems: CELSS '89  
Workshop  
[NASA-TM-102277] p 356 N91-31775

Environmental and cultural considerations for growth of  
potatoes in CELSS p 337 N91-31779

Sweet potato for closed ecological life support systems  
using the nutrient film technique p 356 N91-31782

Use of inedible wheat residues from the KSC-CELSS  
breadboard facility for production of fungal cellulase  
p 357 N91-31785

Biomass production and nitrogen dynamics in an  
integrated aquaculture/agriculture system  
p 358 N91-31789

Controlled ecological life support system breadboard  
project, 1988 p 358 N91-31791

Transpiration during life cycle in controlled wheat  
growth p 358 N91-31795

**BIOMASS ENERGY PRODUCTION**

Biomass production and nitrogen dynamics in an  
integrated aquaculture/agriculture system  
p 358 N91-31789

**BIOPHYSICS**

Biophysical and genetic aspects of light-potentiated  
gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

Biophysical and biomathematical adventures in  
radiobiology  
[DE91-017484] p 337 N91-32750

**BLACKOUT**

Aircrew critique of high-G centrifuge training. Part 1:  
What was the best part of the program?  
[AD-A239781] p 361 N91-31809

**BLACKOUT (PHYSIOLOGY)**

The G-LOC syndrome  
[AD-A239561] p 344 N91-31768

**BLINKING**

The use of cardiac and eye blink measures to determine  
flight segment in F4 crews p 338 A91-53892

**BLOOD**

Basic operation and preliminary trials of a detector for  
stationary gas bubbles  
[AD-A239710] p 344 N91-31769

Operation and performance of the Ciba-Corning 512  
coagulation monitor during parabolic flight  
p 348 N91-32780

**BLOOD CELLS**

Sickle cell anemia trait in the military aircrew population  
- A report from the Military Aviation Safety Subcommittee  
of the Aviation Safety Committee, AsMA  
p 342 A91-55344

**BLOOD FLOW**

The G-LOC syndrome  
[AD-A239561] p 344 N91-31768

Operation and performance of the Ciba-Corning 512  
coagulation monitor during parabolic flight  
p 348 N91-32780

Fluid handling 2: Surgical applications  
p 349 N91-32790

**BLOOD PLASMA**

Pineal physiology in microgravity - Relation to rat gonadal  
function aboard Cosmos 1887 p 333 A91-53891

Increased plasma hypoxanthine values in humans during  
exposure to simulated altitude of 7,620 meters (25,000  
feet) p 341 A91-55333

**BLOOD PRESSURE**

Cardiopulmonary baroreflex control of forearm vascular  
resistance after acute blood volume expansion  
p 338 A91-53888

Markers for development of hypertension in commercial  
flight aviators p 339 A91-53893

The characteristics and theoretical basis of the Cigong  
maneuver p 355 A91-55336

Predicting adaptation potentials in military personnel with  
different constitutional types p 342 A91-55401

**BLOOD VOLUME**

Cardiopulmonary baroreflex control of forearm vascular  
resistance after acute blood volume expansion  
p 338 A91-53888

Cerebrospinal fluid pressure in conscious head-down  
tilted rats p 333 A91-53889

**BLUE GREEN ALGAE**

Cyanobacteria in CELSS: Growth strategies for  
nutritional variation and nitrogen cycling  
p 357 N91-31786

**BODY FLUIDS**

Mechanism of postflight decline in osmotic concentration  
of urine in cosmonauts p 341 A91-55332

**BORON**

Boron in nuclear medicine: New synthetic approaches  
to PET, SPECT, and BNCT agents  
[DE91-016488] p 343 N91-31764

**BRADYCARDIA**

Techniques to enhance safety in acceleration research  
and fighter aircrew training p 339 A91-53898

**BRAIN**

Muramyl peptide-enhanced sleep: Pharmacological  
optimization of performance  
[AD-A239442] p 343 N91-31766

**BRAIN CIRCULATION**

The effect of apomorphine on operant behavior in rats  
under normoxic and hypoxic conditions  
p 335 A91-55334

**BREATHING APPARATUS**

Breathing equipment dynamic requirements  
p 353 A91-54297

**BREEDING (REPRODUCTION)**

Cloning crops in a CELSS via tissue culture: Prospects  
and problems p 356 N91-31783

**BUBBLES**

Doppler detection of decompression bubbles with  
computer assisted digitization of ultrasonic signals  
p 333 A91-53900

Basic operation and preliminary trials of a detector for  
stationary gas bubbles  
[AD-A239710] p 344 N91-31769

**BURNS (INJURIES)**

- Burn injuries from small airplane crashes  
p 341 A91-55340

**C****C-135 AIRCRAFT**

- Medical evaluations on the KC-135 1990 flight report summary  
[NASA-TM-104740] p 361 N91-32776  
Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Mini-rack testbed evaluation p 361 N91-32779

**CANADIAN SPACE PROGRAM**

- MSS collision detection --- on Space Station Freedom p 355 A91-56821

**CAPILLARY FLOW**

- Technology for subsystems of space-based plant growth facilities p 359 N91-31799

**CARBOHYDRATES**

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

- Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787

**CARBON DIOXIDE**

- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027

**CARBON DIOXIDE CONCENTRATION**

- Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

**CARBON DIOXIDE REMOVAL**

- Method and apparatus for bio-regenerative life support system [NASA-CASE-MSC-21629-1] p 360 N91-31803

**CARBOXYLIC ACIDS**

- A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952

**CARCINOGENS**

- Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763  
Biophysical and biomathematical adventures in radiobiology [DE91-017484] p 337 N91-32750  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770

**CARDIAC OUTPUT**

- The use of cardiac and eye blink measures to determine flight segment in F4 crews p 338 A91-53892

**CARDIAC VENTRICLES**

- Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890

**CARDIOVASCULAR SYSTEM**

- Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888

- Markers for development of hypertension in commercial flight aviators p 339 A91-53893

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

- Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769

- Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

**CAROTID SINUS REFLEX**

- Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886

**CATECHOLAMINE**

- The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

**CATHETERIZATION**

- ATLS: Catheter and tube placement p 348 N91-32782

- Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788

**CATIONS**

- Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**CELLULOSE**

- The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784

- Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785

**CENTRAL NERVOUS SYSTEM**

- Techniques to enhance safety in acceleration research and fighter aircrew training p 339 A91-53898

- The G-LOC syndrome [AD-A239561] p 344 N91-31768

**CENTRIFUGAL FORCE**

- Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809

**CEREBROSPINAL FLUID**

- Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889

**CHEMICAL ANALYSIS**

- Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

**CHEMICAL EVOLUTION**

- Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953

**CHLOROPHYLLS**

- Particulate models of photosynthesis [DE91-016842] p 337 N91-32751

- The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

**CIRCADIAN RHYTHMS**

- Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

**CIVIL AVIATION**

- Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804

**CLOSED ECOLOGICAL SYSTEMS**

- Man in space - A European challenge in biological life support p 352 A91-54141

- Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775

- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

- Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778

- Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779

- Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

- Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

- Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

- The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784

- Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

- Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787

- Preliminary evaluation of waste processing in a CELSS p 357 N91-31788

- Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789

- Controlled ecological life support system breadboard project, 1988 p 358 N91-31791

- The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792

- Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793

- A perspective on CELSS control issues p 358 N91-31794

- Preparatory space experiments for development of a CELSS p 359 N91-31796

- Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798

- Method and apparatus for bio-regenerative life support system [NASA-CASE-MSC-21629-1] p 360 N91-31803

**CLOTING**

- Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

**COAGULATION**

- Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

**COCKPIT SIMULATORS**

- Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163

**COCKPITS**

- Heat stress on helicopter pilots during ground standby p 339 A91-53896

- Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804

- Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808

**CODING**

- Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771

- Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773

**COGNITION**

- Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773

- Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms [DE91-017245] p 352 N91-32774

**COGNITIVE PSYCHOLOGY**

- Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339

- Situational awareness is more than exceptional vision p 350 A91-55341

- Examining the effect of information order on expert judgment [AD-A239708] p 351 N91-31774

- Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771

**COLLISION AVOIDANCE**

- A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

- MSS collision detection --- on Space Station Freedom p 355 A91-56821

**COMBAT**

- Situational awareness is more than exceptional vision p 350 A91-55341

**COMET NUCLEI**

- Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**COMMERCIAL AIRCRAFT**

- Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808

**COMMUNICATION THEORY**

- Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771

**COMPLEX SYSTEMS**

- Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms [DE91-017245] p 352 N91-32774

**COMPOSITE MATERIALS**

- Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298

**COMPRESSED AIR**

- The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

**COMPUTER AIDED DESIGN**

- Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775

**COMPUTER AIDED TOMOGRAPHY**

- Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764

**COMPUTER PROGRAMS**

- Human factors engineering design guidelines for the software user interface [DE91-016061] p 359 N91-31802

**COMPUTER TECHNIQUES**

- Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900

- Human factors engineering design guidelines for the software user interface [DE91-016061] p 359 N91-31802

- Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808

**COMPUTERIZED SIMULATION**

- Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793

Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775

**CONFERENCE'S**  
Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775

**CONSUMABLES (SPACECRAFT)**  
Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790

**CONTACT LENSES**  
Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754

**CONTAINMENT**  
Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Dental equipment test during zero-gravity flight p 348 N91-32778

**CONTAMINATION**  
Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755  
Garment selection for cleanrooms and controlled environments for spacecraft [AD-A239512] p 360 N91-31805  
Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794

**CONTRACTION**  
Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

**CONTRAST**  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331

**CONTROL THEORY**  
A perspective on CELSS control issues p 358 N91-31794

**CONTROLLED ATMOSPHERES**  
The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792  
Garment selection for cleanrooms and controlled environments for spacecraft [AD-A239512] p 360 N91-31805

**CORN**  
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root [DE91-016255] p 337 N91-32749

**CORNEA**  
The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294

**COSMONAUTS**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332

**COVERALLS**  
Garment selection for cleanrooms and controlled environments for spacecraft [AD-A239512] p 360 N91-31805

**CRASHES**  
Burn injuries from small airplane crashes p 341 A91-55340

**CREW PROCEDURES (INFLIGHT)**  
An analysis of the crew's role in a highly automated space station crew reentry vehicle p 354 A91-54640

**CREW WORKSTATIONS**  
Advanced Crew Station Integration Cockpit p 354 A91-54662

**CROP GROWTH**  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287  
Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778  
The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792  
A perspective on CELSS control issues p 358 N91-31794

**CULTIVATION**  
Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**CULTURE TECHNIQUES**  
Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775  
Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779  
Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

CYBERNETICS

Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771

**CYCLES**  
Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

**CYCLIC AMP**  
Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890

D

**DATA BASES**  
Crew interface design for a flight deck electronic library system p 354 A91-54647  
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] p 345 N91-32755

**DATA MANAGEMENT**  
Crew interface design for a flight deck electronic library system p 354 A91-54647

**DECISION MAKING**  
Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772

**DECOMPOSITION**  
Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**DECOMPRESSION SICKNESS**  
Decompression sickness - USN operational experience 1969-1989 p 339 A91-53899  
Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900  
Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769

**DENTISTRY**  
Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Dental equipment test during zero-gravity flight p 348 N91-32778

**DEOXYRIBONUCLEIC ACID**  
Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748

**DEPLOYMENT**  
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785  
Minor surgery in microgravity p 349 N91-32786

**DERMATITIS**  
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758

**DESIGN ANALYSIS**  
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

**DIETS**  
Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777  
Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786  
Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787

**DIMERS**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756

**DISORIENTATION**  
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761.

**DISPLAY DEVICES**  
Explicit and implicit horizons for simulated landing approaches p 353 A91-54164  
Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166

**DOSAGE**  
Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763

**DOSIMETERS**  
Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763

Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756

**DRUGS**  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767  
Assessment of drug effectiveness p 347 N91-32768  
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785

**DUMMIES**  
Neck and body loads - 'All the data is needed' p 339 A91-54296  
Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298  
Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

**DYNAMIC LOADS**  
Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298

**E**

**EARTH (PLANET)**  
Electrical energy sources for organic synthesis on the early earth p 363 A91-53951

**ECONOMICS**  
Management of acute and chronic motion sickness p 347 N91-32769

**ECOSYSTEMS**  
Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775

**EDUCATION**  
Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764  
Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773

**EFFLUX**  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778

**EJECTION INJURIES**  
Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298

**ELECTRIC POTENTIAL**  
Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

**ELECTRICAL IMPEDANCE**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885

**ELECTROCARDIOGRAPHY**  
Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions [ETN-91-99973] p 342 N91-31761  
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621

**ELECTROENCEPHALOGRAPHY**  
The EEG in pilot selection p 342 A91-55343

**ELECTROMAGNETIC FIELDS**  
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] p 345 N91-32755  
Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756

**ELECTROMAGNETIC RADIATION**  
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] p 345 N91-32755

**ELECTRON MICROSCOPY**  
Electron microscopy to correlate cell structures and biochemical activity [AD-A239640] p 336 N91-31758

**ELECTRON SPIN**  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

**ELECTRON TRANSFER**  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

**ELECTRORETINOGRAPHY**  
The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294

**EMBRYOLOGY**  
Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

**END EFFECTORS**

- Dynamics and control of robotic systems worn by humans p 354 A91-54874  
 NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839  
 MSS collision detection --- on Space Station Freedom p 355 A91-56821

**ENDOCRINE SECRETIONS**

- Trans-thoracic fluid shifts and endocrine responses to 6-gd head-down tilt p 338 A91-53885

**ENERGY CONVERSION**

- Particulate models of photosynthesis [DE91-016842] p 337 N91-32751

**ENERGY DISSIPATION**

- Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778

**ENERGY SOURCES**

- Electrical energy sources for organic synthesis on the early earth p 363 A91-53951

**ENRICHMENT**

- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

**ENZYMES**

- Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785

**EPIDEMIOLOGY**

- Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756

**ERRORS**

- Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804

**ETIOLOGY**

- Extent and etiology of aeromedical duty restrictions at a U.S. Coast Guard Air Station p 350 A91-53895  
 Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897

**EVACUATING (TRANSPORTATION)**

- Testing and evaluation of the catalyst research MiniOX, 3 oxygen monitor [AD-A239665] p 360 N91-31807

**EXAMINATION**

- A comparison of the routine medical examination of pilots in 12 air forces p 342 A91-55342

**EXERCISE PHYSIOLOGY**

- The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757

**EXOBIOLOGY**

- Lower body negative pressure to provide load bearing in space p 338 A91-53887  
 Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890  
 Aerospace medicine and biology: A continuing bibliography with indexes (supplement 353) [NASA-SP-7011(353)] p 342 N91-31760

**EXPANDABLE STRUCTURES**

- Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794

**EXPERT SYSTEMS**

- Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808

**EXPOSURE**

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767  
 Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756  
 Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] p 345 N91-32757

**EXTRAVEHICULAR ACTIVITY**

- Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826

**EXTREMELY LOW FREQUENCIES**

- Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756

**EYE (ANATOMY)**

- Skin and eye injuries caused by solar UV radiation p 340 A91-55297

**EYE EXAMINATIONS**

- The adequacy of corrective lenses worn by United States Air Force aviators for annual flight medical examinations p 341 A91-55338

**EYE MOVEMENTS**

- Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295

- Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

**EYE PROTECTION**

- The protection of the human eye and skin from solar UV radiation p 355 A91-55296

**F****FACTOR ANALYSIS**

- Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771

**FARM CROPS**

- Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783  
 Preparatory space experiments for development of a CELSS p 359 N91-31796

**FEEDBACK CONTROL**

- Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798

**FEEDERS**

- Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797  
 Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798  
 Technology for subsystems of space-based plant growth facilities p 359 N91-31799

**FEMALES**

- Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801

**FERMENTATION**

- The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784

**FIBERS**

- The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770

**FIBRILLATION**

- Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

**FIELD OF VIEW**

- Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

**FIGHTER AIRCRAFT**

- Breathing equipment dynamic requirements p 353 A91-54297

**FINGERS**

- Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795

**FISHES**

- Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789

**FLAME RETARDANTS**

- The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

**FLIGHT CREWS**

- Extent and etiology of aeromedical duty restrictions at a U.S. Coast Guard Air Station p 350 A91-53895  
 Decompression sickness - USN operational experience 1969-1989 p 339 A91-53899  
 Human factors engineering - An integral part of the flight deck design process [AIAA PAPER 91-3089] p 352 A91-54018  
 Breathing equipment dynamic requirements p 353 A91-54297  
 The adequacy of corrective lenses worn by United States Air Force aviators for annual flight medical examinations p 341 A91-55338  
 Sickle cell anemia trait in the military aircrew population - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, AsMA p 342 A91-55344

- Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801

- Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809

- Management of acute and chronic motion sickness p 347 N91-32769

- Aircrew part-task training research and development in the 1980s: Lessons learned [AD-A239456] p 352 N91-32773

**FLIGHT SAFETY**

- Sickle cell anemia trait in the military aircrew population - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, AsMA p 342 A91-55344

**FLIGHT SIMULATION**

- Advanced Crew Station Integration Cockpit p 354 A91-54662

**FLIGHT SIMULATORS**

- Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759  
 Simulator sickness p 347 N91-32765

**FLIGHT TESTS**

- Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
 Dental equipment test during zero-gravity flight p 348 N91-32778  
 Mini-rack testbed evaluation p 361 N91-32779  
 Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780  
 Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789  
 Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791  
 Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

**FOOD PRODUCTION (IN SPACE)**

- Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775  
 Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777  
 Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778  
 Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779  
 Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
 Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782  
 Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790  
 Controlled ecological life support system breadboard project, 1988 p 358 N91-31791  
 The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792  
 Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793  
 A perspective on CELSS control issues p 358 N91-31794  
 Transpiration during life cycle in controlled wheat growth p 358 N91-31795  
 Preparatory space experiments for development of a CELSS p 359 N91-31796  
 Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797  
 Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798  
 Technology for subsystems of space-based plant growth facilities p 359 N91-31799  
 Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**FOREARM**

- Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888

**FORECASTING**

- Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772

**FORMALDEHYDE**

- Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**FRUITS**

- Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

**FUNGAL DISEASES**

- The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758

**G****GARMENTS**

- Garment selection for cleanrooms and controlled environments for spacecraft [AD-A239512] p 360 N91-31805

## GAS DETECTORS

- Basic operation and preliminary trials of a detector for stationary gas bubbles  
[AD-A239710] p 344 N91-31769
- Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor  
[AD-A239665] p 360 N91-31807

## GAS EXCHANGE

- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour  
p 337 N91-32027

## GASTROINTESTINAL SYSTEM

- Airline pilot incapacitation survey p 341 A91-55337

## GENES

- Biophysical and genetic aspects of light-potentialized gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

## GENETICS

- Biophysical and genetic aspects of light-potentialized gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

## GERMINATION

- Preparatory space experiments for development of a CELSS p 359 N91-31796

## GLUCOSE

- The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat  
[AD-A239461] p 336 N91-31757

## GONADS

- Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891

## GRAINS (FOOD)

- Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

## GRAVITATIONAL EFFECTS

- Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783
- Fluid handling 2: Surgical applications p 349 N91-32790

## GRAVITROPISM

- Biophysical and genetic aspects of light-potentialized gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

## GREENHOUSES

- Method and apparatus for bio-regenerative life support system  
[NASA-CASE-MSC-21629-1] p 360 N91-31803

## GROUND BASED CONTROL

- Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms  
[DE91-017245] p 352 N91-32774

## GROUP DYNAMICS

- Scientific results from the ISEMSI experiment p 350 A91-54143

## GUNS (ORDNANCE)

- An investigation into the potential use of psychometric instruments for the selection of firearms officers  
[CRANFIELD-AERO-9108] p 351 N91-32772

## H

## HABITATS

- Method and apparatus for bio-regenerative life support system  
[NASA-CASE-MSC-21629-1] p 360 N91-31803

## HAND (ANATOMY)

- An ellipsoidal representation of human hand anthropometry p 353 A91-54165

## HAZARDS

- The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials  
[DE91-017516] p 348 N91-32770

## HEAD (ANATOMY)

- Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

## HEAD DOWN TILT

- Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889

## HEAD MOVEMENT

- Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330
- Space sickness p 347 N91-32764

## HEALTH

- The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting  
[DE91-017545] p 346 N91-32758

- The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials  
[DE91-017516] p 348 N91-32770
- Dental equipment test during zero-gravity flight p 348 N91-32778

## HEART FUNCTION

- Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions  
[ETN-91-99973] p 342 N91-31761

## HEART RATE

- The use of cardiac and eye blink measures to determine flight segment in F4 crews p 338 A91-53892
- Markers for development of hypertension in commercial flight aviators p 339 A91-53893
- Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329
- Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401
- The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621

## HEART VALVES

- Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890

## HELMET MOUNTED DISPLAYS

- Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

## HELMETS

- Neck and body loads - 'All the data is needed' p 339 A91-54296

## HEURISTIC METHODS

- Examining the effect of information order on expert judgment  
[AD-A239708] p 351 N91-31774

## HIGH GRAVITY ENVIRONMENTS

- Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897

## HISTAMINES

- Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335

## HOSPITALS

- Developments in medical audit in hospitals in the National Health Service  
[ETN-91-99984] p 343 N91-31762

## HUMAN BEHAVIOR

- Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms  
[DE91-017245] p 352 N91-32774

## HUMAN BODY

- Human analogue models for computer-aided design and engineering applications  
[AD-A229520] p 361 N91-32775

## HUMAN FACTORS ENGINEERING

- Flight deck automation - Strategies for use now and in the future  
[SAE PAPER 911197] p 352 A91-53597
- Human factors engineering - An integral part of the flight deck design process  
[AIAA PAPER 91-3089] p 352 A91-54018
- Human factors engineering design guidelines for the software user interface  
[DE91-016061] p 359 N91-31802
- Human analogue models for computer-aided design and engineering applications  
[AD-A229520] p 361 N91-32775

## HUMAN PATHOLOGY

- Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242

## HUMAN PERFORMANCE

- Scientific results from the ISEMSI experiment p 350 A91-54143
- Toward a movement dynamics perspective on dual-task performance p 350 A91-54162
- Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163
- Sleep logs: Measurement of individual and operational efficiency  
[AD-A239774] p 344 N91-31770
- Effects of stress on judgment and decision making in dynamic tasks  
[AD-A239452] p 351 N91-31772
- Examining the effect of information order on expert judgment  
[AD-A239708] p 351 N91-31774
- Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms  
[DE91-017245] p 352 N91-32774

## HYDROPONICS

- Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776
- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

- Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

- Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782
- Controlled ecological life support system breadboard project, 1988 p 358 N91-31791
- The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792

## HYPERTENSION

- Markers for development of hypertension in commercial flight aviators p 339 A91-53893

## HYPOTHERMIA

- Cold-induced changes in arterial sensitivity  
[AD-A239493] p 343 N91-31767

## HYPOXEMIA

- Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet) p 341 A91-55333

## HYPOXIA

- The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334

## IMAGE ANALYSIS

- Introduction to multiresolution morphology  
[IZF-1991-A-10] p 345 N91-32753

## IMAGE PROCESSING

- Introduction to multiresolution morphology  
[IZF-1991-A-10] p 345 N91-32753

## IMAGE RESOLUTION

- Introduction to multiresolution morphology  
[IZF-1991-A-10] p 345 N91-32753

## IMAGING TECHNIQUES

- Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science  
[DE91-015447] p 342 N91-31759
- Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents  
[DE91-016488] p 343 N91-31764
- Introduction to multiresolution morphology  
[IZF-1991-A-10] p 345 N91-32753

## IMMOBILIZATION

- Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781

## IMMUNE SYSTEMS

- Electron microscopy to correlate cell structures and biochemical activity  
[AD-A239640] p 336 N91-31758

## IMPEDANCE MEASUREMENT

- Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885

## IMPULSES

- Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

## INDEXES (DOCUMENTATION)

- Aerospace medicine and biology: A continuing bibliography with indexes (supplement 353)  
[NASA-SP-7011(353)] p 342 N91-31760

## INFECTIOUS DISEASES

- The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting  
[DE91-017545] p 346 N91-32758

## INFORMATION PROCESSING (BIOLOGY)

- Examining the effect of information order on expert judgment  
[AD-A239708] p 351 N91-31774

## INFORMATION RETRIEVAL

- Crew interface design for a flight deck electronic library system p 354 A91-54647

## INFORMATION SYSTEMS

- Developments in medical audit in hospitals in the National Health Service  
[ETN-91-99984] p 343 N91-31762

## INFORMATION THEORY

- Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771

## INHIBITORS

- Biophysical and genetic aspects of light-potentialized gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

## INJURIES

- The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621

- Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622
- Assessing the risk of chronic lung injury attributable to long-term ozone exposure  
[DE91-016814] p 345 N91-32757

**INSULIN**

The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat  
[AD-A239461] p 336 N91-31757

**INTEGRATED MISSION CONTROL CENTER**

Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms  
[DE91-017245] p 352 N91-32774

**INTERSTELLAR CHEMISTRY**

Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**INTRAVENOUS PROCEDURES**

Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788

**IRRADIANCE**

Preparatory space experiments for development of a CELSS p 359 N91-31796

**IRRADIATION**

Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283

The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284

The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285

The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292

**ISCHEMIA**

The G-LOC syndrome  
[AD-A239561] p 344 N91-31768

**ISOTOPES**

Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents  
[DE91-016488] p 343 N91-31764

**J****JAPANESE SPACECRAFT**

Study of Man-System for Japanese Experiment Module (JEM)  
[AAS PAPER 89-627] p 355 A91-55824

Dexterous manipulator system for Space Station and its future extension  
[AAS PAPER 89-629] p 355 A91-55826

**JET AIRCRAFT**

Visual contrast sensitivity of U.S. Navy jet pilots  
p 340 A91-55331

**JOINTS (JUNCTIONS)**

A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

**JUDGMENTS**

Effects of stress on judgment and decision making in dynamic tasks  
[AD-A239452] p 351 N91-31772

Examining the effect of information order on expert judgment  
[AD-A239708] p 351 N91-31774

**K****KNOWLEDGE**

Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3  
[AD-A239574] p 351 N91-31773

Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771

**L****LABYRINTH**

Assessment of drug effectiveness p 347 N91-32768

**LAMINAR FLOW**

Fluid handling 2: Surgical applications p 349 N91-32790

**LANDING SIMULATION**

Explicit and implicit horizons for simulated landing approaches p 353 A91-54164

**LASERS**

Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

**LEAF AREA INDEX**

Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776

**LEAVES**

Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780

**LENSES**

The adequacy of corrective lenses worn by United States Air Force aviators for annual flight medical examinations p 341 A91-55338

**LIFE SUPPORT SYSTEMS**

Man in space - A European challenge in biological life support p 352 A91-54141

Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780

The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792

Transpiration during life cycle in controlled wheat growth p 358 N91-31795

Method and apparatus for bio-regenerative life support system  
[NASA-CASE-MSC-21629-1] p 360 N91-31803

Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

**LIGHT AIRCRAFT**

Burn injuries from small airplane crashes p 341 A91-55340

**LIGHTNING**

The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621

Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

**LIMBS (ANATOMY)**

Toward a movement dynamics perspective on dual-task performance p 350 A91-54162

**LIPIDS**

Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293

Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

**LIQUIDS**

Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

**LIVER**

Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293

Neck and body loads - 'All the data is needed' p 339 A91-54296

**LOCOMOTION**

Signs and symptoms of motion sickness and its basic nature p 346 N91-32760

**LONG DURATION SPACE FLIGHT**

Scientific results from the ISEMSI experiment p 350 A91-54143

**LOW TEMPERATURE**

Naval medical research and development command  
[AD-A239393] p 343 N91-31765

**LOWER BODY NEGATIVE PRESSURE**

Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886

Lower body negative pressure to provide load bearing in space p 338 A91-53887

**LUNAR BASES**

Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**LUNAR SOIL**

Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**LUNGS**

Assessing the risk of chronic lung injury attributable to long-term ozone exposure  
[DE91-016814] p 345 N91-32757

**M****MAGNETIC RESONANCE**

The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752

**MAN MACHINE SYSTEMS**

Flight deck automation - Strategies for use now and in the future  
[SAE PAPER 911197] p 352 A91-53597

Human factors engineering - An integral part of the flight deck design process  
[AIAA PAPER 91-3089] p 352 A91-54018

Breathing equipment dynamic requirements p 353 A91-54297

Dynamics and control of robotic systems worn by humans p 354 A91-54874

Study of Man-System for Japanese Experiment Module (JEM)  
[AAS PAPER 89-627] p 355 A91-55824

**MAN-COMPUTER INTERFACE**

Crew interface design for a flight deck electronic library system p 354 A91-54647

Human factors engineering design guidelines for the software user interface  
[DE91-016061] p 359 N91-31802

**MANNED SPACE FLIGHT**

Man in space - A European challenge in biological life support p 352 A91-54141

**MANUAL CONTROL**

Flight deck automation - Strategies for use now and in the future  
[SAE PAPER 911197] p 352 A91-53597

**MATERIALS HANDLING**

Dynamics and control of robotic systems worn by humans p 354 A91-54874

**MATHEMATICAL MODELS**

The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752

Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms  
[DE91-017245] p 352 N91-32774

**MEDICAL ELECTRONICS**

The EEG in pilot selection p 342 A91-55343

**MEDICAL EQUIPMENT**

Medical evaluations on the KC-135 1990 flight report summary  
[NASA-TM-104740] p 361 N91-32776

Health maintenance facility: Dental equipment requirements p 348 N91-32777

Dental equipment test during zero-gravity flight p 348 N91-32778

Mini-rack testbed evaluation p 361 N91-32779

Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

ATLS: Catheter and tube placement p 348 N91-32782

ATLS-storage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785

Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788

Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

Medical Science  
Developments in medical audit in hospitals in the National Health Service  
[ETN-91-99984] p 343 N91-31762

Medical Services  
ATLS: Catheter and tube placement p 348 N91-32782

Medicine  
Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783

Membranes  
Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

Memory  
Naval medical research and development command  
[AD-A239393] p 343 N91-31765

Mental Performance  
Situational awareness is more than exceptional vision p 350 A91-55341

Microorganisms  
The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286

Biofilm monitoring coupon system and method of use  
[NASA-CASE-MSC-21585-1] p 336 N91-31755

The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784

Microprocessors  
Aircrew part-task training research and development in the 1980s: Lessons learned  
[AD-A239456] p 352 N91-32773

Mineralogy  
Solid-support substrates for plant growth at a lunar base p 359 N91-31800

Mist  
Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783

Molecular Flow  
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

Monitors  
Biofilm monitoring coupon system and method of use  
[NASA-CASE-MSC-21585-1] p 336 N91-31755

## MORPHINE

- Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor  
[AD-A239665] p 360 N91-31807
- Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

## MORPHINE

- The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334

## MOTION PERCEPTION

- Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295

## MOTION SICKNESS

- The resonance hypothesis of motion sickness on the ground p 340 A91-55300
- Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335
- Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759
- Signs and symptoms of motion sickness and its basic nature p 346 N91-32760
- Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761
- Physical characteristics of stimuli provoking motion sickness p 346 N91-32762
- Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763
- Space sickness p 347 N91-32764
- Simulator sickness p 347 N91-32765
- Sea sickness p 347 N91-32766
- Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767
- Assessment of drug effectiveness p 347 N91-32768

- Management of acute and chronic motion sickness p 347 N91-32769

## MOTION SICKNESS DRUGS

- Space sickness p 347 N91-32764

## MOUNTING

- Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755
- Mini-rack testbed evaluation p 361 N91-32779
- ATLS: Catheter and tube placement p 348 N91-32782

## MURCHISON METEORITE

- A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952

## MUSCLES

- Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511

- The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

## MUSCULAR FUNCTION

- Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511

- The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336

## MYOPIA

- Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242

## N

## NARCOSIS

- The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

## NAUSEA

- Physical characteristics of stimuli provoking motion sickness p 346 N91-32762

## NEUROLOGY

- Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761

## NEURONS

- Muramyl peptide-enhanced sleep: Pharmacological optimization of performance [AD-A239442] p 343 N91-31766

## NEUROPHYSIOLOGY

- Naval medical research and development command [AD-A239393] p 343 N91-31765

## NEUROTRANSMITTERS

- Naval medical research and development command [AD-A239393] p 343 N91-31765

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

## NITROGEN

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

- Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789

- The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

## NITROGEN METABOLISM

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

## NITROGEN OXIDES

- Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778

## NITROGENATION

- The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

## NOREPINEPHRINE

- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767

## NUCLEAR MEDICINE

- Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science [DE91-015447] p 342 N91-31759

- Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764

## NUTRIENTS

- Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

- Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798

- Technology for subsystems of space-based plant growth facilities p 359 N91-31799

## NUTRITION

- Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776

- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

## O

## OCCUPATIONAL DISEASES

- Extent and etiology of aeromedical duty restrictions at a U.S. Coast Guard Air Station p 350 A91-53895

## OPEN CIRCUIT VOLTAGE

- Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

## OPERATIONS

- The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334

## OPERATOR PERFORMANCE

- Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166

## OPHTHALMOLOGY

- Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754

## ORGANIC CHEMISTRY

- Electrical energy sources for organic synthesis on the early earth p 363 A91-53951

## ORGANIC COMPOUNDS

- Electrical energy sources for organic synthesis on the early earth p 363 A91-53951

## OSMOSIS

- Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332

## OXYGEN

- The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

- Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor [AD-A239665] p 360 N91-31807

## OXYGEN REGULATORS

- Breathing equipment dynamic requirements p 353 A91-54297

## OZONE

- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027

- Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] p 345 N91-32757

## OZONE DEPLETION

- Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283

## P

## PACKAGES

- Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

## PACKAGING

- Minor surgery in microgravity p 349 N91-32786
- Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

## PARABOLIC FLIGHT

- Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780

- Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

- Fluid handling 2: Surgical applications p 349 N91-32790

- Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791

- Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

- Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

## PARTICLE MOTION

- The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

## PARTICULATES

- Particulate models of photosynthesis [DE91-016842] p 337 N91-32751

## PATHOGENESIS

- Biophysical and biomathematical adventures in radiobiology [DE91-017484] p 337 N91-32750

- Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756

- The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770

## PATHOLOGICAL EFFECTS

- Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242

## PATTERN RECOGNITION

- Introduction to multiresolution morphology [IZF-1991-A-10] p 345 N91-32753

## PAYLOAD INTEGRATION

- ATLS-storage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785

## PENTOSE

- The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784

## PEPTIDES

- Muramyl peptide-enhanced sleep: Pharmacological optimization of performance [AD-A239442] p 343 N91-31766

## PERFORMANCE TESTS

- Controlled ecological life support system breadboard project, 1988 p 358 N91-31791

- Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801

- Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

- Fluid handling 2: Surgical applications p 349 N91-32790

- Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

- Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

## PERIPHERAL VISION

- Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897

## PERSONNEL

- Developments in medical audit in hospitals in the National Health Service [ETN-91-99984] p 343 N91-31762

- The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758

## PERSONNEL SELECTION

- Female aircrew: The Canadian Forces experience, 1979-1989 p 359 N91-31801  
 [DCIEM-90-P-14] p 359 N91-31801  
 An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772

## PHARMACOLOGY

- Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science [DE91-015447] p 342 N91-31759  
 Muramyl peptide-enhanced sleep: Pharmacological optimization of performance [AD-A239442] p 343 N91-31766  
 Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767

## PHOSPHORYLATION

- Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953

## PHOTOCHEMICAL REACTIONS

- Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953  
 Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756  
 Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748  
 Particulate models of photosynthesis [DE91-016842] p 337 N91-32751

## PHOTONS

- Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780

## PHOTOSENSITIVITY

- Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root [DE91-016255] p 337 N91-32749

## PHOTOSYNTHESIS

- The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290  
 Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

- Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
 Preparatory space experiments for development of a CELSS p 359 N91-31796

- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027  
 Particulate models of photosynthesis [DE91-016842] p 337 N91-32751  
 The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

## PHYSICAL EXERCISE

- The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757

## PHYSICAL FITNESS

- Extent and etiology of aeromedical duty restrictions at a U.S. Coast Guard Air Station p 350 A91-53895

## PHYSIOLOGICAL EFFECTS

- Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
 The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299  
 The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757  
 Naval medical research and development command [AD-A239393] p 343 N91-31765  
 Physical characteristics of stimuli provoking motion sickness p 346 N91-32762  
 Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763

## PHYSIOLOGICAL RESPONSES

- Lower body negative pressure to provide load bearing in space p 338 A91-53887  
 Heat stress on helicopter pilots during ground standby p 339 A91-53896  
 Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401  
 The G-LOC syndrome [AD-A239561] p 344 N91-31768  
 The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806  
 Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

## PHYSIOLOGICAL TESTS

- Lower body negative pressure to provide load bearing in space p 338 A91-53887  
 Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions [ETN-91-99973] p 342 N91-31761

## PHYTONS

- The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792  
 A perspective on CELSS control issues p 358 N91-31794

## PILOT PERFORMANCE

- Flight deck automation - Strategies for use now and in the future [SAE PAPER 911197] p 352 A91-53597  
 The use of cardiac and eye blink measures to determine flight segment in F4 crews p 338 A91-53892  
 Heat stress on helicopter pilots during ground standby p 339 A91-53896

- Explicit and implicit horizons for simulated landing approaches p 353 A91-54164  
 Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242  
 Situational awareness is more than exceptional vision p 350 A91-55341

- Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions [ETN-91-99973] p 342 N91-31761

- Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801  
 Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804

## PILOT SELECTION

- The EEG in pilot selection p 342 A91-55343

## PILOT TRAINING

- Techniques to enhance safety in acceleration research and fighter aircrew training p 339 A91-53898  
 Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339  
 Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804  
 Aircrew part-task training research and development in the 1980s: Lessons learned [AD-A239456] p 352 N91-32773

## PINEAL GLAND

- Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891

## PIPES (TUBES)

- Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797  
 Technology for subsystems of space-based plant growth facilities p 359 N91-31799  
 ATLS: Catheter and tube placement p 348 N91-32782

- Transport suction apparatus and absorption materials evaluation p 361 N91-32784

## PIPETTES

- Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

## PLANTAR TISSUES

- Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511

## PLANTS (BOTANY)

- Method and apparatus for bio-regenerative life support system [NASA-CASE-MSC-21629-1] p 360 N91-31803

## POISONS

- Signs and symptoms of motion sickness and its basic nature p 346 N91-32760

## POLARIZATION (SPIN ALIGNMENT)

- The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

## POLICE

- An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772

## POLYSACCHARIDES

- Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785

## POSITIONING

- Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781

## POTATOES

- Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

## PRESSURE CHAMBERS

- Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet) p 341 A91-55333

## PRESSURE REDUCTION

- Decompression sickness - USN operational experience 1969-1989 p 339 A91-53899

## PRODUCTIVITY

- Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776

## PROPHYLAXIS

- Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759

## PROSTHETIC DEVICES

- Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795

## PROTEIN SYNTHESIS

- Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

## PROTEINS

- Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890  
 Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777  
 Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786

- Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787

## PROTOTYPES

- Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791

## PSYCHOLOGICAL EFFECTS

- Naval medical research and development command [AD-A239393] p 343 N91-31765

## PSYCHOLOGICAL FACTORS

- Scientific results from the ISEMSI experiment p 350 A91-54143

## PSYCHOLOGICAL TESTS

- Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894  
 Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771

## PSYCHOMETRICS

- Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771  
 An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772

## PSYCHOMOTOR PERFORMANCE

- Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894  
 Toward a movement dynamics perspective on dual-task performance p 350 A91-54162  
 Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801

## PUBLIC HEALTH

- Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763  
 Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] p 345 N91-32757

## PULMONARY FUNCTIONS

- Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

## PYRIMIDINES

- Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756

## Q

## QUANTUM MECHANICS

- The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

## R

## RABBITS

- Cold-induced changes in arterial sensitivity  
[AD-A239493] p 343 N91-31767
- RADIATION DOSAGE**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation  
[DE91-015837] p 336 N91-31756  
Biophysical and biomathematical adventures in radiobiology  
[DE91-017484] p 337 N91-32750
- RADIATION EFFECTS**  
Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954  
Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283  
The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287  
Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289  
The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290  
The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291  
Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293  
The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294  
Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation  
[DE91-015837] p 336 N91-31756  
Biophysical and biomathematical adventures in radiobiology  
[DE91-017484] p 337 N91-32750  
Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] p 345 N91-32755
- RADIATION INJURIES**  
Skin and eye injuries caused by solar UV radiation p 340 A91-55297
- RADIATION TOLERANCE**  
The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- RADIOBIOLOGY**  
Biophysical and biomathematical adventures in radiobiology  
[DE91-017484] p 337 N91-32750
- RADIOCHEMISTRY**  
Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science  
[DE91-015447] p 342 N91-31759
- RANGEFINDING**  
MSS collision detection --- on Space Station Freedom p 355 A91-56821
- REACTIVITY**  
Photobiological investigations on spores of *Streptomyces griseus*  
[DLR-FB-91-14] p 337 N91-32748
- RECYCLING**  
Preliminary evaluation of waste processing in a CELSS p 357 N91-31788  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- REDUCED GRAVITY**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887

- Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891  
Preparatory space experiments for development of a CELSS p 359 N91-31796  
Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798  
Technology for subsystems of space-based plant growth facilities p 359 N91-31799  
Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Dental equipment test during zero-gravity flight p 348 N91-32778  
Mini-rack testbed evaluation p 361 N91-32779  
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780  
Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781  
Transport suction apparatus and absorption materials evaluation p 361 N91-32784  
Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789  
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792  
Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794
- REENTRY VEHICLES**  
An analysis of the crew's role in a highly automated space station crew reentry vehicle p 354 A91-54640
- REGENERATION (PHYSIOLOGY)**  
Algae for controlled ecological life support system diet characterization of cyanobacteria "spirulina" in batch cultures p 357 N91-31787  
Controlled ecological life support system breadboard project, 1988 p 358 N91-31791  
Method and apparatus for bio-regenerative life support system [NASA-CASE-MSC-21629-1] p 360 N91-31803
- REMOTE MANIPULATOR SYSTEM**  
A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- REPRODUCTION (BIOLOGY)**  
Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783
- RESIDUES**  
Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785
- RESOURCE MANAGEMENT**  
Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804
- RESPIRATION**  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770
- RESPIRATORY SYSTEM**  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770
- RESUSCITATION**  
Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789
- RETENTION (PSYCHOLOGY)**  
Naval medical research and development command [AD-A239393] p 343 N91-31765
- RISK**  
Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770
- ROBOT ARMS**  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- ROBOT CONTROL**  
Dynamics and control of robotic systems worn by humans p 354 A91-54874  
NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839

## ROBOT DYNAMICS

- Dynamics and control of robotic systems worn by humans p 354 A91-54874
- ROBOTICS**  
Dynamics and control of robotic systems worn by humans p 354 A91-54874  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826  
Technology for subsystems of space-based plant growth facilities p 359 N91-31799
- ROTATION**  
Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795
- RUNWAY ALIGNMENT**  
Explicit and implicit horizons for simulated landing approaches p 353 A91-54164
- S**
- SACCADIC EYE MOVEMENTS**  
The use of cardiac and eye blink measures to determine flight segment in F4 crews p 338 A91-53892
- SAFETY FACTORS**  
Step voltage analysis for the catenoid lightning protection system p 345 N91-32623
- SAMPLING**  
Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792
- SEAS**  
Sea sickness p 347 N91-32766
- SECRECTIONS**  
Transport suction apparatus and absorption materials evaluation p 361 N91-32784
- SEEDS**  
Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783  
Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790  
Preparatory space experiments for development of a CELSS p 359 N91-31796
- SENSITIVITY**  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331
- SENSORIMOTOR PERFORMANCE**  
Toward a movement dynamics perspective on dual-task performance p 350 A91-54162
- SENSORY DISCRIMINATION**  
The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284
- SENSORY STIMULATION**  
Physical characteristics of stimuli provoking motion sickness p 346 N91-32762
- SEPARATORS**  
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791
- SHAPES**  
Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775
- SHEEP**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- SICKNESSES**  
Management of acute and chronic motion sickness p 347 N91-32769
- SIGNS AND SYMPTOMS**  
Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769  
Signs and symptoms of motion sickness and its basic nature p 346 N91-32760  
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761  
Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767
- SIMULATION**  
A perspective on CELSS control issues p 358 N91-31794
- SIMULATORS**  
Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793  
Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804
- SKIN (ANATOMY)**  
The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284

- The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285
- Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293
- The protection of the human eye and skin from solar UV radiation p 355 A91-55296
- Skin and eye injuries caused by solar UV radiation p 340 A91-55297
- The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758
- SLEEP**
- Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329
- Muramyl peptide-enhanced sleep: Pharmacological optimization of performance p 343 N91-31766 [AD-A239442]
- Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- SLEEP DEPRIVATION**
- Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- SOCIAL ISOLATION**
- Scientific results from the ISEMSI experiment p 350 A91-54143
- SOIL SCIENCE**
- The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286
- Solid-support substrates for plant growth at a lunar base p 359 N91-31800
- SOLAR RADIATION SHIELDING**
- The protection of the human eye and skin from solar UV radiation p 355 A91-55296
- SOLAR SYSTEM**
- A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952
- SOYBEANS**
- Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780
- Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781
- SPACE ADAPTATION SYNDROME**
- Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759
- Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763
- Space sickness p 347 N91-32764
- SPACE FLIGHT FEEDING**
- Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775
- Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776
- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777
- Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778
- Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779
- Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780
- Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781
- Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782
- Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790
- Controlled ecological life support system breadboard project, 1988 p 358 N91-31791
- The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792
- Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793
- A perspective on CELSS control issues p 358 N91-31794
- Transpiration during life cycle in controlled wheat growth p 358 N91-31795
- Preparatory space experiments for development of a CELSS p 359 N91-31796
- Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797
- Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798
- Technology for subsystems of space-based plant growth facilities p 359 N91-31799
- SPACE HABITATS**
- Contamination control program for the Space Station habitable modules p 352 A91-53986
- SPACE PSYCHOLOGY**
- Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894
- SPACE SHUTTLE ORBITERS**
- Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793
- SPACE STATION FREEDOM**
- Study of Man-System for Japanese Experiment Module (JEM) [AAS PAPER 89-627] p 355 A91-55824
- MSS collision detection --- on Space Station Freedom p 355 A91-56821
- Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776
- Health maintenance facility: Dental equipment requirements p 348 N91-32777
- Dental equipment test during zero-gravity flight p 348 N91-32778
- Mini-rack testbed evaluation p 361 N91-32779
- Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780
- SPACE STATIONS**
- Contamination control program for the Space Station habitable modules p 352 A91-53986
- A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300
- SPACE TOOLS**
- Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- SPACEBORNE EXPERIMENTS**
- Preparatory space experiments for development of a CELSS p 359 N91-31796
- SPACECRAFT CONTAMINATION**
- Contamination control program for the Space Station habitable modules p 352 A91-53986
- SPACECRAFT ENVIRONMENTS**
- Contamination control program for the Space Station habitable modules p 352 A91-53986
- SPACECRAFT GUIDANCE**
- An analysis of the crew's role in a highly automated space station crew reentry vehicle p 354 A91-54640
- SPACECRAFT MODULES**
- Study of Man-System for Japanese Experiment Module (JEM) [AAS PAPER 89-627] p 355 A91-55824
- SPACECREWS**
- Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- SPATIAL DISTRIBUTION**
- Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166
- SPINE**
- Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781
- SPORES**
- Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748
- SPRAYERS**
- Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783
- STARCHES**
- Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777
- STATISTICAL ANALYSIS**
- Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771
- STERIODS**
- Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767
- STOWAGE (ONBOARD EQUIPMENT)**
- ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785
- STREPTOMYCETES**
- Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748
- STRESS (PHYSIOLOGY)**
- Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772
- STRESS (PSYCHOLOGY)**
- Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772
- STUDENTS**
- Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339
- Examining the effect of information order on expert judgment [AD-A239708] p 351 N91-31774
- SUBSTRATES**
- Solid-support substrates for plant growth at a lunar base p 359 N91-31800
- SUCTION**
- Health maintenance facility: Dental equipment requirements p 348 N91-32777
- Dental equipment test during zero-gravity flight p 348 N91-32778
- Transport suction apparatus and absorption materials evaluation p 361 N91-32784
- Fluid handling 2: Surgical applications p 349 N91-32790
- Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791
- SUGARS**
- The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784
- SURFACE GEOMETRY**
- An ellipsoidal representation of human hand anthropometry p 353 A91-54165
- SURGERY**
- Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776
- Minor surgery in microgravity p 349 N91-32786
- Fluid handling 2: Surgical applications p 349 N91-32790
- Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794
- SURGICAL INSTRUMENTS**
- Minor surgery in microgravity p 349 N91-32786
- SYNTHESIS (CHEMISTRY)**
- Electrical energy sources for organic synthesis on the early earth p 363 A91-53951
- A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952
- SYSTEMS ANALYSIS**
- A perspective on CELSS control issues p 358 N91-31794
- SYSTEMS ENGINEERING**
- Man in space - A European challenge in biological life support p 352 A91-54141
- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027
- SYSTEMS INTEGRATION**
- Advanced Crew Station Integration Cockpit p 354 A91-54662

## T

- TACTILE SENSORS (ROBOTICS)**
- NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839
- TARGET RECOGNITION**
- Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331
- TASK PLANNING (ROBOTICS)**
- NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839
- TELEPHONES**
- Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622
- TELEROBOTICS**
- NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839
- MSS collision detection --- on Space Station Freedom p 355 A91-56821
- TEMPERATURE EFFECTS**
- Naval medical research and development command [AD-A239393] p 343 N91-31765
- TEMPORAL DISTRIBUTION**
- Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166
- TEST STANDS**
- NASA's Telerobotic Testbed [AAS PAPER 89-649] p 355 A91-55839
- THERAPY**
- Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339

Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764

**THERMAL POLLUTION**

Heat stress on helicopter pilots during ground standby p 339 A91-53896

**THIN FILMS**

Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755

**THORAX**

Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885

**TISSUES (BIOLOGY)**

Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

**TOXICITY**

Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763

The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806

The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770

**TRAINING DEVICES**

Aircrew part-task training research and development in the 1980s: Lessons learned [AD-A239456] p 352 N91-32773

**TRAINING EVALUATION**

Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809

**TRAINING SIMULATORS**

Simulator sickness p 347 N91-32765

**TRANSFERRING**

Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

**TRANSMISSION LINES**

Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

**TRANSPIRATION**

Transpiration during life cycle in controlled wheat growth p 358 N91-31795

**U****ULTRAVIOLET PHOTOMETRY**

Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748

**ULTRAVIOLET RADIATION**

Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283

The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284

The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285

The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286

Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287

Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288

The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289

The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290

The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291

The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292

Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293

The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294

Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295

The protection of the human eye and skin from solar UV radiation p 355 A91-55296

Skin and eye injuries caused by solar UV radiation p 340 A91-55297

Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298

The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299

Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756

**UNIVERSITIES**

Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773

**URINE**

Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332

**V****VASOCONSTRICTION**

Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886

**VEGETABLES**

Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789

Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790

**VEGETATION GROWTH**

The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290

The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291

Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775

Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789

Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790

The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792

Preparatory space experiments for development of a CELSS p 359 N91-31796

Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

Technology for subsystems of space-based plant growth facilities p 359 N91-31799

Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**VELOCITY MEASUREMENT**

Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511

**VERBAL COMMUNICATION**

Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773

**VISUAL DISCRIMINATION**

Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163

Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331

**VISUAL FIELDS**

Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897

**VISUAL PERCEPTION**

Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897

Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163

Explicit and implicit horizons for simulated landing approaches p 353 A91-54164

Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242

**VISUAL TASKS**

Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163

Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166

**VOMITING**

Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335

**W****WASHING**

The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758

**WASTE DISPOSAL**

Transport suction apparatus and absorption materials evaluation p 361 N91-32784

**WASTE TREATMENT**

Preliminary evaluation of waste processing in a CELSS p 357 N91-31788

**WATER**

Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755

Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

**WATER VAPOR**

A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027

**WEIGHTLESSNESS**

Space sickness p 347 N91-32764

Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781

Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783

Transport suction apparatus and absorption materials evaluation p 361 N91-32784

Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

**WEIGHTLESSNESS SIMULATION**

ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785

Minor surgery in microgravity p 349 N91-32786

Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787

Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788

**WHEAT**

Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776

Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778

Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785

Transpiration during life cycle in controlled wheat growth p 358 N91-31795

Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

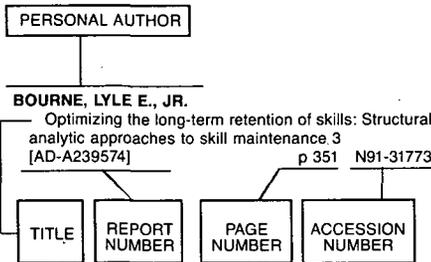
**WORK-REST CYCLE**

Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770

**Z****ZEOLITES**

Solid-support substrates for plant growth at a lunar base p 359 N91-31800

## Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence.

## A

- ABEN, J. M. M.**  
A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027
- ABRAMOV, NIKKI M.**  
Contamination control program for the Space Station habitable modules p 352 A91-53886
- ADELMAN, LEONARD**  
Examining the effect of information order on expert judgment [AD-A239708] p 351 N91-31773
- AIKAWA, MASAMICHI**  
Electron microscopy to correlate cell structures and biochemical activity [AD-A239640] p 336 N91-31758
- AKNAZAROV, O. A.**  
The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291
- ALBIN, GARY**  
Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769
- ALLEN, H. W.**  
Human factors engineering design guidelines for the software user interface [DE91-016061] p 359 N91-31802
- ANDREWS, CHRISTOPHER J.**  
The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621
- Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622
- ARBORELIUS, M., JR.**  
Markers for development of hypertension in commercial flight aviators p 339 A91-53893
- ARMSTRONG, THOMAS J.**  
An ellipsoidal representation of human hand anthropometry p 353 A91-54165
- ARTEM'YEVA, V. V.**  
Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288

- ASLAM, M.**  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778
- ASYEV, L. M.**  
Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242

## B

- BANKEN, JOSEPH A.**  
Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339
- BANKS, ERIC A.**  
The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757
- BANTA, G.**  
Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- BARBER, D. C.**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- BARESI, LARRY**  
The conversion of lignocellulose to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784
- BARKER, D. L.**  
Step voltage analysis for the catenoid lightning protection system p 345 N91-32623
- BARTOL, AILEEN M.**  
Neck and body loads - 'All the data is needed' p 339 A91-54296
- BASON, R.**  
Decompression sickness - USN operational experience 1969-1989 p 339 A91-53899
- BECHTLE, PERRY**  
Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788
- BECK, R. N.**  
Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science [DE91-015447] p 342 N91-31759
- BELAKOVSKII, M. S.**  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- BELCHER, JEWELL G., JR.**  
Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795
- BELLEKES, A. H.**  
Decompression sickness - USN operational experience 1969-1989 p 339 A91-53899
- BELOUSOV, V. V.**  
Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283
- The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294
- BENNETT, SUSAN M.**  
Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779
- BENZ, DARREN**  
ATLS-storage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785
- BILICA, ROGER**  
Health maintenance facility: Dental equipment requirements p 348 N91-32777
- Dental equipment test during zero-gravity flight p 348 N91-32778
- Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781
- Minor surgery in microgravity p 349 N91-32786
- Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788
- Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789
- Fluid handling 2: Surgical applications p 349 N91-32790
- Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791
- BINOT, R.**  
Man in space - A European challenge in biological life support p 352 A91-54141
- BISHOP, WALTON BURRELL**  
Cognitive cybernetics and human communication: The regulatory effects of prior knowledge p 351 N91-32771
- BLACKWELL, ANN L.**  
A perspective on CELSS control issues p 358 N91-31794
- BOCK, R. D.**  
Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771
- BONSI, C. K.**  
Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782
- BOSTROM, P. A.**  
Markers for development of hypertension in commercial flight aviators p 339 A91-53893
- BOURNE, LYLE E., JR.**  
Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773
- BOWER, J.**  
Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- BOYCE, JOEY B.**  
Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781
- Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788
- BRANNON, M. A.**  
Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785
- BRAUNE, ROLF J.**  
Human factors engineering - An integral part of the flight deck design process [AIAA PAPER 91-3089] p 352 A91-54018
- BREEDING, TIFFANY**  
Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793
- BRESNICK, TERRY A.**  
Examining the effect of information order on expert judgment [AD-A239708] p 351 N91-31774
- BRIET, R.**  
Step voltage analysis for the catenoid lightning protection system p 345 N91-32623
- BROWN, B. H.**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- BRUTTIG, STEPHEN P.**  
Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767
- BUBENHEIM, DAVID L.**  
Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777
- The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792
- BUCHHOLZ, BRYAN**  
An ellipsoidal representation of human hand anthropometry p 353 A91-54165
- BUEKER, RICHARD**  
ATLS-storage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785
- BUGBEE, BRUCE**  
Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776
- BULA, R. J.**  
Technology for subsystems of space-based plant growth facilities p 359 N91-31799

AUTHOR

## BURLATON, J. P.

Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions  
[ETN-91-99973] p 342 N91-31761

## BURR, R.

Sleep logs: Measurement of individual and operational efficiency  
[AD-A239774] p 344 N91-31770

## BUTLER, B. D.

Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals  
p 333 A91-53900

## BUTURLIN, A. I.

Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots  
p 340 A91-55242

## C

## CAMMAROTA, JOSEPH P., JR.

Techniques to enhance safety in acceleration research and fighter aircrew training p 339 A91-53898

## CAMPBELL, D. L.

Human factors engineering design guidelines for the software user interface  
[DE91-016061] p 359 N91-31802

## CARDEN, JAMES R.

Rotationally actuated prosthetic helping hand  
[NASA-CASE-MFS-28426-1] p 362 N91-32795

## CARMAN, JOHN G.

Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

## CARNAHAN, TIM

A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

## CASTILLO-ROJAS, SUSANA

Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

## CHAI, J. C.

Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

## CHUMAKOV, V. V.

Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots  
p 340 A91-55242

## CHYBA, CHRISTOPHER

Electrical energy sources for organic synthesis on the early earth p 363 A91-53951

## CLOTHIER, CATHY C.

Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types  
[AD-A239467] p 360 N91-31804

## COHEN, ALEX

Heat stress on helicopter pilots during ground standby  
p 339 A91-53896

## COLLET, J.

Scientific results from the ISEMSI experiment  
p 350 A91-54143

## COLQUHOUN, DAVID M.

The QT interval in lightning injury with implications for the cessation of metabolism hypothesis  
p 344 N91-32621

## COLUMBUS, RICHARD L.

Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

## CONTIGUGLIA, J. J.

Sickle cell anemia trait in the military aircrew population - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, AsMA  
p 342 A91-55344

## CONVERTINO, VICTOR A.

Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure  
p 338 A91-53886

## COPPER, M.

Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science  
[DE91-015447] p 342 N91-31759

## COREY, R. B.

Technology for subsystems of space-based plant growth facilities p 359 N91-31799

## CRANE, CARL D., III

A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

## CREAGER, GERALD J.

Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788

## CRUSE, C. W.

Burn injuries from small airplane crashes  
p 341 A91-55340

## CULLINGFORD, HATICE S.

Development of the CELSS emulator at NASA. Johnson Space Center p 358 N91-31793  
Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798  
Method and apparatus for bio-regenerative life support system  
[NASA-CASE-MS-21629-1] p 360 N91-31803

## D

## D'IAKONOV, A. S.

Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction  
p 333 A91-55283

## DANIELS, J. I.

The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting  
[DE91-017545] p 346 N91-32758

## DARVENIZA, MAT

The QT interval in lightning injury with implications for the cessation of metabolism hypothesis  
p 344 N91-32621

Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

## DAY, MICHELLE

Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790

## DEACON, C. F.

Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885

## DEATON, JOHN

Adaptive function allocation for intelligent cockpits  
[AD-A239714] p 360 N91-31808

## DEMICHEV, V. V.

The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292

## DJUMIC, M.

Developments in medical audit in hospitals in the National Health Service  
[ETN-91-99984] p 343 N91-31762

## DOARN, CHARLES R.

Medical evaluations on the KC-135 1990 flight report summary  
[NASA-TM-104740] p 361 N91-32776

## DRESCHEL, T. W.

Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

## DUELAND, AUD N.

Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet)  
p 341 A91-55333

## DUELAND, SVEIN

Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet)  
p 341 A91-55333

## DUFFY, JOSEPH

A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

## E

## EDWARDS, BERNELL J.

Aircrew part-task training research and development in the 1980s: Lessons learned  
[AD-A239456] p 352 N91-32773

## EFIMENKO, N. V.

The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292

## EKSTRAND, K.

Markers for development of hypertension in commercial flight aviators p 339 A91-53893

## ELEY, H. E.

Step voltage analysis for the catenoid lightning protection system p 345 N91-32623

## EPSTEIN, YORAM

Heat stress on helicopter pilots during ground standby  
p 339 A91-53896

## ERICSSON, K. A.

Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3  
[AD-A239574] p 351 N91-31773

## EZAWA, N.

Dexterous manipulator system for Space Station and its future extension  
[AAS PAPER 89-629] p 355 A91-55826

## F

## FADDEN, DELMAR M.

Flight deck automation - Strategies for use now and in the future  
[SAE PAPER 911197] p 352 A91-53597  
Human factors engineering - An integral part of the flight deck design process  
[AIAA PAPER 91-3089] p 352 A91-54018

## FANTIN, D. M.

Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root  
[DE91-016255] p 337 N91-32749

## FAULK, DEAN M.

Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894

## FIFE, C.

Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals  
p 333 A91-53900

## FIRSOV, D. L.

Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332

## FISHER, FRANK

The use of cardiac and eye blink measures to determine flight segment in F4 crews p 338 A91-53892

## FLANAGAN, DAVID T.

Biofilm monitoring coupon system and method of use  
[NASA-CASE-MS-21585-1] p 336 N91-31755

## FROM, PAUL

Heat stress on helicopter pilots during ground standby  
p 339 A91-53896

## FRY, I. V.

Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling  
p 357 N91-31786

## G

## GALINDO, C.

Solid-support substrates for plant growth at a lunar base p 359 N91-31800

## GANDER, PHILIPPA H.

Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength  
p 340 A91-55329

## GANGE, R. W.

Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation  
[DE91-015837] p 336 N91-31756

## GARLAND, J. L.

Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase  
p 357 N91-31785

## GHARIB, CL

Scientific results from the ISEMSI experiment  
p 350 A91-54143

## GIBBONS, ROBERT D.

Full-information item bi-factor analysis  
[AD-A229346] p 350 N91-31771

## GILLER, IU. E.

The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290

## GLEAVE, SUSAN

An investigation into the potential use of psychometric instruments for the selection of firearms officers  
[CRANFIELD-AERO-9108] p 351 N91-32772

## GLUCKMAN, JONATHAN

Adaptive function allocation for intelligent cockpits  
[AD-A239714] p 360 N91-31808

## GOCKE, ROBYN

Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight  
p 348 N91-32780

## GOMER, FRANK E.

Crew interface design for a flight deck electronic library system p 354 A91-54647

## GOSBEE, JOHN

Health maintenance facility: Dental equipment requirements p 348 N91-32777  
Dental equipment test during zero-gravity flight  
p 348 N91-32778

## Mini-rack testbed evaluation

p 361 N91-32779

Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781

ATLS: Catheter and tube placement p 348 N91-32782

Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783

Transport suction apparatus and absorption materials evaluation p 361 N91-32784

ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785

- Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788  
Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789
- GRAEBER, R. C.**  
Human factors engineering - An integral part of the flight deck design process [AIAA PAPER 91-3089] p 352 A91-54018
- GRAMENITSKII, A. E.**  
The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294
- GRAY, THOMAS H.**  
Aircrew part-task training research and development in the 1980s: Lessons learned [AD-A239456] p 352 N91-32773
- GREEN, ROGER**  
Airline pilot incapacitation survey p 341 A91-55337
- GREENTHNER, NANCY K.**  
Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780
- GRIFFIN, MICHAEL J.**  
Physical characteristics of stimuli provoking motion sickness p 346 N91-32762  
Sea sickness p 347 N91-32766
- GRIGOR'EV, A. I.**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332
- GRINDELAND, RICHARD E.**  
Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890
- GRUNDY, D.**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- GUEDRY, FRED E.**  
Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761  
Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763
- GUESS, TERRELL M.**  
Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
Mini-rack testbed evaluation p 361 N91-32779
- GUO, HONG-ZHANG**  
The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336
- GUPPY, ANDREW**  
An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772
- GUTOROVA, L. V.**  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- H**
- HACHAM, H.**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756
- HALL, C. R.**  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- HALL, L. C.**  
The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting [DE91-017545] p 346 N91-32758
- HAMILTON, RICHARD J.**  
Techniques to enhance safety in acceleration research and fighter aircrew training p 339 A91-53898  
Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809
- HAMMOND, KENNETH R.**  
Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772
- HARGENS, ALAN R.**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887
- HARRIS, JOHN**  
An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772
- HARTMAN, BRYCE O.**  
Situational awareness is more than exceptional vision p 350 A91-55341
- HEALY, ALICE F.**  
Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773
- HEDEKER, DONALD R.**  
Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771
- HENDERSON, I. W.**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- HESS, J. RICHARD**  
Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783
- HICKS, R. J.**  
Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801
- HILL, W. A.**  
Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782
- HOLLAND, AL W.**  
Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894
- HOLLEY, DANIEL C.**  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- HOLLINGSWORTH, JOHN E.**  
Breathing equipment dynamic requirements p 353 A91-54297
- HUFFAKER, R. C.**  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778
- I**
- IHARA, H.**  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- IPATOVA, A. G.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- IVANOV, V. L.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- J**
- JACQUEZ, RICARDO B.**  
Preliminary evaluation of waste processing in a CELSS p 357 N91-31788
- JAMES, MELANIE**  
Airline pilot incapacitation survey p 341 A91-55337
- JING, BAI-SHENG**  
The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336
- JOHANNESEN, LEILA**  
An analysis of the crew's role in a highly automated space station crew reentry vehicle p 354 A91-54640
- JOHNSON, N. F.**  
The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials [DE91-017516] p 348 N91-32770
- JOHNSON, STEVE**  
Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790
- K**
- KABALKA, G. W.**  
Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764
- KABESHEVA, T. A.**  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- KADDIS, FARIDA**  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- KAJI, TAKAHIDE**  
Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335
- KALEPS, INTS**  
Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298
- KANASH, E. V.**  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287  
Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288
- KARIEVA, F. A.**  
The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290
- KAZEROONI, H.**  
Dynamics and control of robotic systems worn by humans p 354 A91-54874
- KEIL, LANNY C.**  
Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889
- KELLER, BIRGIT**  
Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748
- KELLY, T.**  
Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- KERRIDGE, JOHN F.**  
A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952
- KHAIDAKOV, M. S.**  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- KHODKEVICH, IU. N.**  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- KIRSCH, K.**  
Scientific results from the ISEMSI experiment p 350 A91-54143
- KIZZEE, VICTOR D.**  
Minor surgery in microgravity p 349 N91-32786  
Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
Fluid handling 2: Surgical applications p 349 N91-32790  
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792
- KNEE, H. E.**  
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms [DE91-017245] p 352 N91-32774
- KNIGHT, DOUGLAS R.**  
The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806
- KNOTT, W. M.**  
Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
Controlled ecological life support system breadboard project, 1988 p 358 N91-31791  
Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797
- KOLESNIKOV, M. P.**  
Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953
- KONDRAT'EV, A. S.**  
Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242
- KOTHE, G.**  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752
- KOZ'MIN, G. V.**  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289
- KOZLOV, V. A.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- KRASNOV, IGOR'**  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- KRASNOVIDOV, V. S.**  
The protection of the human eye and skin from solar UV radiation p 355 A91-55296  
Skin and eye injuries caused by solar UV radiation p 340 A91-55297
- KROCK, LARRY P.**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887

**KRUEGER, JAMES M.**  
 Muramyl peptide-enhanced sleep: Pharmacological optimization of performance [AD-A239442] p 343 N91-31766

**KRUPA, DEBRA T.**  
 Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781  
 ATLS: Catheter and tube placement p 348 N91-32782  
 Transport suction apparatus and absorption materials evaluation p 361 N91-32784  
 Minor surgery in microgravity p 349 N91-32786  
 Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
 Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788  
 Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789

**KUDRIASHOV, IU. B.**  
 Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293

**KUMAMOTO, K.**  
 Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826

**KURAOKA, K.**  
 Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826

**LANG, VIRGINIA A.**  
 Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166

**LASSEUR, C.**  
 Man in space - A European challenge in biological life support p 352 A91-54141

**LAZAREV, A. O.**  
 The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284

**LEBEDEV, V. I.**  
 The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299

**LEGER, ALAIN**  
 Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

**LILJA, B.**  
 Markers for development of hypertension in commercial flight aviators p 339 A91-53893

**LINTERN, GAVAN**  
 Explicit and implicit horizons for simulated landing approaches p 353 A91-54164

**LIPKIND, B. I.**  
 The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290

**LIU, YEYOU-TEH**  
 Explicit and implicit horizons for simulated landing approaches p 353 A91-54164

**LLOYD, CHARLES W.**  
 Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
 Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780  
 Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783  
 ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785  
 Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

**LOBACHEVA, G. V.**  
 The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285

**LORETAN, P. A.**  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

**LOWERY, W.**  
 Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

**LU, J. Y.**  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

**LUDWIG, DAVID A.**  
 Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886

L

**LUSK, CYNTHIA M.**  
 Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772

**LUTTGES, MARVIN**  
 Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790

**LYCHAKOV, D. V.**  
 The resonance hypothesis of motion sickness on the ground p 340 A91-55300

**LYSAK, V. F.**  
 The protection of the human eye and skin from solar UV radiation p 355 A91-55296  
 Skin and eye injuries caused by solar UV radiation p 340 A91-55297

M

**MACDONALD, JOHN A.**  
 Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

**MACELROY, ROBERT D.**  
 Controlled Ecological Life Support Systems: CELSS '89 Workshop [NASA-TM-102277] p 356 N91-31775

**MACK, G. W.**  
 Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888

**MACKOWIAK, C. L.**  
 Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
 Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781

**MAHONE, CHARLES H.**  
 Brief cognitive behavior therapy in an undergraduate pilot student - A case report p 350 A91-55339

**MAHONEY, S. L.**  
 Dynamics and control of robotic systems worn by humans p 354 A91-54874

**MAIDLOW, KRISTIN**  
 Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793

**MAISURADZE, V. N.**  
 Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293

**MAPES, PETER B.**  
 The adequacy of corrective lenses worn by United States Air Force aviators for annual flight medical examinations p 341 A91-55338

**MARKHAM, SANFORD M.**  
 Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794

**MARKLEY, CAROL L.**  
 Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891

**MARTIN, WILLIAM J.**  
 Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783

**MASSELL, PAUL**  
 Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769

**MATSUKI, NORIO**  
 Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335

**MCARDLE, F. J.**  
 Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885

**MCKINLEY, B. A.**  
 Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

**MEDNIEKS, MAIJA I.**  
 Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890

**MENDELSON, M. L.**  
 Biological dosimetry and mechanisms of carcinogenesis [DE91-015689] p 343 N91-31763

**MING, D. W.**  
 Solid-support substrates for plant growth at a lunar base p 359 N91-31800

**MITCHELL, CARY A.**  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

**MONEY, K. E.**  
 Signs and symptoms of motion sickness and its basic nature p 346 N91-32760  
 Space sickness p 347 N91-32764

Simulator sickness p 347 N91-32765

**MONTGOMERY, JOHN C.**  
 Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

**MOROZ, M. P.**  
 Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401

**MORRIS, A. L.**  
 The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

**MORRIS, AILENE**  
 Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331

**MORRIS, C. E.**  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

**MORRISON, JEFFREY**  
 Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808

**MORROW, BRET A.**  
 Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889

**MORROW, R. C.**  
 Technology for subsystems of space-based plant growth facilities p 359 N91-31799

**MORROW, ROBERT C.**  
 Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779

**MORTLEY, D. G.**  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

**MOYE, STANLEY J.**  
 Burn injuries from small airplane crashes p 341 A91-55340

**MURDOCH, B. D.**  
 The EEG in pilot selection p 342 A91-55343

**MURPHY, LINDA**  
 Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
 Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791

**MYHRE, KJELL**  
 Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet) p 341 A91-55333

**NADEL, E. R.**  
 Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888

**NAITOH, P.**  
 Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770

**NAKAJIMA, TERUMI**  
 Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335

**NAKAMURA, AKIO**  
 The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334

**NATOCHIN, IU. V.**  
 Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332

**NAVARRO-GONZALEZ, RAFAEL**  
 Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**NEGRON-MENDOZA, ALICIA**  
 Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

**NG, TERRY**  
 MSS collision detection p 355 A91-56821

**NIELSEN, JAN N.**  
 A comparison of the routine medical examination of pilots in 12 air forces p 342 A91-55342

**NIELSEN, SUZANNE S.**  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777

**NIKANDROVA, O. V.**  
 Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288

**NILSSON, J. A.**  
 Markers for development of hypertension in commercial flight aviators p 339 A91-53893

N

- NISHIYASU, T.**  
Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888
- NOGUCHI, N.**  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- NORFLEET, WILLIAM T.**  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792
- NORTON, WILLIAM E.**  
Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795
- NOSKOV, V. B.**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332
- O**
- OGBUEHI, C. R. A.**  
Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782
- OLESON, MEL W.**  
Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798
- OOSTERVELD, W. J.**  
Assessment of drug effectiveness p 347 N91-32768
- ORSAK, DEBRA**  
ATLS: Catheter and tube placement p 348 N91-32782  
ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785
- OSIPOVICH, V. K.**  
The protection of the human eye and skin from solar UV radiation p 355 A91-55296  
Skin and eye injuries caused by solar UV radiation p 340 A91-55297
- OTAO, J.**  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826
- OVECHKIN, I. G.**  
Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242
- OWENS, L. P.**  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- P**
- PACKER, L.**  
Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786
- PALMER, HARVEY J.**  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792
- PANFEROVA, N. E.**  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- PAQUETTE, STEVEN P.**  
Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775
- PARNOVA, R. G.**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332
- PASTUKHOV, V. V.**  
Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401
- PAULIN, MICHAEL G.**  
Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329
- PAYNE, DAVID G.**  
Visual monitoring with spatially versus temporally distributed displays p 353 A91-54166
- PENCIKOWSKI, PAUL**  
Advanced Crew Station Integration Cockpit p 354 A91-54662
- PEPPER, L.**  
ATLS: Catheter and tube placement p 348 N91-32782
- PERROTT, DAVID R.**  
Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163
- PERVUSHIN, V. I.**  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- PETERSEN, GENE R.**  
The conversion of lignocellulosics to fermentable sugars: A survey of current research and application to CELSS p 357 N91-31784
- PHILBECK, THOMAS E., JR.**  
Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor [AD-A239665] p 360 N91-31807
- PLATONOV, A. G.**  
Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293
- POPOVA, IRINA A.**  
Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890
- POPPER, STEPHEN E.**  
Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897
- Q**
- QUIGLEY, B. M.**  
Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888
- R**
- RAU, GUENTER**  
Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511
- RAVINDRAN, R.**  
MSS collision detection p 355 A91-56821
- REID, K.**  
Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885
- RICKS, EDWARD**  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331
- RILEY, VICTOR**  
An analysis of the crew's role in a highly automated space station crew reentry vehicle p 354 A91-54640
- ROBERTS, DONALD E.**  
Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767
- ROBINSON, R.**  
Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900
- ROCK, JOHN A.**  
Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794
- ROSADO, N. R.**  
Sickle cell anemia trait in the military aircrew population - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, AsMA p 342 A91-55344
- ROY, ERNEST G.**  
Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor [AD-A239665] p 360 N91-31807
- RUMMEL, JOHN D.**  
Transpiration during life cycle in controlled wheat growth p 358 N91-31795
- RUSHING, DOUG**  
Fluid handling 2: Surgical applications p 349 N91-32790
- RUSTANDI, R. R.**  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752
- RYKOVA, M. P.**  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299
- S**
- SABERI, KOUROSH**  
Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163
- SADRALODABAI, TOKTAM**  
Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163
- SAGAN, CARL**  
Electrical energy sources for organic synthesis on the early earth p 363 A91-53951
- SAGER, J. C.**  
Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781  
Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797
- SAITO, HIROSHI**  
Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335
- SAKATA, H.**  
MSS collision detection p 355 A91-56821
- SAKURAI, IZO**  
The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334
- SALISBURY, FRANK B.**  
Preparatory space experiments for development of a CELSS p 359 N91-31796
- SANDOR, PATRICK B.**  
Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330
- SANTY, PATRICIA A.**  
Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894
- SATO, TSUNEHISA**  
The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334
- SAUER, RICHARD L.**  
Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755
- SAUGSTAD, OLA D.**  
Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet) p 341 A91-55333
- SAVAGE, C.**  
Man in space - A European challenge in biological life support p 352 A91-54141
- SAVIN, V. N.**  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287
- SCHNEIDER, JOCHEN**  
Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511
- SCHRYVER, J. C.**  
Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms [DE91-017245] p 352 N91-32774
- SCHULTZ, REBECCA B.**  
Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor [AD-A239665] p 360 N91-31807
- SCHULZ, JOHN M.**  
Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793
- SCHWANDT, DOUGLAS F.**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887
- SCHWARTZKOPF, STEVEN H.**  
Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798
- SCOTT, B. R.**  
Biophysical and biomathematical adventures in radiobiology [DE91-017484] p 337 N91-32750
- SECOND, BERTHA B.**  
Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754
- SECRIST, GRANT E.**  
Situational awareness is more than exceptional vision p 350 A91-55341
- SEELY, G. R.**  
Particulate models of photosynthesis [DE91-016842] p 337 N91-32751

- SEIGNEURIC, A.**  
Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions  
[ETN-91-99973] p 342 N91-31761
- SEVERS, WALTER B.**  
Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889
- SHAKHMATOVA, E. I.**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332
- SHCHERBAKOVA, I. IU.**  
The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290
- SHERRY, DAVID**  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331
- SHEVCHENKO, A. S.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- SHEVCHENKO, T. S.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- SHI, X.**  
Cardiopulmonary baroreflex control of forearm vascular resistance after acute blood volume expansion p 338 A91-53888
- SHIMODA, TAKANOBU**  
Study of Man-System for Japanese Experiment Module (JEM)  
[AAS PAPER 89-627] p 355 A91-55824
- SHIRAKI, K.**  
Dexterous manipulator system for Space Station and its future extension  
[AAS PAPER 89-629] p 355 A91-55826
- SHISHKIN, V. A.**  
The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290
- SHOCHAT, IGAL**  
Heat stress on helicopter pilots during ground standby p 339 A91-53896
- SHOMANSUROV, S. SH.**  
The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291
- SILNY, JIRI**  
Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511
- SIMONENKOVA, E. D.**  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289
- SMITH, MAUREEN**  
Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791
- SNYDER, S. S.**  
The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752
- SOLIMAN, MAGDI R. I.**  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- STEGMANN, BARBARA**  
Mini-rack testbed evaluation p 361 N91-32779
- STOCKY, J. F.**  
NASA's Telerobotic Testbed  
[AAS PAPER 89-649] p 355 A91-55839
- STONESTREET, ROBERT**  
Minor surgery in microgravity p 349 N91-32786
- STOTT, J. R. R.**  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767  
Management of acute and chronic motion sickness p 347 N91-32769
- STRAYER, R. F.**  
Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785
- STRICHMAN, LIORA**  
Heat stress on helicopter pilots during ground standby p 339 A91-53896
- STRYBEL, THOMAS Z.**  
Aurally aided visual search in the central visual field - Effects of visual load and visual enhancement of the target p 353 A91-54163
- STRZHIZHOVSII, A. D.**  
Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283  
The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285  
Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295
- SUKHANOV, IU. V.**  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332
- SUKHANOVA, N. N.**  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292
- SULIMO-SAMUILO, Z. K.**  
Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401
- SUTHERLAND, B. M.**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation  
[DE91-015837] p 336 N91-31756
- SUTHERLAND, J. C.**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation  
[DE91-015837] p 336 N91-31756
- SUTTON, T.**  
Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900
- SWINNEN, STEPHAN P.**  
Toward a movement dynamics perspective on dual-task performance p 350 A91-54162
- T**
- TADROS, M. G.**  
Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787
- TAKARADA, S.**  
Dexterous manipulator system for Space Station and its future extension  
[AAS PAPER 89-629] p 355 A91-55826
- TAMPONNET, C.**  
Man in space - A European challenge in biological life support p 352 A91-54141
- TANAKA, HIDETAKA**  
Study of Man-System for Japanese Experiment Module (JEM)  
[AAS PAPER 89-627] p 355 A91-55824
- TANG, JAU**  
The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752
- TEMME, LEONARD A.**  
Visual contrast sensitivity of U.S. Navy jet pilots p 340 A91-55331
- TENFORDE, T. S.**  
Interaction of extremely-low-frequency electromagnetic fields with humans  
[DE91-015779] p 345 N91-32756
- THALMANN, EDWARD**  
Basic operation and preliminary trials of a detector for stationary gas bubbles  
[AD-A239710] p 344 N91-31769
- THOMAS, TERRI**  
Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790
- THOMPSON, CYNTHIA A.**  
Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886
- THURNAUER, M. C.**  
The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752
- TIBBITTS, T. W.**  
Technology for subsystems of space-based plant growth facilities p 359 N91-31799
- TIBBITTS, THEODORE W.**  
Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779
- TOET, A.**  
Introduction to multiresolution morphology  
[IZF-1991-A-10] p 345 N91-32753
- TOLCOTT, MARTIN A.**  
Examining the effect of information order on expert judgment  
[AD-A239708] p 351 N91-31774
- TOLSTIKOV, IU. V.**  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289
- TOMITA, S.**  
Dexterous manipulator system for Space Station and its future extension  
[AAS PAPER 89-629] p 355 A91-55826
- TREDICI, THOMAS J.**  
Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990  
[AD-A239458] p 345 N91-32754
- TRIPP, LLOYD D., JR.**  
Unequal narrowing of the visual field in a +Gz environment p 339 A91-53897
- U**
- UENO, SHINYA**  
Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335
- UNGS, TIMOTHY J.**  
Extent and etiology of aeromedical duty restrictions at a U.S. Coast Guard Air Station p 350 A91-53895
- URALETS, T. I.**  
The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286
- V**
- VAERNES, R. J.**  
Scientific results from the ISEMSI experiment p 350 A91-54143
- VANINGEN-DUNN, CAROLINE**  
Use of composite materials to develop a test manikin with improved inertial properties p 353 A91-54298
- VOGE, V. M.**  
*Sickle cell anemia trait in the military aircrew population* - A report from the Military Aviation Safety Subcommittee of the Aviation Safety Committee, AsMA p 342 A91-55344
- VOLK, TYLER**  
Transpiration during life cycle in controlled wheat growth p 358 N91-31795
- W**
- WALLSTEN, T. S.**  
Assessing the risk of chronic lung injury attributable to long-term ozone exposure  
[DE91-016814] p 345 N91-32757
- WALTER, CHARLES B.**  
Toward a movement dynamics perspective on dual-task performance p 350 A91-54162
- WANG, ZHIYU**  
The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752
- WARD, M. R.**  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778
- WATENPAUGH, DONALD E.**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887
- WATKINS, GEORGE M.**  
Burn injuries from small airplane crashes p 341 A91-55340
- WATTS, ETHEL J.**  
Garment selection for cleanrooms and controlled environments for spacecraft  
[AD-A239512] p 360 N91-31805
- WEBER, S.**  
The role of spin chemistry in the primary events of photosynthesis  
[DE91-017301] p 337 N91-32752
- WEST, THOMAS W.**  
Rotationally actuated prosthetic helping hand  
[NASA-CASE-MFS-28426-1] p 362 N91-32795
- WHALEN, ROBERT T.**  
Lower body negative pressure to provide load bearing in space p 338 A91-53887
- WHEELER, R. M.**  
Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781  
Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797

**WHINNERY, JAMES E.**

Techniques to enhance safety in acceleration research  
and fighter aircrew training p 339 A91-53898  
The G-LOC syndrome

[AD-A239561] p 344 N91-31768

Aircrew critique of high-G centrifuge training. Part 1:  
What was the best part of the program?

[AD-A239781] p 361 N91-31809

**WHITE, RICHARD P., JR.**

Neck and body loads - 'All the data is needed'  
p 339 A91-54296

**WHITFIELD, R. G.**

Assessing the risk of chronic lung injury attributable to  
long-term ozone exposure

[DE91-016814] p 345 N91-32757

**WHITING, CHARLES W.**

Medical evaluations on the KC-135 1990 flight report  
summary

[NASA-TM-104740] p 361 N91-32776

**WILSON, GLENN F.**

The use of cardiac and eye blink measures to determine  
flight segment in F4 crews

p 338 A91-53892

**WILSON, WILLIAM W.**

Flight deck automation - Strategies for use now and in  
the future

[SAE PAPER 911197] p 352 A91-53597

**WINKLER, R. L.**

Assessing the risk of chronic lung injury attributable to  
long-term ozone exposure

[DE91-016814] p 345 N91-32757

**Y****YACAVONE, D.**

Decompression sickness - USN operational experience  
1969-1989 p 339 A91-53899

**YAMAGUCHI, TAKAO**

Study of Man-System for Japanese Experiment Module  
(JEM)

[AAS PAPER 89-627] p 355 A91-55824

**YASUHARA, TADASHI**

Role of histamine in motion sickness in *Suncus  
murinus*

p 335 A91-55335

**YOSHIOKA, TOSHITADA**

The effect of apomorphine on operant behavior in rats  
under normoxic and hypoxic conditions

p 335 A91-55334

**YOUNG, JOHN**

Health maintenance facility: Dental equipment  
requirements

p 348 N91-32777

Dental equipment test during zero-gravity flight

p 348 N91-32778

Fluid handling 2: Surgical applications  
p 349 N91-32790

**Z****ZAKHAROV, A. V.**

Predicting adaptation potentials in military personnel with  
different constitutional types

p 342 A91-55401

**ZEINALOV, A. A.**

The effect of chronic irradiation by UV-B light on the  
growth, development, and productivity of fodder beet

p 334 A91-55289

**ZHANG, SHU-XIA**

The characteristics and theoretical basis of the Qigong  
maneuver

p 355 A91-55336

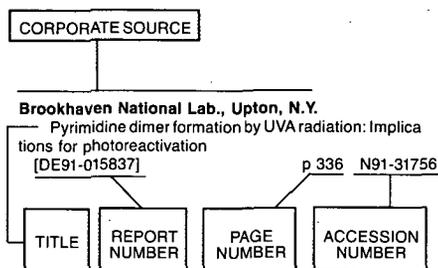
**ZIABLITSKAIA, E. IA.**

The effect of chronic irradiation by UV-B light on the  
growth, development, and productivity of fodder beet

p 334 A91-55289

# CORPORATE SOURCE INDEX

## Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession 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.

### A

- Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).**  
Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759
- Aerospace Corp., El Segundo, CA.**  
Garment selection for cleanrooms and controlled environments for spacecraft [AD-A239512] p 360 N91-31805
- Aerospace Corp., Los Angeles, CA.**  
Step voltage analysis for the catenoid lightning protection system p 345 N91-32623
- Air Force Human Resources Lab., Williams AFB, AZ.**  
Aircrew part-task training research and development in the 1980s: Lessons learned [AD-A239456] p 352 N91-32773
- Air Force Inst. of Tech., Wright-Patterson AFB, OH.**  
The effect of exercise training on skeletal muscle glucose transporter isoform GLUT4 concentration in the obese Zucker rat [AD-A239461] p 336 N91-31757  
Cockpit resource management: Effects on behavioral interactions across airlines and aircraft types [AD-A239467] p 360 N91-31804
- Alabama A & M Univ., Normal.**  
Algae for controlled ecological life support system diet characterization of cyanobacteria 'spirulina' in batch cultures p 357 N91-31787
- Amsterdam Univ. (Netherlands).**  
Assessment of drug effectiveness p 347 N91-32768
- Argonne National Lab., IL.**  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752  
Assessing the risk of chronic lung injury attributable to long-term ozone exposure [DE91-016814] p 345 N91-32757

- Arizona State Univ., Tempe.**  
Particulate models of photosynthesis [DE91-016842] p 337 N91-32752
- Army Natick Research and Development Command, MA.**  
Human analogue models for computer-aided design and engineering applications [AD-A229520] p 361 N91-32775
- Army Research Inst. of Environmental Medicine, Natick, MA.**  
Cold-induced changes in arterial sensitivity [AD-A239493] p 343 N91-31767
- Auckland Univ. (New Zealand).**  
Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

### B

- Bionetics Corp., Cocoa Beach, FL.**  
Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886  
Use of inedible wheat residues from the KSC-CELSS breadboard facility for production of fungal cellulase p 357 N91-31785  
Biomass production and nitrogen dynamics in an integrated aquaculture/agriculture system p 358 N91-31789
- Brookhaven National Lab., Upton, NY.**  
Pyrimidine dimer formation by UVA radiation: Implications for photoreactivation [DE91-015837] p 336 N91-31756

### C

- California Univ., Berkeley. Lawrence Berkeley Lab.**  
Cyanobacteria in CELSS: Growth strategies for nutritional variation and nitrogen cycling p 357 N91-31786  
Biophysical and genetic aspects of light-potentiated gravitropic curvature in the maize primary root [DE91-016255] p 337 N91-32749
- California Univ., Davis.**  
Efficiency of N use by wheat as a function of influx and efflux of NO<sub>3</sub> p 356 N91-31778
- California Univ., Los Angeles.**  
A note on the prebiotic synthesis of organic acids in carbonaceous meteorites p 363 A91-53952
- Case Western Reserve Univ., Cleveland, OH.**  
Electron microscopy to correlate cell structures and biochemical activity [AD-A239640] p 336 N91-31758
- Chicago Univ., IL.**  
Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890  
Nuclear medicine and imaging research: Quantitative studies in radiopharmaceutical science [DE91-015447] p 342 N91-31759
- Colorado Univ., Boulder.**  
Effects of stress on judgment and decision making in dynamic tasks [AD-A239452] p 351 N91-31772  
Optimizing the long-term retention of skills: Structural and analytic approaches to skill maintenance 3 [AD-A239574] p 351 N91-31773  
Seed sprout production: Consumables and a foundation for higher plant growth in space p 358 N91-31790
- Cornell Univ., Ithaca, NY.**  
Electrical energy sources for organic synthesis on the early earth p 363 A91-53951
- Cranfield Inst. of Tech., Bedford (England).**  
An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772

### D

- Decision Science Consortium, Inc., Reston, VA.**  
Examining the effect of information order on expert judgment [AD-A239708] p 351 N91-31774
- Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).**  
Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801
- Defence and Civil Inst. of Environmental Medicine, North York (Ontario).**  
Signs and symptoms of motion sickness and its basic nature p 346 N91-32760  
Space sickness p 347 N91-32764  
Simulator sickness p 347 N91-32765
- Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).**  
Photobiological investigations on spores of Streptomyces griseus [DLR-FB-91-14] p 337 N91-32748

### E

- Eastman Kodak Co., Rochester, NY.**  
Precision metering of microliter volumes of biological fluids in micro-gravity p 362 N91-32792

### F

- Florida Agricultural and Mechanical Univ., Tallahassee.**  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- Florida Univ., Gainesville.**  
A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300

### G

- Georgetown Univ., Washington, DC.**  
Deployment and testing of a second prototype expandable surgical chamber in microgravity p 362 N91-32794

### H

- Hopital d'Instruction des Armees, Versailles (France).**  
Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions [ETN-91-99973] p 342 N91-31761

### I

- Illinois Univ., Chicago.**  
Full-information item bi-factor analysis [AD-A229346] p 350 N91-31771
- Institute for Perception RVO-TNO, Soesterberg (Netherlands).**  
Introduction to multiresolution morphology [IZF-1991-A-10] p 345 N91-32753
- Institute of Aviation Medicine, Farnborough (England).**  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767  
Management of acute and chronic motion sickness p 347 N91-32769
- Institute of Biomedical Problems, Moscow (USSR).**  
Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890  
Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891

## J

- Jet Propulsion Lab., California Inst. of Tech., Pasadena.**  
 NASA's Telerobotic Testbed  
 [AAS PAPER 89-649] p 355 A91-55839  
 The conversion of lignocellulosics to fermentable sugars:  
 A survey of current research and application to CELSS  
 p 357 N91-31784

## K

- Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).**  
 A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour  
 p 337 N91-32027
- Krug International, Houston, TX.**  
 Mini-rack testbed evaluation p 361 N91-32779  
 Transport suction apparatus and absorption materials evaluation p 361 N91-32784  
 Minor surgery in microgravity p 349 N91-32786  
 Evaluation of prototype Advanced Life Support (ALS) pack for use by the Health Maintenance Facility (HMF) on Space Station Freedom (SSF) p 362 N91-32787  
 Evaluation of cardiopulmonary resuscitation techniques in microgravity p 349 N91-32789  
 Fluid handling 2: Surgical applications p 349 N91-32790  
 Evaluation of prototype air/fluid separator for Space Station Freedom Health Maintenance Facility p 362 N91-32791

## L

- Lawrence Livermore National Lab., CA.**  
 Biological dosimetry and mechanisms of carcinogenesis  
 [DE91-015689] p 343 N91-31763  
 The effect of shower/bath frequency on the health and operational effectiveness of soldiers in a field setting  
 [DE91-017545] p 346 N91-32758
- Lockheed Engineering and Sciences Co., Houston, TX.**  
 Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793
- Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM.**  
 Biophysical and biomathematical adventures in radiobiology  
 [DE91-017484] p 337 N91-32750  
 The relevance of animal bioassays to assess human health hazards to inorganic fibrous materials  
 [DE91-017516] p 348 N91-32770
- Lowell Univ., MA.**  
 An ellipsoidal representation of human hand anthropometry p 353 A91-54165

## M

- Manchester Univ. (England).**  
 Developments in medical audit in hospitals in the National Health Service  
 [ETN-91-99984] p 343 N91-31762
- Maryland Univ., College Park.**  
 Cognitive cybernetics and human communication: The regulatory effects of prior knowledge  
 p 351 N91-32771
- Michigan Univ., Ann Arbor.**  
 An ellipsoidal representation of human hand anthropometry p 353 A91-54165

## N

- National Aeronautics and Space Administration, Washington, DC.**  
 Aerospace medicine and biology: A continuing bibliography with indexes (supplement 353)  
 [NASA-SP-7011(353)] p 342 N91-31760  
 Transpiration during life cycle in controlled wheat growth p 358 N91-31795
- National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.**  
 Lower body negative pressure to provide load bearing in space p 338 A91-53887  
 Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889  
 Cyclic AMP-receptor proteins in heart muscle of rats flown on Cosmos 1887 p 333 A91-53890  
 Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

- Controlled Ecological Life Support Systems: CELSS '89 Workshop  
 [NASA-TM-102277] p 356 N91-31775  
 Environmental modification of yield and food composition of cowpea and leaf lettuce p 356 N91-31777  
 The crop growth research chamber: A ground-based facility for CELSS research p 358 N91-31792
- National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.**  
 A kinematic analysis of the Space Station remote manipulator system (SSRMS) p 353 A91-54300
- National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, FL.**  
 Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886  
 Effects of atmospheric CO<sub>2</sub> on photosynthetic characteristics of soybean leaves p 356 N91-31780  
 Effects of elevated atmospheric carbon dioxide concentrations on water and acid requirements of soybeans grown in a recirculating hydroponic system p 356 N91-31781  
 Controlled ecological life support system breadboard project, 1988 p 358 N91-31791  
 Factors affecting plant growth in membrane nutrient delivery p 359 N91-31797
- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.**  
 Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894  
 Biofilm monitoring coupon system and method of use [NASA-CASE-MSC-21585-1] p 336 N91-31755  
 Development of the CELSS emulator at NASA, Johnson Space Center p 358 N91-31793  
 Conceptual design of a closed loop nutrient solution delivery system for CELSS implementation in a micro-gravity environment p 359 N91-31798  
 Solid-support substrates for plant growth at a lunar base p 359 N91-31800  
 Method and apparatus for bio-regenerative life support system [NASA-CASE-MSC-21629-1] p 360 N91-31803  
 Medical evaluations on the KC-135 1990 flight report summary [NASA-TM-104740] p 361 N91-32776  
 Operation and performance of the Ciba-Corning 512 coagulation monitor during parabolic flight p 348 N91-32780  
 Application and use of spinal immobilization devices in zero-gravity flight p 348 N91-32781  
 ATLS: Catheter and tube placement p 348 N91-32782  
 Evaluation of aerosolized medications during parabolic flight maneuvers p 348 N91-32783  
 ATLS-stowage and deployment testing of medical supplies and pharmaceuticals p 361 N91-32785  
 Venipuncture and intravenous infusion access during zero-gravity flight p 349 N91-32788  
 Shuttle Orbiter medical system equipment/supplies evaluation p 362 N91-32793
- National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.**  
 Rotationally actuated prosthetic helping hand [NASA-CASE-MFS-28426-1] p 362 N91-32795
- National Inst. for Occupational Safety and Health, Cincinnati, OH.**  
 Scientific workshop on the Health Effects of Electromagnetic Radiation on Workers: Bibliography [PB91-173351] p 345 N91-32755
- Naval Aerospace Medical Inst., Pensacola, FL.**  
 Motion sickness and its relation to some forms of spatial orientation: Mechanisms and theory p 346 N91-32761  
 Factors influencing susceptibility: Individual differences and human factors p 346 N91-32763
- Naval Air Development Center, Warminster, PA.**  
 The G-LOC syndrome [AD-A239561] p 344 N91-31768  
 Adaptive function allocation for intelligent cockpits [AD-A239714] p 360 N91-31808  
 Aircrew critique of high-G centrifuge training. Part 1: What was the best part of the program? [AD-A239781] p 361 N91-31809
- Naval Health Research Center, San Diego, CA.**  
 Sleep logs: Measurement of individual and operational efficiency [AD-A239774] p 344 N91-31770
- Naval Medical Research and Development Command, Bethesda, MD.**  
 Naval medical research and development command [AD-A239393] p 343 N91-31765
- Naval Medical Research Inst., Bethesda, MD.**  
 Basic operation and preliminary trials of a detector for stationary gas bubbles [AD-A239710] p 344 N91-31769

## O

- Naval Submarine Medical Research Lab., Groton, CT.**  
 The medical hazards of flame-suppressant atmospheres [AD-A239618] p 360 N91-31806
- New Mexico State Univ., Las Cruces.**  
 Preliminary evaluation of waste processing in a CELSS p 357 N91-31788
- North Carolina Univ., Greensboro.**  
 Carotid baroreceptor influence on forearm vascular resistance during low level lower body negative pressure p 338 A91-53886

## P

- Oak Ridge National Lab., TN.**  
 Models of human operators: Their need and usefulness for improvement of advanced control systems and control rooms [DE91-017245] p 352 N91-32774
- Otago Univ., Dunedin (New Zealand).**  
 Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329

## S

- Pacific Northwest Lab., Richland, WA.**  
 Interaction of extremely-low-frequency electromagnetic fields with humans [DE91-015779] p 345 N91-32756
- Pennsylvania State Univ., Hershey.**  
 Cerebrospinal fluid pressure in conscious head-down tilted rats p 333 A91-53889
- San Jose State Univ., CA.**  
 Pineal physiology in microgravity - Relation to rat gonadal function aboard Cosmos 1887 p 333 A91-53891
- San Jose State Univ., Moffett Field, CA.**  
 Adaptation of sleep and circadian rhythms to the Antarctic summer - A question of zeitgeber strength p 340 A91-55329
- Sandia National Labs., Albuquerque, NM.**  
 Human factors engineering design guidelines for the software user interface [DE91-016061] p 359 N91-31802
- School of Aerospace Medicine, Brooks AFB, TX.**  
 Lower body negative pressure to provide load bearing in space p 338 A91-53887  
 Testing and evaluation of the catalyst research MiniOX 3 oxygen monitor [AD-A239665] p 360 N91-31807  
 Publications and presentations of the Ophthalmology Branch, USAF School of Aerospace Medicine, 1981-1990 [AD-A239458] p 345 N91-32754
- Southampton Univ. (England).**  
 Physical characteristics of stimuli provoking motion sickness p 346 N91-32762  
 Sea sickness p 347 N91-32766

## T

- Tennessee Univ., Knoxville.**  
 Boron in nuclear medicine: New synthetic approaches to PET, SPECT, and BNCT agents [DE91-016488] p 343 N91-31764
- Tennessee Univ., Memphis.**  
 Muramyl peptide-enhanced sleep: Pharmacological optimization of performance [AD-A239442] p 343 N91-31766
- Texas Univ., Arlington.**  
 A perspective on CELSS control issues p 358 N91-31794
- Texas Univ., Galveston.**  
 Psychiatric diagnoses in a group of astronaut applicants p 349 A91-53894
- Texas Univ., Houston.**  
 Doppler detection of decompression bubbles with computer assisted digitization of ultrasonic signals p 333 A91-53900
- Texas Univ. Health Science Center, San Antonio.**  
 Health maintenance facility: Dental equipment requirements p 348 N91-32777  
 Dental equipment test during zero-gravity flight p 348 N91-32778
- Tuskegee Inst., AL.**  
 Sweet potato for closed ecological life support systems using the nutrient film technique p 356 N91-31782

**U**

**Utah State Univ., Logan.**

Exploring the limits of crop productivity: A model to evaluate progress p 336 N91-31776

Cloning crops in a CELSS via tissue culture: Prospects and problems p 356 N91-31783

Preparatory space experiments for development of a CELSS p 359 N91-31796

**W**

**Wesley Hospital, Brisbane (Australia).**

The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621

Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

**Wisconsin Univ., Madison.**

Environmental and cultural considerations for growth of potatoes in CELSS p 337 N91-31779

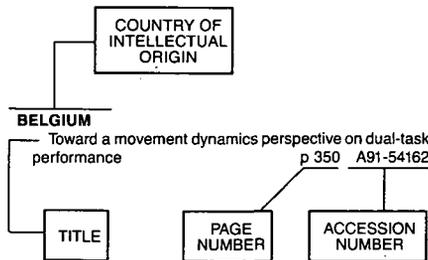
Technology for subsystems of space-based plant growth facilities p 359 N91-31799

# FOREIGN TECHNOLOGY INDEX

AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 357)

January 1992

## Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

### A

#### AUSTRALIA

- The QT interval in lightning injury with implications for the cessation of metabolism hypothesis p 344 N91-32621  
Further identification and treatment modalities in telephone mediated lightning strike p 344 N91-32622

### B

#### BELGIUM

- Toward a movement dynamics perspective on dual-task performance p 350 A91-54162

### C

#### CANADA

- MSS collision detection p 355 A91-56821  
Female aircrew: The Canadian Forces experience, 1979-1989 [DCIEM-90-P-14] p 359 N91-31801  
Signs and symptoms of motion sickness and its basic nature p 346 N91-32760  
Space sickness p 347 N91-32764  
Simulator sickness p 347 N91-32765

#### CHINA, PEOPLE'S REPUBLIC OF

- The characteristics and theoretical basis of the Qigong maneuver p 355 A91-55336

### F

#### FRANCE

- Scientific results from the ISEMSI experiment p 350 A91-54143  
Tracking with a restricted field of view - Performance and eye-head coordination aspects p 355 A91-55330

- Continuous 24 hour ECG study, on ground and in flight, of 19 Mirage 2000 pilots stationed at the Dijon airbase (France). Comparison with similar recordings taken on other types of fighter aircraft or in operationally different conditions [ETN-91-99973] p 342 N91-31761  
Motion Sickness: Significance in Aerospace Operations and Prophylaxis [AGARD-LS-175] p 346 N91-32759

### G

#### GERMANY, FEDERAL REPUBLIC OF

- Influence of tissue inhomogeneities on noninvasive muscle fiber conduction velocity measurements - Investigated by physical and numerical modeling p 354 A91-54511  
Photobiological investigations on spores of *Streptomyces griseus* [DLR-FB-91-14] p 337 N91-32748  
The role of spin chemistry in the primary events of photosynthesis [DE91-017301] p 337 N91-32752

### I

#### INTERNATIONAL ORGANIZATION

- Man in space - A European challenge in biological life support p 352 A91-54141

#### ISRAEL

- Heat stress on helicopter pilots during ground standby p 339 A91-53896

### J

#### JAPAN

- The effect of apomorphine on operant behavior in rats under normoxic and hypoxic conditions p 335 A91-55334  
Role of histamine in motion sickness in *Suncus murinus* p 335 A91-55335  
Study of Man-System for Japanese Experiment Module (JEM) [AAS PAPER 89-627] p 355 A91-55824  
Dexterous manipulator system for Space Station and its future extension [AAS PAPER 89-629] p 355 A91-55826

### M

#### MEXICO

- Experimental and computational study of the radiation-induced decomposition of formaldehyde - Implications to cometary nuclei p 363 A91-53954

### N

#### NETHERLANDS

- A system to determine whole-plant exchange rates of ozone, carbon dioxide and water vapour p 337 N91-32027  
Introduction to multiresolution morphology [IZF-1991-A-10] p 345 N91-32753  
Assessment of drug effectiveness p 347 N91-32768

#### NORWAY

- Increased plasma hypoxanthine values in humans during exposure to simulated altitude of 7,620 meters (25,000 feet) p 341 A91-55333

### S

#### SOUTH AFRICA, REPUBLIC OF

- The EEG in pilot selection p 342 A91-55343

#### SWEDEN

- Markers for development of hypertension in commercial flight aviators p 339 A91-53893

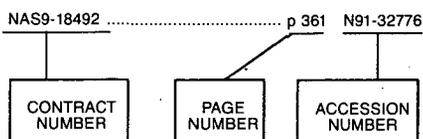
### U

#### U.S.S.R.

- Proteinoid microspheres and the process of prebiological photophosphorylation p 363 A91-53953  
Clinical and physiological assessment of basic nosological forms of vision-organ pathology in pilots p 340 A91-55242  
Biomedical effects of natural UV radiation - Global consequences of the ozone layer destruction p 333 A91-55283  
The effect of UV radiation on the sensory and nociceptive skin sensitivity in nude mice p 334 A91-55284  
The effect of a single irradiation with supererythema doses of UV radiation on the general resistance of nude mice p 334 A91-55285  
The effect of chronic irradiation by UV-B radiation on the nitrogen-fixing capacity of soil in a field study p 334 A91-55286  
Investigation of the sensitivity of various farm crops to short-term UV stress p 334 A91-55287  
Barley yield under continuous exposure to increased levels of UV radiation during growth p 334 A91-55288  
The effect of chronic irradiation by UV-B light on the growth, development, and productivity of fodder beet p 334 A91-55289  
The effect of medium-wavelength-range UV radiation on the photosynthetic apparatus and the productivity of higher plants p 334 A91-55290  
The effect of natural UV radiation on the growth and activity of endogenous growth regulators in barley leaves p 335 A91-55291  
The effect of increased levels of chronic irradiation by natural UV-B light on the functional status of the sheep organism p 335 A91-55292  
Disorders in the regulation of active oxygen forms and of lipid peroxidation in the skin and liver of rats following irradiation by UV-B light p 335 A91-55293  
The electroretinographic parameters and the state of the cornea in the rabbit eye after an acute exposure of the eye to UV radiation of various intensities p 335 A91-55294  
Parameters of the optokinetic reaction of the rabbit after an acute irradiation of the eyes with UV radiation p 335 A91-55295  
The protection of the human eye and skin from solar UV radiation p 335 A91-55296  
Skin and eye injuries caused by solar UV radiation p 340 A91-55297  
Effect of supererythematous doses of UV radiation on the general condition of human organism p 340 A91-55298  
The duration of the aftereffects of UV irradiation under conditions of UV insufficiency p 340 A91-55299  
The resonance hypothesis of motion sickness on the ground p 340 A91-55300  
Mechanism of postflight decline in osmotic concentration of urine in cosmonauts p 341 A91-55332  
Predicting adaptation potentials in military personnel with different constitutional types p 342 A91-55401
- #### UNITED KINGDOM
- Trans-thoracic fluid shifts and endocrine responses to 6-deg head-down tilt p 338 A91-53885  
Airline pilot incapacitation survey p 341 A91-55337  
Developments in medical audit in hospitals in the National Health Service [ETN-91-99984] p 343 N91-31762  
Physical characteristics of stimuli provoking motion sickness p 346 N91-32762  
Sea sickness p 347 N91-32766  
Prevention and treatment of motion sickness: Non-pharmacological therapy p 347 N91-32767  
Management of acute and chronic motion sickness p 347 N91-32769  
An investigation into the potential use of psychometric instruments for the selection of firearms officers [CRANFIELD-AERO-9108] p 351 N91-32772

# CONTRACT NUMBER INDEX

## Typical Contract Number Index Listing

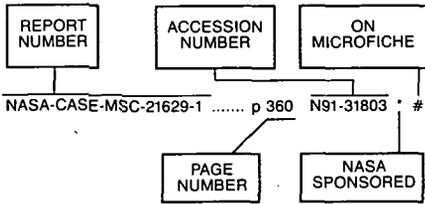


Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under the contract are shown. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF PROJ. 1123 .....	p 352	N91-32773
AF PROJ. 7755 .....	p 345	N91-32754
AF PROJ. 7930 .....	p 360	N91-31807
A87/D/149 .....	p 345	N91-32753
DA PROJ. 161-62786-AH-98 .....	p 361	N91-32775
DA PROJ. 3M1-61102-BS-13 .....	p 336	N91-31758
DA PROJ. 3M1-61102-BS-15 .....	p 343	N91-31766
DAMD17-86-C-6194 .....	p 343	N91-31766
DAMD17-90-C-0010 .....	p 336	N91-31758
DE-AC02-76CH-00016 .....	p 336	N91-31756
DE-AC03-76SF-00098 .....	p 337	N91-32749
DE-AC04-76DP-00789 .....	p 359	N91-31802
DE-AC04-76EV-01013 .....	p 337	N91-32750
	p 348	N91-32770
DE-AC05-84OR-21400 .....	p 352	N91-32774
DE-AC06-76RL-01830 .....	p 345	N91-32756
DE-FG02-86ER-13620 .....	p 337	N91-32751
DE-FG02-86ER-60438 .....	p 342	N91-31759
DE-FG05-86ER-60434 .....	p 343	N91-31764
DRET-87-1027 .....	p 342	N91-31761
DRET-87-1361 .....	p 355	A91-55330
F04701-88-C-0089 .....	p 360	N91-31805
MDA903-86-C-0142 .....	p 351	N91-31772
MDA903-86-C-0169 .....	p 353	A91-54164
MDA903-86-K-0155 .....	p 351	N91-31773
MDA903-89-C-0134 .....	p 351	N91-31774
NADC PROJ. RS-3-4-H20 .....	p 360	N91-31808
NAG10-24 .....	p 356	N91-31782
NAG9-215 .....	p 333	A91-53900
NASA ORDER A-53751-C .....	p 333	A91-53891
NAS10-10285 .....	p 338	A91-53886
NAS9-17900 .....	p 358	N91-31793
NAS9-17981 .....	p 359	N91-31798
NAS9-18492 .....	p 361	N91-32776
NATO-732/86 .....	p 350	A91-54162
NCA2-101 .....	p 358	N91-31795
NCC2-100 .....	p 356	N91-31777
NCC2-127 .....	p 333	A91-53889
NGT-23-005-802 .....	p 353	A91-54165
NGT-50302 .....	p 363	A91-53951
NGT-60002 .....	p 338	A91-53886
NIH-HL-20634 .....	p 338	A91-53888
NIH-HL-39818 .....	p 338	A91-53888
NR PROJ. RR0-42046 .....	p 350	N91-31771
N00014-89-J-1104 .....	p 350	N91-31771
W-31-109-ENG-38 .....	p 337	N91-32752
	p 345	N91-32757
W-7405-ENG-48 .....	p 343	N91-31763
	p 346	N91-32758
199-61-12 .....	p 356	N91-31775

# REPORT NUMBER INDEX

## Typical Report Number Index Listing

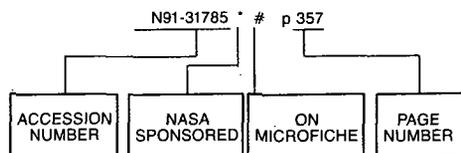


Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (\*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-90059	p 356	N91-31775	* #	CRANFIELD-AERO-9108	p 351	N91-32772	#	S-646	p 361	N91-32776	* #
AAS PAPER 89-627	p 355	A91-55824		CTN-91-60197	p 359	N91-31801		SAE PAPER 911197	p 352	A91-53597	
AAS PAPER 89-629	p 355	A91-55826		CU-153-0638	p 351	N91-31773	#	SAND-91-0872	p 359	N91-31802	#
AAS PAPER 89-649	p 355	A91-55839	*	DCIEM-90-P-14	p 359	N91-31801		SSD-TR-91-26	p 360	N91-31805	#
AD-A229346	p 350	N91-31771	#	DE91-015447	p 342	N91-31759	#	TD-91-0038	p 345	N91-32753	
AD-A229520	p 361	N91-32775	#	DE91-015689	p 343	N91-31763	#	TR-0090(5530-02)-1	p 360	N91-31805	#
AD-A239393	p 343	N91-31765	#	DE91-015779	p 345	N91-32756	#	UCRL-CR-105166-1	p 346	N91-32758	#
AD-A239442	p 343	N91-31766	#	DE91-015837	p 336	N91-31756	#	UCRL-JC-107755	p 343	N91-31763	#
AD-A239452	p 351	N91-31772	#	DE91-016061	p 359	N91-31802	#	US-PATENT-APPL-SN-378548	p 360	N91-31803	* #
AD-A239456	p 352	N91-32773	#	DE91-016255	p 337	N91-32749	#	US-PATENT-APPL-SN-493529	p 336	N91-31755	*
AD-A239458	p 345	N91-32754	#	DE91-016488	p 343	N91-31764	#	US-PATENT-APPL-SN-508154	p 362	N91-32795	*
AD-A239461	p 336	N91-31757	#	DE91-016814	p 345	N91-32757	#	US-PATENT-CLASS-210-748	p 360	N91-31803	* #
AD-A239467	p 360	N91-31804	#	DE91-016842	p 337	N91-32751	#	US-PATENT-CLASS-244-159	p 360	N91-31803	* #
AD-A239493	p 343	N91-31767	#	DE91-017245	p 352	N91-32774	#	US-PATENT-CLASS-244-163	p 360	N91-31803	* #
AD-A239512	p 360	N91-31805	#	DE91-017301	p 337	N91-32752	#	US-PATENT-CLASS-422-101	p 336	N91-31755	*
AD-A239561	p 344	N91-31768	#	DE91-017484	p 337	N91-32750	#	US-PATENT-CLASS-422-99	p 336	N91-31755	*
AD-A239574	p 351	N91-31773	#	DE91-017516	p 348	N91-32770	#	US-PATENT-CLASS-435-30	p 336	N91-31755	*
AD-A239618	p 360	N91-31806	#	DE91-017545	p 346	N91-32758	#	US-PATENT-CLASS-47-1.4	p 360	N91-31803	* #
AD-A239640	p 336	N91-31758	#	DLR-FB-91-14	p 337	N91-32748	#	US-PATENT-CLASS-47-62	p 360	N91-31803	* #
AD-A239665	p 360	N91-31807	#	DOE/ER-13620/4	p 337	N91-32751	#	US-PATENT-CLASS-55-75	p 360	N91-31803	* #
AD-A239708	p 351	N91-31774	#	DOE/ER-60434/6	p 343	N91-31764	#	US-PATENT-CLASS-623-62	p 362	N91-32795	*
AD-A239710	p 344	N91-31769	#	DOE/ER-60438/T3	p 342	N91-31759	#	US-PATENT-CLASS-623-63	p 362	N91-32795	*
AD-A239714	p 360	N91-31808	#	ESA-TT-1269	p 337	N91-32748	#	US-PATENT-CLASS-73-863.22	p 336	N91-31755	*
AD-A239774	p 344	N91-31770	#	ETN-91-90044	p 337	N91-32748	#	US-PATENT-CLASS-73-863.41	p 336	N91-31755	*
AD-A239781	p 361	N91-31809	#	ETN-91-99897	p 351	N91-32772	#	US-PATENT-CLASS-73-863.85	p 336	N91-31755	*
AFIT/CI/CIA-91-028	p 360	N91-31804	#	ETN-91-99973	p 342	N91-31761	#	US-PATENT-CLASS-73-863.86	p 336	N91-31755	*
AFIT/CI/CIA-91-054	p 336	N91-31757	#	ETN-91-99984	p 343	N91-31762	#	US-PATENT-5,005,787	p 360	N91-31803	* #
AGARD-LS-175	p 346	N91-32759	#	ETN-91-99990	p 345	N91-32753	#	US-PATENT-5,021,065	p 362	N91-32795	*
AIAA PAPER 91-3089	p 352	A91-54018	#	INT-PATENT-CLASS-A61F-2/58	p 362	N91-32795	*	US-PATENT-5,049,492	p 336	N91-31755	*
AL-TR-1991-0005	p 352	N91-32773	#	INT-PATENT-CLASS-A61F-2/68	p 362	N91-32795	*	USAFSAM-SR-90-6	p 345	N91-32754	#
ANL/CP-73656	p 337	N91-32752	#	INT-PATENT-CLASS-B64G-1/46	p 360	N91-31803	* #	USAFSAM-TR-90-25	p 360	N91-31807	#
ANL/EAIS-2	p 345	N91-32757	#	ISBN-1-871564-29-8	p 351	N91-32772	#	USARIEM-T11-91	p 343	N91-31767	#
ARI-RN-91-78	p 351	N91-31774	#	ISBN-92-835-0634-0	p 346	N91-32759	#				
ARI-RN-91-81	p 351	N91-31773	#	ISSN-0939-2963	p 337	N91-32748	#				
ARI-RN-91-82	p 351	N91-31772	#	IZF-1991-A-10	p 345	N91-32753					
BNL-46391	p 336	N91-31756	#	LBL-30682	p 337	N91-32749	#				
CONF-9010405-1	p 348	N91-32770	#	NADC-91028-60	p 360	N91-31808	#				
CONF-9103198-1	p 337	N91-32750	#	NADC-91042-60	p 344	N91-31768	#				
CONF-9104280-1	p 343	N91-31763	#	NADC-91054-60-PT-1	p 361	N91-31809	#				
CONF-9106254-1	p 336	N91-31756	#	NAS 1.15:102277	p 356	N91-31775	* #				
CONF-9107136-4	p 345	N91-32756	#	NAS 1.15:104740	p 361	N91-32776	* #				
CONF-9107163-1	p 337	N91-32752	#	NAS 1.21:7011(353)	p 342	N91-31760	*				
CONF-911001-2	p 352	N91-32774	#	NASA-CASE-MFS-28426-1	p 362	N91-32795	*				
				NASA-CASE-MSC-21585-1	p 336	N91-31755	*				
				NASA-CASE-MSC-21629-1	p 360	N91-31803	* #				
				NASA-SP-7011(353)	p 342	N91-31760	*				
				NASA-TM-102277	p 356	N91-31775	* #				
				NASA-TM-104740	p 361	N91-32776	* #				
				NATICK/TR/90/054	p 361	N91-32775	#				
				NHRC-90-29	p 344	N91-31770	#				
				NMRI-91-39	p 344	N91-31769	#				
				NSMRL-1167	p 360	N91-31806	#				
				PB91-173351	p 345	N91-32755	#				
				PNL-SA-19016	p 345	N91-32756	#				
				REPT-90-6	p 351	N91-31774	#				

# ACCESSION NUMBER INDEX

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Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (\*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A91-53597	p 352	A91-55298	p 340
A91-53885	p 338	A91-55299	p 340
A91-53886	p 338	A91-55300	p 340
A91-53887 *	p 338	A91-55329 *	p 340
A91-53888	p 338	A91-55330	p 355
A91-53889 *	p 333	A91-55331	p 340
A91-53890 *	p 333	A91-55332	p 341
A91-53891 *	p 333	A91-55333	p 341
A91-53892	p 338	A91-55334	p 335
A91-53893	p 339	A91-55335	p 335
A91-53894 *	p 349	A91-55336	p 355
A91-53895	p 350	A91-55337	p 341
A91-53896	p 339	A91-55338	p 341
A91-53897	p 339	A91-55339	p 350
A91-53898	p 339	A91-55340	p 341
A91-53899	p 339	A91-55341	p 350
A91-53900 *	p 333	A91-55342	p 342
A91-53951 *	p 363	A91-55343	p 342
A91-53952 *	p 363	A91-55344	p 342
A91-53953	p 363	A91-55401	p 342
A91-53954	p 363	A91-55824	p 355
A91-53986	p 352	A91-55826	p 355
A91-54018 #	p 352	A91-55839 *	p 355
A91-54141	p 352	A91-56821	p 355
A91-54143	p 350		
A91-54162	p 350	N91-31755 *	p 336
A91-54163	p 353	N91-31756 #	p 336
A91-54164	p 353	N91-31757 #	p 336
A91-54165 *	p 353	N91-31758 #	p 336
A91-54166	p 353	N91-31759 #	p 342
A91-54296	p 339	N91-31760 *	p 342
A91-54297	p 353	N91-31761 #	p 342
A91-54298	p 353	N91-31762 #	p 343
A91-54300 *	p 353	N91-31763 #	p 343
A91-54511	p 354	N91-31764 #	p 343
A91-54640	p 354	N91-31765 #	p 343
A91-54647	p 354	N91-31766 #	p 343
A91-54662	p 354	N91-31767 #	p 343
A91-54874	p 354	N91-31768 #	p 344
A91-55242	p 340	N91-31769 #	p 344
A91-55283	p 333	N91-31770 #	p 344
A91-55284	p 334	N91-31771 #	p 350
A91-55285	p 334	N91-31772 #	p 351
A91-55286	p 334	N91-31773 #	p 351
A91-55287	p 334	N91-31774 #	p 351
A91-55288	p 334	N91-31775 #	p 356
A91-55289	p 334	N91-31776 #	p 336
A91-55290	p 334	N91-31777 #	p 356
A91-55291	p 335	N91-31778 #	p 356
A91-55292	p 335	N91-31779 #	p 337
A91-55293	p 335	N91-31780 #	p 356
A91-55294	p 335	N91-31781 #	p 356
A91-55295	p 335	N91-31782 #	p 356
A91-55296	p 355	N91-31783 #	p 356
A91-55297	p 340	N91-31784 #	p 357

N91-31785 *	#	p 357
N91-31786 *	#	p 357
N91-31787 *	#	p 357
N91-31788 *	#	p 357
N91-31789 *	#	p 358
N91-31790 *	#	p 358
N91-31791 *	#	p 358
N91-31792 *	#	p 358
N91-31793 *	#	p 358
N91-31794 *	#	p 358
N91-31795 *	#	p 358
N91-31796 *	#	p 359
N91-31797 *	#	p 359
N91-31798 *	#	p 359
N91-31799 *	#	p 359
N91-31800 *	#	p 359
N91-31801		p 359
N91-31802 #		p 359
N91-31803 *	#	p 360
N91-31804 #		p 360
N91-31805 #		p 360
N91-31806 #		p 360
N91-31807 #		p 360
N91-31808 #		p 360
N91-31809 #		p 361
N91-32027 #		p 337
N91-32621 *	#	p 344
N91-32622 *	#	p 344
N91-32623 *	#	p 345
N91-32748 #		p 337
N91-32749 #		p 337
N91-32750 #		p 337
N91-32751 #		p 337
N91-32752 #		p 337
N91-32753		p 345
N91-32754 #		p 345
N91-32755 #		p 345
N91-32756 #		p 345
N91-32757 #		p 345
N91-32758 #		p 346
N91-32759 #		p 346
N91-32760 #		p 346
N91-32761 #		p 346
N91-32762 #		p 346
N91-32763 #		p 346
N91-32764 #		p 347
N91-32765 #		p 347
N91-32766 #		p 347
N91-32767 #		p 347
N91-32768 #		p 347
N91-32769 #		p 347
N91-32770 #		p 348
N91-32771		p 351
N91-32772 #		p 351
N91-32773 #		p 352
N91-32774 #		p 352
N91-32775 #		p 361
N91-32776 *	#	p 361
N91-32777 #		p 348
N91-32778 *	#	p 348
N91-32779 *	#	p 361
N91-32780 *	#	p 348
N91-32781 *	#	p 348
N91-32782 *	#	p 348
N91-32783 *	#	p 348
N91-32784 *	#	p 361
N91-32785 *	#	p 361
N91-32786 *	#	p 349
N91-32787 *	#	p 362
N91-32788 *	#	p 349
N91-32789 *	#	p 349
N91-32790 *	#	p 349
N91-32791 *	#	p 362
N91-32792 *	#	p 362
N91-32793 *	#	p 362
N91-32794 *	#	p 362
N91-32795 *		p 362

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(201) 733-7812 FAX: (201) 733-5648

## NEW MEXICO

**UNIV. OF NEW MEXICO**  
General Library  
Govt. Publications Dept.  
Albuquerque, NM 87131-1466  
(505) 277-5441 FAX: (505) 277-6019

## NEW MEXICO STATE LIBRARY

325 Don Gaspar Avenue  
Santa Fe, NM 87503  
(505) 827-3826 FAX: (505) 827-3820

## NEW YORK

**NEW YORK STATE LIBRARY**  
Documents/Gift & Exchange Section  
Federal Depository Program  
Cultural Education Center  
Albany, NY 12230  
(518) 474-5563 FAX: (518) 474-5786

## NORTH CAROLINA

**UNIV. OF NORTH CAROLINA - CHAPEL HILL**  
CB#3912, Davis Library  
BA/SS Dept. - Documents  
Chapel Hill, NC 27599  
(919) 962-1151 FAX: (919) 962-0484

## NORTH DAKOTA

**NORTH DAKOTA STATE UNIV. LIBRARY**  
Documents Office  
Fargo, ND 58105  
(701) 237-8886 FAX: (701) 237-7138  
In cooperation with Univ. of North  
Dakota, Chester Fritz Library  
Grand Forks

## OHIO

**STATE LIBRARY OF OHIO**  
Documents Dept.  
65 South Front Street  
Columbus, OH 43266  
(614) 644-7051 FAX: (614) 752-9178

## OKLAHOMA

**OKLAHOMA DEPT. OF LIBRARIES**  
U.S. Govt. Information Div.  
200 NE 18th Street  
Oklahoma City, OK 73105-3298  
(405) 521-2502, ext. 252, 253  
FAX: (405) 525-7804

## OKLAHOMA STATE UNIV.

Edmon Low Library  
Documents Dept.  
Stillwater, OK 74078  
(405) 744-6546 FAX: (405) 744-5183

## OREGON

**PORTLAND STATE UNIV.**  
Millar Library  
934 SW Harrison - P.O. Box 1151  
Portland, OR 97207  
(503) 725-3673 FAX: (503) 725-4527

## PENNSYLVANIA

**STATE LIBRARY OF PENN.**  
Govt. Publications Section  
Walnut St. & Commonwealth Ave.  
P.O. Box 1601  
Harrisburg, PA 17105  
(717) 787-3752

## SOUTH CAROLINA

**CLEMSON UNIV.**  
Cooper Library  
Public Documents Unit  
Clemson, SC 29634-3001  
(803) 656-5174 FAX: (803) 656-3025  
In cooperation with Univ. of South  
Carolina, Thomas Cooper Library,  
Columbia

## TENNESSEE

**MEMPHIS STATE UNIV. LIBRARIES**  
Govt. Documents  
Memphis, TN 38152  
(901) 678-2586 FAX: (901) 678-2511

## TEXAS

**TEXAS STATE LIBRARY**  
United States Documents  
P.O. Box 12927 - 1201 Brazos  
Austin, TX 78711  
(512) 463-5455 FAX: (512) 463-5436

## TEXAS TECH. UNIV. LIBRARY

Documents Dept.  
Lubbock, TX 79409  
(806) 742-2268 FAX: (806) 742-1920

## UTAH

**UTAH STATE UNIV.**  
Merrill Library & Learning Resources  
Center, UMC-3000  
Documents Dept.  
Logan, UT 84322-3000  
(801) 750-2684 FAX: (801) 750-2677

## VIRGINIA

**UNIV. OF VIRGINIA**  
Alderman Library  
Govt. Documents  
Charlottesville, VA 22903-2498  
(804) 924-3133 FAX: (804) 924-4337

## WASHINGTON

**WASHINGTON STATE LIBRARY**  
Document Section  
MS AJ-11  
Olympia, WA 98504-0111  
(206) 753-4027 FAX: (206) 753-3546

## WEST VIRGINIA

**WEST VIRGINIA UNIV. LIBRARY**  
Govt. Documents Section  
P.O. Box 6069  
Morgantown, WV 26506  
(304) 293-3640

## WISCONSIN

**ST. HIST. SOC. OF WISCONSIN LIBRARY**  
Govt. Publications Section  
816 State Street  
Madison, WI 53706  
(608) 262-2781 FAX: (608) 262-4711  
In cooperation with Univ. of Wisconsin-  
Madison, Memorial Library

## MILWAUKEE PUBLIC LIBRARY

Documents Div.  
814 West Wisconsin Avenue  
Milwaukee, WI 53233  
(414) 278-2167 FAX: (414) 278-2137

## WYOMING

**WYOMING STATE LIBRARY**  
Supreme Court & Library Bldg.  
Govt. Publications  
Cheyenne, WY 82002  
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