AEROSPACE MEDICINE
AND BIOLOGY

A CONTINUING BIBLIOGRAPHY
WITH INDEXES

(Supplement 308)

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

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

NASA
Scientific and Technical Information Division 1988
National Aeronautics and Space Administration
Washington, DC
INTRODUCTION

This Supplement to Aerospace Medicine and Biology lists 175 reports, articles and other documents announced during February 1988 in Scientific and Technical Aerospace Reports (STAR) or in International Aerospace Abstracts (IAA). The first issue of the bibliography was published in July 1964.

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

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

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

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

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

**TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT**

NASA SPONSORED

ACCESSION NUMBER A88-12321*

TITLE CONTINUOUS MONITORING OF BLOOD VOLUME CHANGES IN HUMANS

AUTHORS H. HINGHOFER-SZALKAY and J. E. GREENLEAF (NASA, Ames Research Center, Moffett Field, CA; Graz, Universitaet, Austria)

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

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

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

A Continuing Bibliography (Suppl. 308)

MARCH 1988

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LIFE SCIENCES (GENERAL)

A88-13695

The significance of the presence in high numbers of the ultraforms of soil- and sea-inhabiting bacteria is discussed along with the structures of the natural populations of ultramicrobacteria and their relationships with higher plants and animals. Methods used for isolating ultramicrobacteria and for studying their viability and metabolism are described. Attention is given to the various species of soil microbacteria, including the smallest forms of Azotobacter and Rhizobium genera, and to the ultramicroforms found in sea water and in sediments. The data collected suggest that the appearance of such microorganisms is connected with an unfavorable environment. The organisms can be formed as a result of mini-cell formation, multiple cleavage of the mother cell, or L- transformation. Their ecological role is interpreted in terms of adaptation to unfavorable conditions. I.S.

A88-13697

The paper studies the potential of para-aminobenzoic acid (PABA) for restoring the activity of alkaline RNase after its partial inactivation by heat, X-rays, or UV light. The activating effect of PABA was found to depend on its concentration and on the deactivating agent dose. Joint incubation with PABA protected the enzyme during 2-min-long incubation at 100°C or 5-day-long incubation at 60°C. It is suggested that PABA stabilizes the RNase by interacting with the active form of the enzyme. I.S.

A88-13698

The intensity of stimulating current delivered to hypothalamus was correlated with the features of hypothalamic self-stimulation in rabbits fitted with unipolar electrodes implanted into lateral region of the hypothalamus. The extent of the hypothalamic self-stimulation reaction was measured by a specific motor reaction that was expressed in rabbits by frequent pressing on a pedal installed into the cage wall. Three different pattern types were found in different rabbits for the current-intensity/ pedal compression-rate correlation. I.S.

A88-13699

The mechanisms of homosynaptic depression of rhythmic discharges in the cerebrospinal monosynaptic arc were investigated in cats subjected to tracheotomy, isolation of a number of individual hind-limb nerves, laminecetomy, and the excision of ventral and dorsal roots of the lumbar segments VI and VII and the sacral segment I. Intracellular motor neuron postsynaptic potentials and action potentials of these segments were diverted under anesthesia and artificial respiration. A high functional stability of the spinal cord motor neurons was demonstrated under conditions of long-term orthodromic and antidromic stimulation of afferent neurons. It was shown that the depression of reflex discharges observed was related to a drop in the probability of the transmitter release from the primary afferents’ terminals. The analysis of the signs of the habituation phenomenon reveals their similarity to the phenomenon of the homosynaptic depression.

A88-14422
THE METAPHYSICAL PRESUPPOSITIONS OF THE 'ANTHROPIC PRINCIPLE'

The 'anthropic principle' states that the discussion of the values of fundamental constants is possible only if these values allow for the development of biological molecules in the expanding universe required to develop intelligence. This statement rests on the implicit, and naive, hypothesis that 'knowledge' is a natural consequence of neuronal activity which is a prerequisite for its existence. This hypothesis constitutes a highly metaphysical prejudice. It will be discussed (and criticized) in the light of transcendental schematism (Kant) and transcendental semiotics (Appel). Author
A88-14548 FEMTOSECOND LASER-TISSUE INTERACTIONS - RETINAL INJURY STUDIES

The first study of laser-tissue interaction in the femtosecond time domain was reported. Retinal damage mechanisms induced by exposure to high-intensity femtosecond laser pulses were investigated in chinchilla grey rabbits. Exposures were performed using single laser pulses of 80 fs duration at 625 nm. ED50 injury thresholds of 0.75 and 4.5 micro-J were measured using fluorescein angiographic and ophthalmoangiographic visibility criteria evaluating 204 laser exposures. Ultrastructural studies including light and electron microscopy were performed on selected lesions. Results suggest that the primary energy deposition in the retina occurs in melanin. However, in contrast to laser injuries produced by longer pulses, exposures of more than 100 x threshold in the 50-100 micro-J range did not produce significantly more severe lesions or hemorrhage. This suggests the presence of a non-linear damage limiting mechanics in tissue exposed to femtosecond laser pulses.

A88-14767 ANALYSIS OF THE SYNERGISTIC EFFECT OF HEAT AND RADIATION ON BACTERIOPHAGE T4 AND THE SPORES OF BACILLUS SUBTILIS [ANALIZ EFFEKTA SINERGIZMA PRI TERRMORADIATSIONNOI VOZDElSTVII NA BAKTERIOFAG T4 I SPORY BACILLUS SUBTILIS]
V. P. KOMAROV and V. G. PETIN (AMN SSSR, Nauchno-Issledovatel'ski Institut Meditsinskoi Radiologii, Obninsk, USSR) Radiobiologiya (ISSN 0033-8192), vol. 27, July-Aug. 1987, p. 449-454. In Russian. refs

Using inactivation data on the bacteriophage T4 and the spores of B. subtilis subjected to the combined action of heat and ionizing radiation, a semiempirical model was developed describing the combined effect of hyperthermia and ionizing radiation in terms of lethal damage threshold mechanisms produced by exposure to high-intensity femtosecond laser pulses were investigated in chinchilla grey rabbits. Exposures were performed using single laser pulses of 80 fs duration at 625 nm. ED50 injury thresholds of 0.75 and 4.5 micro-J were measured using fluorescein angiographic and ophthalmoangiographic visibility criteria evaluating 204 laser exposures. Ultrastructural studies including light and electron microscopy were performed on selected lesions. Results suggest that the primary energy deposition in the retina occurs in melanin. However, in contrast to laser injuries produced by longer pulses, exposures of more than 100 x threshold in the 50-100 micro-J range did not produce significantly more severe lesions or hemorrhage. This suggests the presence of a non-linear damage limiting mechanics in tissue exposed to femtosecond laser pulses.

A88-14769 ANALYSIS OF THE LIFE-SHORTENING EFFECT IN AN EXPERIMENT WITH CHRONIC EXTERNAL GAMMA-IRRADIATION - IN SUPPORT OF THE AGING HYPOTHESIS [ANALIZ SOKRASHCHENII PRODOLZHITEL'NOSTI ZHIZNI V EKSPERIMENTE S KHRONICHESKIM VNESHNIM GAMMA-OBLUCHENIEM V ZASHCHITU GIPOTEZY STARENIIA]
P. V. GOLOSHCHAPOV and M. I. VORO'B'EVA (Institut Biofiziki, Moscow, USSR) Radiobiologiya (ISSN 0033-8192), vol. 27, July-Aug. 1987, p. 501-504. In Russian. refs

A88-14770 CORRELATION BETWEEN CHANGES IN RADIOSENSITIVITY AND THE ACTIVITY OF BLOOD LYMPHOCYTE SUCINNATE DEHYDROGENASE EFFECTED BY EXOGENIC HYPOXIA [SOPOSTAVLENIE IZMENENII AKTIVNOSTI SUKTSINAT-DEGIDROGENAZY V LIMFOTSITAH KROVI I MODIFIT-SIREMOI RADIOCHUVSTVITEL'NOSTI POD VLIIANIEM EK-ZOGENNOI GIPOKSII]
A. N. GAIDAMAKIN and M. M. ABRAMOV Radiobiologiya (ISSN 0033-8192), vol. 27, July-Aug. 1987, p. 524-528. In Russian. refs

The radioprotective efficiency of experimental hypoxia, expressed as a dose-modifying factor (DMF), was correlated with the reaction rate of blood-lymphocyte succinate dehydrogenase, V(SDH), determined as a measure of lymphocyte oxygen content. Following whole-body irradiation by Co-60, dogs and rats were exposed to oxygen/nitrogen atmospheres containing from 5 to 12 percent O2, and the values of V(SDH) were correlated with the O2 content in the gas mixture and with the LD50/30 of the animal. The empirical formulas for the relationships between the V(SDH) and the O2-content and between the DMF and the V(SDH) are presented.

A88-14771 RADIOPROTECTIVE ACTIVITY OF AMINOARYLTIAZOLES AND SOME MECHANISMS OF THEIR ACTION [RADIOZASHCHITYNAIA AKTIVNOST' AMINOARILTIAZOLOV I NEKOTORYE MEKHANIZMY IKH DEISTVIIA]

The radioprotective efficiencies of 17 derivatives of 2-amino-4-phenylthiazole were compared using mice irradiated with gamma-rays (7.3 cGy/min) and treated with the compound one hour before irradiation; survival rates were determined on the 30th day after irradiation. It is shown that the reaction center primarily responsible for the radioprotective effect of the aminoaryltiazoles is the amino group of the compounds. Phenyl residue also contributes. The 2-amino-4-phenylthiazole itself is the most efficient radioprotector and has relatively low toxicity.

A88-14772 COMBINED EFFECTS OF IONIZING RADIATION AND PHYSICAL EXERCISE ON SOME INDICES OF NONSPECIFIC BIOPROTECTION AND IMMUNITY [SOCHETANNOE DEISTVIE IONIZIRUUSCHIKH IZLUCHENII I FIZICHESKIH NAGRUZOK NA NEKOTORYE POZITIVNEI NESPETSIFICHESKII ZASCHITCH I IMMUNITETA]

The combined effects of ionizing radiation and physical loads of various type and intensity on some indices of nonspecific bioprotection (such as lysozyme activity and leucocyte migration in agarose) and immunity (such as bactericidal activity, lysozyme activity, and complement concentration) were determined in rats and mice. Rats were either forced to swim several times a week for various periods of time or were subjected to static loads.
system, and striolar cells (primary Type I cells) report skull
lower corner frequency, peripheral sensory cells report skull
acceleration information to the central nervous system. Below the
system dynamic response indicates that, between the two
corner frequencies, the peripheral sensory cells (primary
was determined by bending (using modified quasi-static cantilever
bending methods and equipment described by Wunder et al., 1977
and 1979) and Ca content (C, by mass pct) determined by atomic
absorption spectrometry; results were compared with data obtained
on both normal and harnessed control animals at 1 G. Multiple
regression showed significant dependence of S upon earth’s
gravity, independent from C, for which there was no significant
coefficient of partial regression. It is suggested that the lack of
S/C correlation might have been due to the fact that considerable
fraction of the calcium in these young, developing bones has not
yet crystallized into the hydroxyapatite which provides strength.

A88-14773
EFFECT OF MICROWAVE RADIATION ON THE
DOPAMINE-DEPENDENT BEHAVIOR OF RABBITS [VLJANIE
ELEKTROMAGNITNYKH IZLUCHENII SVCH-DIAPAIZONA NA
DOPAMINAZVISIMOE POVEDENIE KROLIKOV]
L. A. ANDREEVA, V. F. KONOVALOV, and I. IA. PODOLSKII
(AN SSSR, Institut Biologicheski Fiziki, Pushchino, USSR)
Radiobiologii (ISSN 0033-8192), vol. 27, July-Aug. 1987, p.
567-569. In Russian. refs

The effect of caudal-area irradiation by microwaves on the
stereotyped dopamine-induced behavior of rabbits was studied in
animals injected with a dopamine receptor stimulator, apomorphine,
and then exposed to microwaves (of 880 MHz frequency delivered to
the caudal area) for 30 min in the following regimes: uniform
exposure; exposure with 2-ms impulse modulation at 16 Hz; and
exposure with 30-Hz modulation. The specific dopamine-stimulated
behavior of rabbits (i.e., strong synergic blows with hind limbs, alternating with intensive licking and gnawing of the cage walls) observed in irradiated and control rabbits was recorded for one
hour post-apomorphine, as a number of hind-limb blows every 3
min. Exposure to microwaves did not influence the stereotyped
behavior of rabbits. However, 10 percent of animals exhibited a
marked decrease in the test-response after irradiation with 16-Hz
impulse. It is suggested that this reaction reflected an elevated
individual sensitivity of some animals to microwaves.

A88-15341
OTOLITH-ORGAN MECHANICS - LUMPED PARAMETER MODEL
AND DYNAMIC RESPONSE
WALLACE GRANT and WILLIAM BEST (Virginia Polytechnic
Institute and State University, Blacksburg) Aviation, Space, and
970-976. refs

The otolith organs comprise a second-order system whose
response is overdamped and whose dynamics can be expressed by
two time constants. The long time constant has been experimentally measured at 10 s. The short time constant is approximately 0.002 s using a maximum mechanical displacement
criterion for the otoclaral layer. With these two values determined,
the system dynamic response indicates that, between the two
system corner frequencies, the peripheral sensory cells (primary
Type II cells) report skull velocity information to the central nervous
system, and striolar cells (primary Type I cells) report skull
acceleration information to the central nervous system. Below the
lower corner frequency, peripheral sensory cells report skull
acceleration information to the central nervous system, and striolar
sensory cells report rate of change of acceleration information to
the central nervous system.

A88-15342*  Iowa Univ., Iowa City.
FEMUR-BENDING PROPERTIES AS INFLUENCED BY GRAVITY.
V - STRENGTH VS. CALCIUM AND GRAVITY IN RATS EXPOSED
FOR 2 WEEKS
CHARLES C. WUNDER, KENNETH M. COOK, STANLEY R.
WATKINS, and WILLIAM J. MORESSI (Iowa, University, Iowa City;
Coe College, Cedar Rapids, IA; Winthrop College, Rock Hills, SC)
Aviation, Space, and Environmental Medicine (ISSN 0095-6562),
vol. 58, Oct. 1987, p. 977-982. refs

The dependence of gravitationally related changes in femur
bone strength on the comparable changes in calcium content was
investigated in rats exposed to chronic simulations of altered gravity
from the 28th to 42nd day of age. Zero G was simulated by
harness suspension; 1 G by control. Bone strength (S) was
determined by bending (using modified quasi-static cantilever
bending methods and equipment described by Wunder et al., 1977
and 1979) and Ca content (C, by mass pct) determined by atomic
absorption spectrometry; results were compared with data obtained
on both normal and harnessed control animals at 1 G. Multiple
regression showed significant dependence of S upon earth’s
gravity, independent from C, for which there was no significant
coefficient of partial regression. It is suggested that the lack of
S/C correlation might have been due to the fact that considerable
fraction of the calcium in these young, developing bones has not
yet crystallized into the hydroxyapatite which provides strength.

A88-15343*  National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
INHIBITED INTERFERON-GAMMA BUT NORMAL INTER-
LEUKIN-3 PRODUCTION FROM RATS FLOWN ON THE SPACE
SHUTTLE
CHERYL L. GOULD, MARK LYTE, JOANN WILLIAMS, ADRIAN
D. MANDELM, and GERALD SONNENFELD (NASA, Ames Research
Center, Moffett Field, CA; Louisville, University, KY; Pittsburgh,
University, PA) Aviation, Space, and Environmental Medicine
(ISSN 0095-6562), vol. 58, Oct. 1987, p. 983-986. refs

Rats were flown on Space Shuttle SL-3 for one week. When
spine cells were removed from these rats and challenged with
concanavalin-A, interferon-gamma production was severely
inhibited, while interleukin-3 production was unaffected compared
to ground-based control rats. These data indicate that there is a
defect in interferon-gamma production in rats that have been
exposed to spaceflight. This defect could contribute to, and be
one reason for, immunosuppression observed after spaceflight.

A88-15344*  Wright State Univ., Dayton, Ohio.
BUSPIRONE BLOCKS MOTION SICKNESS AND XYLAZINE-IN-
DUCED EMESIS IN THE CAT
JAMES B. LUCOT and GEORGE H. CRAMPTON (Wright State
University, Dayton, OH) Aviation, Space, and Environmental
Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 989-991. refs

The ability of buspirone to prevent motion sickness and the
mechanism of the buspirone action were tested in cats pretreated
(s.c. injection) by buspirone 30 min before being subjected to
motion stimulus (in a device described by Crampton and Lucot,
1985) or to an injection of an emetic drug xylazine (using only
cats susceptible to motion sickness or to xylazine, respectively).
Buspirone treatment was found to block motion sickness with an
effective dose-50 of 0.46 mg/kg. Buspirone pretreatment (with
4.0 mg/kg) has also significantly blocked vomiting in cats later
injected with 0.66 mg/kg xylazine. The results indicate that
buspirone is acting at the vomiting center, the point of convergence
for the separate mechanisms subserving chemically-induced
emesis and motion sickness.

A88-15345  Decompression and occurrence of cataract in
enucleated eyes of experimental animals
H. S. FANG and H. M. CHEN (National Taiwan University, Taipei,
Republic of China) Aviation, Space, and Environmental Medicine
(ISSN 0095-6562), vol. 58, Oct. 1987, p. 992-995. Sponsorship:
National Science Council of the Republic of China. refs

Chamber flight at a simulated altitude of 58,000 ft (17,680 m)
or more caused marked lens opacities in enucleated eyes of the
experimental animals. After descent to ground level, the opacity
could subsequently be regressed despite complete deprivation
of blood supply to the eye. The present finding suggests that
decompression might play an important role in inducing such a
phacoemulsification.

Author
A88-15346* Louisville Univ., Ky.

DISUSE ATROPHY, PLASMA CORTICOSTERONE, AND MUSCLE GLUCOCORTICOID RECEPTOR LEVELS

J. M. STEFFEN and X. J. MUSACCHIA (Louisville, University, KY) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 996-1000. refs (Contract N 5325, NAGW-70)

The effect of whole-body suspension on the time course and the extent of plasma corticosterone changes and the tissue sensitivity to glucocorticoids were investigated in rats subjected to seven days of whole-body suspension. Plasma corticosterone increased significantly on the first and the third days of suspension, but returned to control levels by day seven. Muscle glucocorticoid receptors exhibited a characteristic hormonal specificity (evaluated in competitive-displacement experiments). In controls, receptor site concentration in the slow-twitch soleus was comparable to that in the fast-twitch gastrocnemius and plantaris, but was significantly less than in the extensor; seven days of suspension resulted in significant differential effects on muscle receptor levels. The largest increase in receptor concentration was observed in the soleus in which it remained elevated after the receptor levels in other muscles returned to normal. I.S.

A88-15696

TRIPHENYLDIOXANE - A NEW POWERFUL INDUCER OF CYTOCHROME P-450 [TRIFENILDIOKSAN - NOVYY MOSHCHNYI INYKTOR TSITOKROMA P-450]


The following compounds were tested for their ability to induce the synthesis of cytochrome-P450 in liver microsomes of the rat: trans-stilbene oxide; 1,2-naphthylisoxazene; 2,6-diphenylpyridine; 2,5-diphenyltetrahydrofuran; 2,6-diphenylpiperidine; 2,4,5,6-tetraphenylpyridine; 2,4,6,8-tetraphenyl-dioxane-1:3; 2,4-diphenyl-dioxane-1:3; and 2,4,6-triphenyl-dioxane-1:3. The contents of the cytochrome-450 were determined 3 days after injection. Among the tested compounds, only 2,4,6-triphenyl-dioxane-1:3 (TPD) displayed significant induction activity. An injection of 10 mg/kg of cis-TPD increased cytochrome-P450 concentration in rat liver by 90 percent; neither diphenyl nor tetraphenyl derivatives had a significant effect, and the trans-TPD was much less active. The TPD was only active in rats (Wistar and Fisher lines), but not in mice of DBA/2 and C57BL lines, indicating that TPD has a structural similarity with the receptor regulating the synthesis of cytochrome P-450 in rats, but not in mice. I.S.

A88-16153#

INSULIN RECEPTORS AND ENZYME ACTIVITIES IN LIVER OF RATS AFTER SPACE FLIGHT ON BIOSATELLITE COSMOS 1867


An investigation of insulin plasma levels, insulin binding to receptors, and enzyme activity of liver aminoadibac metabolism in rats exposed to space flight for seven days aboard COSMOS 1867 is presented. Significant increases in the activity of tyrosine aminotransferase, tryptophan pyrrolase, alanine aminotransferase, and aspartate aminotransferase were noted following space flight. The present results show that increase of insulin plasma levels during flight was not followed by a decrease of insulin binding to receptors in the liver, and that the activity of enzymes involved in liver aminoadibac metabolism increases due to short term space flight. R.R.

A88-16162#

SUPPORT OF LIFE SCIENCE RESEARCH IN SPACE BY THE DFVLR MICROGRAVITY USER SUPPORT CENTER (MUCS)


The activities being undertaken by DFVLR-MUCS to facilitate the planning and execution of space biomedical research are reviewed and illustrated with diagrams, drawings, and tables. Consideration is given to the experiments planned for the Exobiology and Radiation Assembly of Euracea-1; ground simulation of Anthroparck physiology experiments for the second FRG Spacelab mission (D-2); and the Ariadne information system for the acquisition, processing, and dissemination of experimental data. T.K.

A88-16173#

ULTRASTRUCTURE OF PEA MERISTEM AND ROOT CAP CELLS UNDER SPACE FLIGHT CONDITIONS


The effect of space flight conditions on the ultrastructure of pea meristem and root-cap cells was investigated using 7-day pea seedlings grown aboard the Salyut-6 station within the Oasis system. Electron microscopic observations detected essential changes in the plastid apparatus, mitochondria, and Golgi apparatus of root meristem and statenchyma cells; in these structures, the thickening and fusion of membranes were observed together with many electron-dense globules associated with membranes. The results of the treatment of ultrathin seedling sections with EDTA and EGTA and with proteolitic and phospholipid enzymes indicated that the electron-dense globules were binding sites, containing proteins, phospholipids, and Ca(2+) ions. The observed superlocalization of bound calcium suggests an increase of Ca concentration in these structures. The possible resources of this Ca are discussed. I.S.

A88-16174#

PHYSICO-CHEMICAL AND BIOLOGICAL ASPECTS OF WEAK MAGNETIC FIELD EFFECTS ON PLANTS


The effect of the weakening of the geomagnetic field on the growth and reproduction of plant cells was studied in root-meristem cells of the pea, flax, and lentil grown for 60-72 h under conditions of hypomagnetic field (produced by the use of magnetic screening devices). Geomagnetic screening was found to inhibit growth of all cells. Growth-cycle data, obtained on root cells exposed to tritiated thymidine, showed that the lengths of the presynthetic and postsynthetic stages increased significantly, with the result of a significant increase in the cell life-cycle length. The screening of the geomagnetic field also resulted in a considerable decrease in the numbers of proliferating (i.e., tritium-labeled) cells. The physical factors determining the interaction of magnetic field with biological structures are discussed. I.S.
51 LIFE SCIENCES (GENERAL)

A88-16175#  GRAVITY EFFECTS ON MEMBRANE EQUILIBRIA

The paper considers the effect of gravity on the transport properties of membranous systems, applying the theory of concentration and potential variations at interfaces to the membrane-solution interface. Published results of model calculations for surface potentials were used to evaluate densities at the interfacial layer between the membrane and two electrolyte solutions, KCl and CaCl2. The results indicate that the fluid layer covering the membrane surface has higher density than the bulk fluid. Density differences of up to 0.04 g/cm³ for KCl and up to 0.1 g/cm³ for CaCl2 solutions in a layer of about 1 nm thickness were found. It is suggested that the presence of density variations at the membrane-solution interface should be considered in the interpretation of the results from space-relevant experiments.

I.S.

A88-16178#  EXPERIMENT ON STS 51-C - EFFECT OF WEIGHTLESSNESS ON THE MORPHOLOGY OF AGGREGATION OF HUMAN RED CELLS IN DISEASE
L. DINTENFASS (Sydney, University; Rachel Forster Hospital, Redfern, Australia) IAF, International Astronautical Congress, 38th, Brighton, England, Oct. 10-17, 1987. 9 p. Research supported by the Bushel Trust, CSIRO, Department of Science and Technology, et al. refs

A space-rated automatic Slit-capillary Photo-Viscometer was placed on the middeck of Discovery STS 51-C, to study the effect of near zero g on the kinetics and morphology of aggregation of red cells obtained from patients with ischaemic heart disease, hyperlipidaemia, diabetes, cancer, etc. Aggregation was followed for 6 min during stasis by macro and microphotography, at a temperature of 25 C. Results show that aggregates are smaller under zero g than at 1 g; that morphology is drastically altered, and that aggregates formed at zero g show normal rouleaux formation although at 1 g the same samples show formation of compact clumps (sludges). Thus, it appears that zero g affects cell-cell interaction and probably the microstructure of the cell membrane.

A88-16179#  BIOLOGY AND MICROGRAVITY

Results of the first flight of the ESA Biorack facility on the German Spacelab mission D1 in 1985 have revealed pronounced effects of microgravity on a cellular level. Here, an attempt is made to provide a framework for the interaction between gravity and biological organisms. A very generalized picture of an arbitrary biological organism is drawn, and three levels at which gravity could act on it (via genes, sensors, and directly) are examined. Experiments that could test some of the presumptions are suggested.

V.L.

A88-16803  FAUNAL COMPOSITION AND ORGANIC SURFACE ENCRUSTATIONS AT HYDROTHERMAL VENTS ON THE SOUTHERN JUAN DE FUCA RIDGE
VERENA TUNNICLIFFE and A. R. FONTAINE (Victoria, University, Canada) Journal of Geophysical Research (ISSN 0148-0227), vol. 92, Oct. 10, 1987, p. 11303-11314. Research supported by NSERC and Victoria University. refs

Examination of a small collection of macroinvertebrates from three vents of the southern Juan de Fuca vent field reveals differences between the vents with respect to species composition, species habits, and microbial and metallic deposits on their surfaces. Two apparently new vestimentiferan species were found, and for the first time the Pinctada miliaris clams were observed to dwell on smokers. High acidity values recorded in this system may interfere with the process of shell calcification in an archaeogastropod snail. The surfaces of vestimentiferan tubes at two vents are heavily encrusted with microbial and metallic accumulations. SEM, TEM and energy dispersive X-ray microanalysis observations show that iron-based crusts on orange tubes are built from accumulations of an Fe-rich particle of distinctive size and shape. Morphological evidence is presented for the microbial origin of Fe-rich particles. Zn-rich particles found on black tubes are not of microbial origin.

Author

JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
5 Aug. 1987 103 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-87-009) Avail: NTIS HC A06/MF A01

Articles from the open literature are presented or summarized on the following topics: aerospace medicine, agricultural science, biochemistry, biotechnology, epidemiology, genetics, immunology, industrial medicine, laser bioeffects, medicine, microbiology, military medicine, nonionizing radiation effects, pharmacology and toxicology, physiology, public health, radiation biology, and virology. Recent research in the U.S.R. is the focus.

JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
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(JPRS-ULS-87-009) Avail: NTIS HC A06/MF A01

Chronic experiments on alert rabbits studied the dynamics of changes in EEG, EMG, pulse rate, blood pressure, general and local circulation of the brain during rocking and its aftereffect to determine the peculiarities of individual reactions of the animals. Experiments were performed on 18 rabbits of both sexes with implanted platinum electrodes to record local blood flow by the hydrogen clearance method in several segments of the cerebral hemispheres. Steel subcutaneous electrodes in the cervical and subscapular areas were used to record EMG and EKG. The dynamics of changes in bioelectric activity of the various segments of the cerebral hemispheres, pulse rate, blood pressure, local and total brain blood flow and muscular tonus had features in common plus some specific features. One hour of rocking resulted in persistent changes in the status of all parameters studied, particularly the frequency components of the EEG. Local and total brain blood flow increased. EKG changes, bradycardia and hypotension were observed. Changes were greater in winter than in summer, indicating significant reserve capacity of the regulatory centers of the brain in summer.

Author
51 LIFE SCIENCES (GENERAL)


STUDY OF CERTAIN BIOLOGICAL CHARACTERISTICS OF BACTERIA DURING THE FRENCH-SOVET CYTOS-2 SPACE EXPERIMENT


Aval: NTIS HC A06/MD A01

The major purpose of the studies reported in this article was to determine the antibiotic sensitivity of opportunistic microorganisms among the autoflora of astronauts by in vitro cultivation in orbital flight. Experiments were performed on the Salyut-7 spacecraft during a visit by a French astronaut utilizing S. aureus and E. coli isolated from the astronaut before the flight. Antibiotic sensitivity of the microorganisms was determined by double serial dilution. S. aureus were tested with oxacillin, chloramphenicol and erythromycin, E. coli--with kanamycin and colistin. The toxicity, immunogenicity and serotype membership of three strains of Pseudomonas aeruginosa were also determined. The antibiotic sensitivity of the microorganisms was found to be slightly higher under orbital conditions. Ultrastructural studies performed after the flight showed no significant morphologic changes in the E. coli, but some thickening of the cell walls, particularly in S. aureus. Characteristics of the P. aeruginosa were found to be stable and unaltered by space flight. 

A88-13162 MEDICAL ASPECTS OF ORBITAL SPACEFLIGHT AND THEIR IMPLICATIONS FOR MANUFACTURING IN SPACE


A general review of the biomedical consequences of prolonged orbital spaceflight is presented. Data from Apollo, Skylab and Soviet space programs is used to describe a number of the physiologic changes associated with adaptation to a microgravity environment. The author concludes by speculating on how these medical aspects may influence the design and development of orbital manufacturing facilities.

A88-13377 LIMB FLAIL INJURIES IN USAF EJECTIONS - 1979-1985


USAF ejection experience from January, 1978 through December, 1985 was analyzed for evidence of limb flail trauma caused by windblast during ejection. An effort was made to use the same criteria as Belk (1978). This analysis yielded 15 cases of significant limb-flail trauma. These cases are presented by aircraft type, seat type, airspeed, and probability of occurrence.

A88-13379 SIMULATION OF A HIGHLY DYNAMIC G-TIME PROFILE - A PREDICTIVE ALGORITHM FOR CREW G-ACCELERATION TOLERANCE


An empirical model has been developed to predict air crew tolerance to dynamic G-time exposure. The resultant algorithm accurately predicts the onset of visual symptoms and loss of consciousness (LOC) based on human centrifuge data published in the literature. The model has been incorporated into the simulator to control cockpit and dome lights and provide positive feedback to simulator pilots on their G-endurance. The model provides a necessary link for the crew incapacitation decision algorithm for an aircraft G-LOC autorecovery system.

52 AEROSPACE MEDICINE

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

A88-13401 LIMB FLAIL INJURIES IN USAF EJECTIONS - 1979-1985


This study sought to determine the bends risk on decompression from sea level to 8.3 psia. On the basis of several prior studies by NASA and the Air Force, this differential was expected to result in a minimal (about 5 percent) incidence of mild decompression sickness, and may be the pressure of choice for the next-generation NASA extravehicular activity (EVA) pressure suit. Thirty-one volunteer subjects, performing light work characteristic of EVA, were exposed to 8.3 psia pressure altitude for six hours. Limb bends incidence was 3.2 percent, and 25.8 percent of the subjects demonstrated significant intravascular bubbling. Those who bubbled were significantly older than the bubble-free group, but differed in no other aspect. An 8.3 psia advanced pressure suit design was considered insufficient to totally preclude the risk of decompression sickness.

A88-13401* School of Aerospace Medicine, Brooks AFB, Tex.

DECOMPRESSION SICKNESS AND VENOUS GAS EMBOLI AT 8.3 PSA


This study sought to determine the bends risk on decompression from sea level to 8.3 psia. On the basis of several prior studies by NASA and the Air Force, this differential was expected to result in a minimal (about 5 percent) incidence of mild decompression sickness, and may be the pressure of choice for the next-generation NASA extravehicular activity (EVA) pressure suit. Thirty-one volunteer subjects, performing light work characteristic of EVA, were exposed to 8.3 psia pressure altitude for six hours. Limb bends incidence was 3.2 percent, and 25.8 percent of the subjects demonstrated significant intravascular bubbling. Those who bubbled were significantly older than the bubble-free group, but differed in no other aspect. An 8.3 psia advanced pressure suit design was considered insufficient to totally preclude the risk of decompression sickness.

A88-13377
men living under otherwise identical circumstances. The concentrations of adrenaline and noradrenaline in urine, and the indices of lipid metabolism (total cholesterol, triglycerides, lipid hydroperoxides, and the cholesterol contents of low- and high-density lipoproteins) were measured in stressed and control subjects during two periods: the initial 20 days after the start of stress and the period between the 35th and 50th day. A long-lasting hormonal disbalance was recorded in subjects under psychoemotional stress, causing disturbances of lipid metabolism. Such abnormalities can potentially cause the thinning of arterial walls and the formation of lipoprotein deposits in the arterial walls.

I.S.

A88-14728
REGULATION OF THE HEMODYNAMICS DURING THE SIMULATION OF WEIGHTLESSNESS (MATHEMATICAL MODELING) [REGULIATSAIA GEMODINAMIKI PRI IMIATSSII PEREKHODA K NEVESOMOSTI /MATEMATICHESKOE MODELIROVANIE/]

A mathematical model of human circulation dynamics, based on the model of Palets et al. (1985), was used to study rapid responses of the cardiovascular system to the onset of weightlessness. The model was also used to study the effects on circulation of some weightlessness-counteracting methods, such as hypovolemia, lower-body negative pressure (LBNP), and hip cuffs. The analytical results show that upon the onset of weightlessness the right heart ventricle, due to the blood-volume overload, starts to function in a 'plateau' range of the accretion function. Hypovolemia, LBNP, and occlusion cuffs all function to decrease the volume load of the right ventricle. Among the counter-weightlessness methods, the LBNP is the most effective.

I.S.

A88-14729
ACCLIMATIZED DEFICIT OF IRON [AKKLIMATIZATSIONNYY DEFISIT ZHELEZAA]

The effect of geographical conditions on the effect of the iron deficit (FeD) was studied in male subjects residing in different geographical regions. The indices of erythropoiesis, Fe metabolism, and bioenergetics, as well as the morphological and functional characteristics of erythrocytes, were determined in residents of Moscow, Archangelsk, and several cities in northern Asia. The results indicated that the dynamic equilibrium of hemoglobin and erythrocyte numbers is maintained by the equilibrium between erythropoiesis and erythrocyte breakdown. Chronic exposure to cold leads to shifts in the Fe/transferrin/erythron equilibrium, causing FeD. The acclimatization to FeD state leads to an insufficiency of essential microelements which in turn can cause breakdown of erythropoietic processes, the onset of FeD-anemia, and the lowering of immunity.

I.S.

A88-14730
PHYSIOLOGICAL MECHANISMS OF THERMOREGULATION IN HUMANS DURING ADAPTATION TO COLD [O FIZIOLOGICHESKII MEKANIZMAK TERMOREGULATIONSICheloveka PRI ADAPTATSSII K KOLODU]

Male subjects were adapted to cold by being exposed (2 h daily for 24 days) to 14 °C in a climatic chamber, and changes in their tympanic and skin temperatures and respiratory coefficient, as well as the values of the indices of muscle contractile activity and thermogenesis, were measured at different stages of...
adaptation. The exposures to cold were found to initiate the development of physiological thermoregulatory processes characteristic of adaptation. Thus, the 'engagement' of processes responsible for thermogenesis was detected in the subjects much sooner at the end of 24 days than in the same subjects at the beginning of the experiment. In the cold-adapted subjects, cold-induced shivering became more effective than in the control state: heat production per one unit of muscle contraction increased by a factor of 5, and the energy expenditure of homoiothermy fell by 70 percent. I.S.

A88-14731
THE ROLE OF THE INDIVIDUAL CHARACTERISTICS OF VEGETATIVE REACTIONS DURING THE ACTION OF ADAPTOGENS ON PHYSICAL AND MENTAL WORK CAPACITY (ROL INDIVIDUAL'NYKH OСУТВЕТСТВIЙ NACHY JUMOTOGOBO B PSYCHITEKHN REAKTSIY PРI DЕJSTVII AДAPTOGENOV НA FIZICHESKIJU I UМSTVENNUIU RABOTOSPOSOBNOSTI')

A88-14744
PHYSIOLOGICAL CHARACTERISTICS OF ADAPTATION PROCESSES PRECEDING ACTIVITY CONDITIONS (FIZIOLOGICHESKIE ZAKONOMERNOSTI ADAPTACII CHETRNIKH PROTSESSOV, OPEREZHAUSHCHIH USLOVIY DEJATEL'NOSTI')

A88-15339
COMPARATIVE ASSESSMENT OF VESTIBULAR, OPTOKINETIC, AND OPTOVESTIBULAR STIMULATION IN THE DEVELOPMENT OF EXPERIMENTAL MOTION SICKNESS
EDUARDO M. MACHEL, MICHAIL P. KUZMIN, and IUDMILA N. ZAKHAROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 954-957. refs

The contribution of vestibular, optokinetic, and optovestibular stimulation to experimental motion sickness was evaluated in 28 volunteer subjects. Vestibular stimulation (Coriolis effect) was found to induce the most significant vestibular-autonomic disorders. Optokinetic stimulation (pseudo-Coriolis effect) and optovestibular stimulation could provoke such disorders only in susceptible subjects. In quantitative terms, optokinetic and optovestibular stimulation were less effective than vestibular Coriolis stress. Nystagmic reactions of susceptible subjects to the three types of stimulation differed significantly from those of tolerant subjects. This may be important from the theoretical point of view because susceptibility to motion sickness and responses to vestibular and optokinetic stimulation may be universal and associated with the general CNS mechanism, i.e., inhibition mechanism. The identified correlation between the duration of postoptokinetic illusion and motion sickness susceptibility may be used to differentiate susceptible and tolerant subjects. Author

A88-15347
APICAL HYERTROPHIC NONOBSTRUCTIVE CARDIOMYOPATHY IN A PILOT
J. M. NEUTEL and D. P. MYBURGH (Institute for Aviation Medicine, Verwoerdburg, Republic of South Africa) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 1005-1008. refs

Apical hypertrophic cardiomyopathy is a form of nonobstructive hypertrophic cardiomyopathy characterized by disproportionate hypertrophy of the left ventricular apical region; this condition is certain to be diagnosed amongst airmen. The question of flying status in these pilots may create a problem for the flight surgeon. This paper presents a pilot with clinical and morphological features typical of apical hypertrophic cardiomyopathy who has remained asymptomatic over a 15-year follow-up period. There appears to be a spectrum of severity in apical hypertrophic cardiomyopathy ranging from mild to severe. Those having the mild form of the disorder may be considered for restricted licensing subject to having a normal exercise test and no significant arrhythmias on 24-h ambulatory electrocardiogram. If licensed, review by a cardiologist should be required every six months. Author

A88-15349
CONSIDERATIONS IN PRESCRIBING PREFLIGHT AEROBIC EXERCISE FOR ASTRONAUTS
MARY ANNE BASSETT FREY (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 1014-1023. refs

The physiological effects of prolonged exposure to weightlessness are discussed together with the effects of aerobic exercise on human characteristics affected by weightlessness. It is noted that, although early data on orthostatic intolerance after spaceflight led to a belief that a high level of aerobic fitness for astronauts was detrimental to orthostatic tolerance on return to earth, most of the data available today support the opposite. Aerobic fitness was found to be beneficial to cardiovascular function and to mental performance; therefore, it may be important in performing extravehicular activities during flight. I.S.
A88-15350
G-TOLERANCE STANDARDS FOR AIRCREW TRAINING AND SELECTION
KENT K. GILLINGHAM (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Oct. 1987, p. 1024-1026. refs
Gravity tolerance ranges from +2.2 Gz to +7 Gz for unprotected young males and also varies within individuals from day to day. Inability to tolerate a 7-G 15-s rapid-onset G profile without totally losing peripheral vision or losing consciousness is the basis for internationally recognized (NASA, ASCC, and USAF) definitions of low G tolerance. The rationale for choosing this standard is discussed. Experience with the use of this standard, and the equivalent standard of 8 G for 15 s when the F-16-configured seat is used, reveals that fewer than 1 percent of actively flying aircrew are unable to meet the standard. Adaptation of a formal, more stringent, G tolerance standard (e.g., 10 G for 15 s, with anti-G suit and straining maneuver in an ATF-configured centrifuge seat) is urged for selecting and training aircrew for high-performance fighter aircraft.
I.S.

A88-15650
RESULTS OF MEDICAL INVESTIGATIONS CONDUCTED ABOARD THE 'SALYUT-6'-'SOYUZ' ORBITAL RESEARCH COMPLEX [REZULTATY MEDITINSKIIKH ISSLEDOVANII VYPOLNENNYKH NA ORBITAL'NOM NAUCHNO-ISSLEDOVATELSKOM KOMPLEXE 'SALIUT-6'-'SOIUI']
N. N. GUROVSKII, ED. Moscow, Izdatel'stvo Nauka, 1986, 400 p. In Russian. No individual items are abstracted in this volume.
The results of medical tests investigating the health status of the Salyut-6-Soyuz space crew during the flight and after landing are presented. Consideration is given to changes found in various physiological systems, metabolic processes, sensor system functions, intestinal microflora, psychological status, and work capacity. The conditions of the space-station cabin, such as the atmosphere, microclimate, water supply, and chemical and microbial contamination, are discussed together with measures suggested to alleviate unfavorable effects of space flight and cosmic rays. Special attention is given to the Intercosmos program, developed to coordinate the space-flight-related experiments planned by the participating country members. The program's activities in the areas of radiation safety, the selection and training of cosmonauts, the development of the instruments for the evaluation of cosmonaut physiological and psychological reactions are discussed together with the results of these investigations during multinational flights.
I.S.

A88-15655
HUMAN ADAPTATION AND CONSTITUTION [ADAPTATSIIA I KONSTITUTSIIA CHELOVEKA]
VLAIL' PETROVICH KAZNACHEEV and SERGEI VLAIL'EVICH KAZNACHEEV Novosibirsk, Izdatel'stvo Nauka, 1986, 120 p. In Russian. refs
This monograph discusses the division of human beings into one of the major body-constitution types, I and II, and the differences in physiological and metabolic functions, as well as in the two constitutional types upon being subjected to physical loads, climatic extremes, and unfavorable living conditions. Special attention is given to the tests to be used for classifying the two constitutional types on the basis of the subjects' reactions to experimental loads: the respiration rate changes, hand strength, the ergographically measured work capacity, and the maximal oxygen consumption during work. It is also shown that types I and II exhibit significant differences with respect to adaptability to unfavorable conditions of work and/or living and with respect to susceptibility to several diseases, such as peptic ulcer and bronchial pneumonia, as well as to the course of these ailments. I.S.

A88-16150#
MAN IN SPACE FLIGHT
(IAF PAPER 87-527)
Physiological changes that occur in man during spaceflight are examined. The mechanisms which cause these main physiological changes, such as a change in the afferent load, the elimination of hydrostatic pressure, and the lack of weight load on the musculoskeletal system, are discussed, and methods for countering these mechanisms are described. Changes in man's vestibular functions, motor system, fluid-electrolyte metabolism, cardiovascular system, calcium metabolism, circulatory system, and immunological system during spaceflight are considered.
I.F.

A88-16152#
A NEUROPHARMACOLOGICAL APPROACH TO SPACE MOTION SICKNESS
(IAF PAPER 87-529)
Laboratory data from provocative tests employing a rotating chair were used to investigate the role of the dopaminergic system in the physiopathogenesis of space motion sickness (SMS). Administration of 100 mg of a benzamide derivative (O-methoxy-p-amino benzamide) was found to partly or wholly prevent any occurrence of the symptoms related to the sensory conflict produced by chair rotation, supporting the involvement of the dopaminergic system in the pathogenesis of SMS. The impact of the present data on three hypotheses concerning the mechanisms governing SMS (the neurosensory conflict hypothesis, the hemodynamic hypothesis, and the digestive hypothesis) is considered.
R.R.

A88-16154#
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, Washington, D.C.
INFLIGHT COMBINED VERTICAL AND LATERAL SPACE VEHICULAR ACCELERATIONS - HUMAN TOLERANCES
(IAF PAPER 87-531)
Human tolerance studies related to inflight rolling (tumbling) accelerations are discussed, with emphasis on the need to provide data on combinations of Gy, as experienced during an anomalous roll aboard Gemini VIII during which upper body (-) Gz forces and lower body (+) Gz forces were experienced. The study also points to the need to provide data on tolerances to (+) or (-) Gy combined with (-) Gz, in addition to the lowered tolerances to Gy and Gz accelerations experienced by those adapted to microgravity. It is noted that such data can be used to establish limits on spacecraft acceleration maneuvering specifications.
R.R.

A88-16155#
HEAT DISSIPATION UNDER LOWER BODY NEGATIVE PRESSURE STRESS
(IAF PAPER 87-532)
In the course of lower body negative pressure differential (LBNPD) development the question arose whether a temperature stimulus has an adverse effect on the test subject. This report summarizes the results of eight tests carried out with five different test subjects. The tests show that skin temperature in the areas inside the LBNPD varies only slightly with an increase in surrounding air temperature. The results also indicate that moderate values of airflow through the LBNPD perform the double task of noticeably
decreasing the box temperature while at the same time keeping relative humidity well within comfort condition levels. It may therefore be concluded that an additional temperature stimulus need not be considered.

Author


The French-Sovet long-duration flight, planned for the second half of 1988, is expected to have a duration of 30 days. The mission payload will include the study of the cardiovascular system, the study of sensori-motor interactions, and radioprotection. Hemodynamic data will be collected using a new version of Echograph which makes it possible to obtain imagery of all organs and blood vessels accessible to clinical echography. The Physiace experiment will permit a better understanding of the effects of lack of gravity on the components of the central nervous system and their interaction both in the fast and longer term phases of adaptation.

K.K.


A set of freshly collected and separated human platelet suspensions were transported, in three types of plastic containers, on a 6 day, 2 hr mission of the orbiter Columbia to study the effect of prolonged exposure of human blood cells to microgravity. A controlled environment at a temperature of 22 + or - 1 deg C with air flow was provided and another set of samples held on a 6 day, 2 hr mission of the orbiter Columbia to study the effect of prolonged exposure of human blood cells to microgravity. When viewed in terms of plastic type, ug platelets in plastic type, ug platelets in containers fabricated from PVC-TOTM displayed the best overall postflight viability.

K.K.


The activities of the RAF Institute of Aviation Medicine are surveyed. The history of the Institute is reviewed; the increased centrifuge-training requirements of advanced aircraft such as the Experimental Fighter Aircraft are discussed; and research on the effects of the cockpit temperature on crew performance, onboard oxygen systems, cockpit routines and workloads, sleep cycles, pilot clothing, and vibration problems is summarized. Extensive photographs are provided.

T.K.

A88-16750# RADIATION HAZARDS IN SPACE REIN SILBERGEB, CHEN H. TSAO, JAMES H. ADAMS, JR. (U.S. Navy, Naval Research Laboratory, Washington, DC), and JOHN R. LETAW (Severn Communications Corp., Severna Park, MD) Aerospace America (ISSN 0740-722X), vol. 25, Oct. 1987, p. 38-41.

Three basic types of radiation are of concern in manned space missions: galactic cosmic rays, solar flare particles, and trapped Van Allen radiation. Radiobiologists have observed that the same degree of biological damage can be inflicted at a lower dose by more highly ionizing types of radiation, such as cosmic rays, which are not only the most energetic but possess the highest fraction of such highly ionizing heavy nuclei as carbon, oxygen, neon, and iron. The radiation dose rate on a manned Mars mission is comparable to that of Apollo astronauts during a moon mission.

O.C.
methodology. The development of new analysis methods, new technology, and new biochemical probes for the study of DNA damage and repair are described.

**N88-12242#** Naval Submarine Medical Research Lab., Groton, Conn.

**SUPEROXIDE DISMUTASE ASSAYS Interim Report**


(AD-A183972; NSMRL-M87-3)  Avail: NTIS HC A03/MF A01

CSCL 06A

A number of studies support the idea that superoxide dismutase is one of the enzymes that modulates the threat of oxidative stress. This technical report presents detailed instructions for two methods presently being used at the Naval Submarine Medical Research Laboratory (NSMRL) to assay for superoxide dismutase. Both assays are of the indirect type consisting of two components: a superoxide generator and a superoxide detector. In the first method the generator produces the radical at a controlled rate, and in the absence of superoxide dismutase (SOD), the radical produced reacts with the detector. A unit of SOD then has been defined as that amount which will reduce the rate produced by the generator to 50% of its control value. The second method, which is about 100-fold more sensitive, takes advantage of the biphasic nature of the production of the radical and its dismutation both spontaneously and by SOD. By allowing the generator to react for a specific time period before addition of the detector, a burst of reduction is obtained followed by linear rate after the detector reaches a steady state. The height of this burst in the presence and absence of SOD thereby gives a sensitive assay for which the unit (50 percent of control burst) is in the picomolar range.

**N88-12243#** Naval Submarine Medical Research Lab., Groton, Conn.

**SCOTOPIC SENSITIVITY WITH 10 PERCENT OXYGEN Interim Report**

S. M. LURIA and DOUGLAS R. KNIGHT  9 Jul. 1987  17 p

(AD-A183973; NSMRL-1097)  Avail: NTIS HC A03/MF A01

CSCL 06E

The night vision (scotopic) sensitivity of 6 subjects was measured while they were breathing either air (21 percent oxygen, PO2 160 torr) or 10 percent oxygen, balance nitrogen (PO2 76 torr). Continuous monitoring showed that the mean oxygen content in the arterial blood (Sao2) dropped from 97 to 77 percent during the first seven minutes of breathing 10 percent oxygen, and there was a significant degradation of scotopic sensitivity. The reduced sensitivity was attributed solely to hypoxia with no contribution from hypocapnia.

**N88-12244#** Washington Univ., St. Louis, Mo.

**STUDIES OF THE PROCESSING OF SINGLE WORDS USING POSITRON TOMOGRAPHIC MEASURES OF CEREBRAL BLOOD FLOW CHANGE**

STEVEN E. PETERSEN, PETER T. FOX, MICHAEL I. POSNER, and MARCUS RAICHEL  1987  53 p

Contract N00014-85-K-029B; RR0-4206

(AD-A184058; TR-87-7-ONR)  Avail: NTIS HC A04/MF A01

CSCL 05H

Language is an essential characteristic of the human species, and as such has been a focal point for study in disciplines ranging from linguistics to neurology. Cognitive and neurological investigations of language often narrow the focus of study to the processing of individual words (lexical items). Lexical processing involves a network of several levels of internal coding that can be isolated by experiment. Examples of some of these separate codes include a visual image of the form of a spoken word (visual code), pronunciation of the word (phonological code) or the association of related words (semantic codes). Studies of the time course of activation of these internal codes of words and the roles they play in performance has been a central topic in the cognitive psychology of reading and listening. Behavioral neurologists have been concerned as well with issues in lexical processing, but the focus has been in correlating the internal stages of processing with different brain regions. Recent advances in activation techniques and data analysis strategies using positron emission tomographic (PET) measurements of blood flow change have made it possible to address concerns relevant to both cognitive science and behavioral neurology. In this paper, we take advantage of these techniques to study words in normal subjects.

**N88-12245#** Naval Postgraduate School, Monterey, Calif.

**ASSESSMENT OF FATIGUE IN AVIATION CREWS M.S. Thesis**

MARK L. HUTCHINS  6 Jul. 1987  119 p

(AD-A184129)  Avail: NTIS HC A06/MF A01

CSCL 06J

This study investigated the relationship of Schonpflug’s model of regulatory behavior and a questionnaire which was designed to assess behavioral change due to fatigue in aviation crew members. Data was gathered from three patrol aviation squadrons. Rotated factor analysis was used to determine designation of factors and their related question. A paired sample t-test was utilized for the determination of change due to a one month period of flight operations. The two statistical tests were graphically combined and compared to Schonpflug’s model of regulatory behavior. The psychological costs to benefit economics of Schonpflug’s regulatory model were confirmed. Schonpflug’s model was found to be an excellent evaluative tool when coupled with the questionnaire’s statistical test in determining non resolution of problems brought about by fatigue.


**MOTION AND SPACE SICKNESS**

NAOKI ISU  In its JPRS Report: Science and Technology, Japan 28-30  24 Aug. 1987  Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Nov. 1986  2-4

Avail: NTIS HC A06/MF A01

An experiment was conducted using 65 cats under anesthesia. After insertion of electrodes, neurone activities were recorded from nuclei vestibulares. Four kinds of vestibular secondary neurones of the posterior semicircular duct system were found, serving in part to control the motor nerve of contralateral cervical muscles. The existence of these neurones is believed to have advantageous functions, coordinating movements of the eyeballs and the neck.

**N88-12525#** Naval Submarine Medical Research Lab., Groton, Conn.

**FIRE-RELATED MEDICAL SCIENCE**

DOUGLAS R. KNIGHT  in NASA, Lewis Research Center, Spacecraft Fire Safety p 59-64  1987

Avail: NTIS HC A07/MF A01

Spacecraft fire safety may be improved by the use of a fire-retardant atmosphere in occupied spaces. Low concentrations of oxygen can protect humans from fire damage by reducing the rate and spread of combustion, but care must be taken to avoid the hypoxic effects of oxygen-lean atmospheres. Crews can live and work in 11 percent oxygen if barometric pressure were adjusted to maintain the partial pressure of oxygen above 15.5 kPa. Eleven percent oxygen should prevent most types of fires, since 15 percent oxygen retards the combustion of paper and 13 percent oxygen extinguishes pentane flames. Test results indicate that seated humans can perform mental tasks in atmospheres containing 11.5 percent oxygen. Although this strategy of fire safety is under consideration for submarines, it could be adapted to spacecraft once operational procedures define a maximum hyperbaric pressure and fire research defines the effects of reduced oxygen concentrations on combustion in low gravity environments.

Author
as a function of retinal location, we have also examined effects to other cortical areas (even sensory cortical areas) that receive content. DOE

of neuronal receptive-field size and since receptive-field size varies STORAGE AND RECOGNITION OF COMPLEX STIMULI, A

temporal and spatial resolution of neuromagnetic measurements, applied in psychophysical studies as well as invasive anatomical, or iatrogenic exposures to nickel compounds. DOE

N88-12919# Los Alamos National Lab., N. Mex.

The present study applies neuromagnetic measurement techniques to probe the neurophysiological processing of spatial frequency (SF) by normal human observers. By exploiting the temporal and spatial resolution of neuromagnetic measurements, we hope to discriminate and characterize underlying neural functions and explore their correlation with perceptual or behavioral performance measures. Spatial frequency analysis has proven a useful paradigm for the study of visual perception and has been applied in psychophysical studies as well as invasive anatomical and physiological studies of experimental animals. These approaches have produced evidence of specialized neural activity and network structure for the analysis of spatial frequency information. Because the encoding of spatial frequency is a function of neuronal receptive-field size and since receptive-field size varies as a function of retinal location, we have also examined effects of visual field on responses to stimuli of defined spatial frequency content. DOE

N88-12920# California Univ., Irvine. Center for the Neurobiology of Learning and Memory.

LARGE-SCALE NEURONAL CIRCUITS FOR SELECTIVE STORAGE AND RECOGNITION OF COMPLEX STIMULI, A PILOT STUDY Final Report

1 Jul. 1987 3 p

(Contract N00014-85-K-0650) (AD-A184134) Avail: NTIS HC A02/MF A01 CSCL 06D

Studies are undertaken on the nature and behavior of neural circuits based on the known anatomical and physiological characteristics of cortical circuits in rat brain. They are focused on olfactory (piriform) cortex, for a number of reasons, including the fact that piriform cortex is phylogenetically old, and significantly simpler than neocortical areas, and that piriform receives its inputs monosynaptically from the olfactory bulb, which in turn receives inputs monosynaptically from the nasal epithelium, directly in response to chemical olfactory inputs. This offers an unusual opportunity to study cortical mechanisms operating on inputs that have only minimally been preprocessing, in contrast to the inputs to other cortical areas (even sensory cortical areas) that receive extensive preprocessing before reaching the cortex. GRA


HUMAN RESPIRATORY RESPONSES DURING HIGH PERFORMANCE FLIGHT

R. M. HARDING (Institute of Aviation Medicine, Farnborough, England.) Nov. 1987 93 p


The respiratory responses of experienced pilots were studied during flight in a high performance jet aircraft. Over 38 hours of physiological monitoring was carried out involving over 47,000 breaths. The importance and relevance of information about these respiratory responses is reviewed, with particular emphasis on the difficulties of in-flight recording and the history of such experimentation in four specific areas of respiratory physiology: respiratory frequency and flow, added external resistance, hyperventilation, and the metabolic cost of flying. Author
A88-15348
SMALL GROUPS IN ORBIT - GROUP INTERACTION AND CREW PERFORMANCE ON SPACE STATION
JOHN M. NICHOLAS (Loyola University, Chicago, IL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1987, p. 1009-1013. Research supported by the James A. Kemper Foundation. refs
Orbiting space stations raise unprecedented demands on crew performance and group interaction. Previously, Antarctic studies revealed evidence of deterioration in social relationships and work effectiveness, particularly during the long winter; a decline was observed in compatibility, group pride, teamwork, and group efficiency, and groups with the greatest decline had the lowest morale and experienced most difficulty in keeping essential equipment operating. These findings are consistent with reports from Soviet Salyut missions. It is noted that, in spite of these reports, the interpersonal criterion is virtually ignored in the current Space Station planning. Directions for possible training and team development are suggested. I.S.

A88-15880
AUTOMATED LEARNING SYSTEMS FOR THE OCCUPATIONAL TRAINING OF FLIGHT-VEHICLE OPERATORS [AVTOVTIZIROVANNYE OBUCHAIUSCHIE SISTEMY PROFESSIONAL'NOI PODGOVOKI OPERATOROV LETATEL'NYKH APPARATOV]
LEV STEPANOVICH DEMIN, IURI GRIGOR'EVICH ZHUVOVSKII, ALEKSEI PETROVICH SEMENIN, ALEKSAANDR IAKOVLEVICH KRAMARENKO, IGOR' VLADIMIROVICH MIJUKOV et al. Moscow, Izdatel'stvo Mashinostroenie, 1986, 240 p. In Russian. refs
Aspects of the design and development of automated learning systems (ALSs) for the training of operators of manned spacecraft and aircraft are described. Consideration is given to methodological, engineering, software, language, informational, and experimental support for such systems. The training of cosmonauts and pilots is considered in a man-machine framework. ALS design principles are elaborated which provide for both theoretical training and the acquisition of occupational skills. B.J.

A88-16151#
COSMONAUT BEHAVIOUR IN ORBITAL FLIGHT SITUATION - PRELIMINARY ETHOLOGICAL ANALYSIS
A frame by frame analysis of current video-tape recordings reveals that the behavioral adaptation process of the cosmonaut to weightlessness is achieved via adaptation of the motor units patterns according to the movement direction, differential responses in the movement kinetics according to the attention level of the cosmonaut while performing the task, and to the needed accuracy. Results are presented pertaining to the cosmonaut's posture and body orientation. It is found that the cosmonaut systematically orientates according to visual references of his proximate spatial environment. K.K.

A88-16171#
A ROLE FOR BIOBEHAVIORAL APPLICATIONS IN SUPPORT OF SPACEFLIGHT OPERATIONS Programs
The psychosocial and biobehavioral aspects of long-duration manned spaceflights are discussed together with some of the adverse consequences of failing to adequately address this issue. The importance of incorporating biobehavioral expertise into the spaceflight operations programs is emphasized; it is suggested that experienced behavioral aerospace professionals should contribute to astronaut selection, training, and other relevant professional activities. In view of the advent of long-duration missions and multicultural/multinational crews, the need for international unity and uniformity regarding psychosocial factors is stressed. I.S.

A88-16679*
National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT SIMULATOR REQUIREMENTS FOR AIRLINE TRANSPORT PILOT TRAINING - AN EVALUATION OF MOTION SYSTEM DESIGN ALTERNATIVES
The effect of motion platform systems on pilot behavior is considered with emphasis placed on civil aviation applications. A dynamic model for human spatial orientation based on the physiological structure and function of the human vestibular system is presented. Motion platform alternatives were evaluated on the basis of the following motion platform conditions: motion with six degrees-of-freedom required for Phase II simulators and two limited motion conditions. Consideration was given to engine flameout, airwork, and approach and landing scenarios. K.K.

A88-16741
PASSENGER BEHAVIOR IN AIRCRAFT EMERGENCIES
Although more passengers are likely to escape harm in such aircraft emergencies as cabin fires if evacuation is orderly, rather than disorderly, the factor of individual vs. group motivation has been found to create an important differentiation between real and demonstration evacuations due to the maximization of individual motivation in the former. It is accordingly recommended that the individual's perceived likelihood of escape be enhanced through the use of smoke hoods, which greatly increase feelings of security and thereby reduce disorderly attempts at self-preservation that jeopardize the entire evacuation operation. O.C.

N88-12245*
INTEGRATED VOICE AND VISUAL SYSTEMS RESEARCH TOPICS
(NASA-CR-177417; NAS 1.26:177417) Avail: NTIS HC AO2/MF 18679
A series of studies was performed to investigate factors of helicopter speech and visual system design and measure the effects of these factors on human performance, both for pilots and non-pilots. The findings and conclusions of these studies were applied by the U.S. Army to the design of the Army's next generation threat warning system for helicopters and to the linguistic functional requirements for a joint Army/NASA
flightworthy, experimental speech generation and recognition system. Author

N88-12247# European Space Agency, Paris (France). INFLUENCE OF PILOT BEHAVIOR IN A TRAINING PROGRAM FOR ASSESSING HANDLING QUALITIES USING A GROUND SIMULATOR DIETRICH ALTENKIRCH Sep. 1987 40 p Transl. into ENGLISH of Untersuchung des Pilotenverhaltens im Rahmen eines Trainingsprogrammes im Bodensimulator zur Flugeigenschaftsbeurteilung (Brunswick, Federal Republic of Germany) Original language document was previously announced as N86-52975 (ESA-TT-999; DFVLR-MITT-86-01; ETN-87-91111) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, Federal Republic of Germany DM 15.50

A pilot training session for rating handling qualities of transport aircraft was conducted with four test pilots by using a moving cockpit ground simulator. Each pilot flew three tasks take-off/climb, cruise/landing, approach/touchdown. In addition to the basic version of the aircraft, the pilots rated the handling qualities of two configurations differing in dynamics and control modes. Cooper-Harper pilot ratings and special effort ratings, as well as statistical values computed from measured performance data of the pilot/aircraft system are presented as a function of the configuration and turbulence levels.


A study was conducted over seven months in a winter Antarctic isolated and confined environment (ICE). Physiological and psychological data was collected several times a week. Information was collected on a monthly basis on behavior and the use of physical facilities. Adaptation and information indicated that there was a significant decrease in epinephrine and norepinephrine during the middle trimester of the winter. No vital changes were found for blood pressure. Self reports of hostility and anxiety show a middle trimester of the winter. No vital changes were found for blood pressure. Self reports of hostility and anxiety show a significant decrease in epinephrine and norepinephrine during the middle trimester of the winter. The physiological and psychological data do not move in a synchronous fashion over time. The data also support that both ambient qualities of an ICE and discrete social environmental events, such as the arrival of the summer crew, have an impact on the cognitive measures used. It may be most appropriate to develop a model for ICE's that incorporates not only global chronic stressors common to all ICE's but also the role of discrete environmental effects which can minimize or enhance the influence of more chronic stressors. Behavioral adjustment information highlight the importance of developing schedules which balance work and recreational activities.

Author

N88-12250# Washington Univ., St. Louis, Mo. Dept. of Neurology. EFFECTS OF DIVIDED ATTENTION ON IDENTITY AND SEMANTIC PRIMING JENNIFER SANDSON and MICHAEL I. POSNER 1987 41 p (Contract N00014-86-K-0268; DA PROJ. RRO-4206) (AD-A184269; TR-87-6-ONR) Avail: NTIS HC A03/MF A01 CSCL 05I

According to some models of lexical access visual information can directly activate semantic memory. Priming can be obtained from stimuli that are either physically identical or semantically related to the target. Studies show that identity priming is not reduced by performance of a simultaneous auditory shadowing task. The strength of identity priming does not vary between conditions in which the relatedness of the prime provides information about the correct response (lexical decision) and conditions in which it does not (semantic classification). On the other hand, semantic priming is reduced during shadowing with lexical decision and in semantic classification. These data suggest that identity primes operate upon a visual code of the input that is not influenced by simultaneous auditory processing while semantic priming involves a system to which both auditory and visual information have access.

GRA


An annotated bibliography of the research reports written by participants in NASA's Workload Research Program since 1981 is presented, representing the results of theoretical and applied research conducted at Ames Research Center and at universities and industrial laboratories funded by the program. The major program elements included: 1) developing an understanding of the workload concept; 2) providing valid, reliable, and practical measures of workload; and 3) creating a computer model to predict workload. The goal is to provide workload-related design principles, measures, guidelines, and computational models. The research results are transferred to user groups by establishing close ties with manufacturers, civil and military operators of aerospace systems, and regulatory agencies; publishing scientific articles; participating in and sponsoring workshops and symposia; providing information, guidelines, and computer models; and contributing to the formulation of standards. In addition, the methods and theories developed have been applied to specific operational and design problems at the request of a number of industry and government agencies.

Author
A88-13376
SAFE ASSOCIATION, ANNUAL SYMPOSIUM, 24TH, SAN ANTONIO, TX, DEC. 11-13, 1986, PROCEEDINGS
Newhall, CA, SAFE Association, 1987, p. 310. For individual items see A88-13377 to A88-13413.

Various papers on safety systems are presented. The topics addressed include: limb flail injuries in USAF ejections, decompression tests of personal flight equipment, simulation of a highly dynamic G-time profile, computer simulation of manikin head-neck system, CREST system design, CREST restraint system development program, CREST seat structure development, CREST windblast protection system design, development of the true human analog, ADAM, Koch emergency egress lighting systems, Space Shuttle Orbiter ejection seat survey, Mk15 ejection seat, aircraft passenger protection from smoke and fire, CREST flight controller, and NACES program and seat. Also discussed are: RU-36/P HELO emergency egress device, H-46 helicopter emergency flotation system, ADAM data acquisition system, emergency command recognizer for voiced system control, decompression sickness and venous gas emboli, mechanical analog of the human dynamic spin/viscera, delayed ejection, biodynamics data bank, laser fiber optic initiation system, inductively coupled initiator, and mental and physical performance at low core temperatures. C.D.

A88-13380
A COMPUTER SIMULATION OF THE HYBRID II MANIKIN HEAD-NECK SYSTEM

A data set for the Hybrid II manikin head-neck system has been developed for the Head-Spine Model (HSM). The HSM is briefly described, as is the dummy specimen used in the study. The use of the Part 572 Head-Neck Pendulum Compliance Test to validate the data set is reviewed. An adequate fit was obtained. C.D.

A88-13382
THE CREST RESTRAINT SYSTEM DEVELOPMENT PROGRAM

This paper discusses the requirements and progress toward the development of the CREST (Crew Escape Technologies) crew member restraint subsystem. The development of the seat-mounted X-band harness and the pilot-worn X-band harness is described. The Haulback system, which provides maximum protection during in-flight maneuvers associated with sudden, high-acceleration motions of advanced fighter aircraft, is addressed, discussing the design challenges and performance expectations. Seat interface equipment and functions are described. C.D.

A88-13386
ADAM - THE NEXT STEP IN DEVELOPMENT OF THE TRUE HUMAN ANALOG

The basic goals of the ADAM (Advanced Dynamic Anthropomorphic Manikin) development program are summarized along with some of the basic features of the ADAM that distinguish it from previous manikins designed for ejection testing. The manikin anthropometry, flexible spine/viscera system, body articulation, and unique instrumentation system are examined. The program status regarding design, fabrication, and subsystem checkout testing is discussed. C.D.

A88-13393
DEVELOPMENT OF THE TACTICAL AIRCREW EYE RESPIRATORY SYSTEMS

This paper presents the background and development philosophy utilized in designing and fabricating protective mask systems for the USAF Aircrew Eye Respiratory Protection program. The interface criteria and design requirements for the various USAF aircraft and operational user constraints are reviewed, showing that a single mask cannot meet all the requirements. Three kinds of masks, all within the Tactical Aircrew Eye Respiratory System (TAERS), are described. Qualification tests that have been completed by the Air Force on the TAERS mask for the limited safe-to-fly certification are reviewed. C.D.
THE DESIGN EVOLUTION OF THE MECHANICAL ANALOG OF THE HUMAN DYNAMIC SPINE/ VISCERA

As part of the Crew Escape Technologies Program, an advanced dynamic anthropometric manikin was developed to duplicate human biofluidity to the greatest degree possible. The dynamic spine/viscera design that evolved in an attempt to simulate the dynamic characteristics of various body organs is described. Ways in which the final design might duplicate the desired response of the human body during dynamic loadings associated with ejection are discussed.

CURRENT RESEARCH ON AN ARTIFICIAL INTELLIGENCE-BASED LOSS OF CONSCIOUSNESS MONITORING SYSTEM FOR ADVANCED FIGHTER AIRCRAFT

The evolution of the conceptual approach in the search for a reliable ‘signature’ of an incapacitated pilot is outlined. A list is given of candidate sensor technologies that could be applied in this system without any significant encumbrance of the pilot. Included are head status, hand/grip status, seizure activity, straining behavior, anti-G suit status, eye status/blink rates, superficial temporal artery pulse, and blood pressure modeling. It is noted that the use of an expert system is central to the Loss of Consciousness Monitoring System concept.

DELETHALIZED CYCLIC CONTROL STICK

The design, development and testing of a delethalized cyclic control stick for the UH-60A Black Hawk is discussed. A low-friction joint was designed which satisfied both operational and crash requirements. Full-scale testing with an anthropomorphic dummy and an energy-absorbing UH-60A Blackhawk crew seat was conducted with both the delethalized and the existing sticks. While the design constraints appear to prevent the exclusion of all injury, the tests demonstrated that the delethalized stick should reduce both the frequency and severity of serious injury.

THE PROSPECTS FOR HELICOPTER HELMET DESIGN TO MEET RAPIDLY EXPANDING REQUIREMENTS

The evolution of a new SPH helmet system that is created by the SPH helmet shell shape and a lightweight balanced array of integrated modular components is addressed. A thermal plastic liner (TPL), when used in conjunction with a 0.825” thick styrofoam liner, will increase impact protection by approximately 200 percent over that of the existing 0.500” styrofoam and web suspension combination. In addition to the increased protective properties of the retrofit TPL and styrofoam liner combination, it is possible to
use the helmet and liner as provided prior to custom fitting and to fit it with no special fixtures or hazardous chemicals. K.K.

A88-13542
PERFORMANCE STUDIES ON A MOLECULAR SIEVE OXYGEN CONCENTRATOR (MSOC) - COMPARISON OF MG3, 5AMG, AND 13X MOLECULAR SIEVES
GEORGE W. MILLER and C. F. THEIS (USAF, School of Aerospace Medicine, Brooks AFB, TX) SAFE Journal, vol. 17, Fall 1987, p. 43-51.
A comparison is made between three molecular sieve adsorbents (MG3, 5AMG, and 13X) employed in molecular sieve oxygen concentrators to determine which is the most efficient at concentrating oxygen from air based on air consumption, oxygen purity, and oxygen recovery. Overall, the performance of MG3 and 13X molecular sieves was similar, and superior to 5AMG. The three-bed aircraft MSOC loaded with MG3 produced the highest oxygen concentrations over the product flow range. The two-bed aircraft MSOC gave the greatest oxygen recovery when loaded with MG3 or 13X molecular sieves. MG3 was found to be the optimum molecular sieve in terms of air consumption, oxygen purity, and oxygen recovery. K.K.

A88-15283
TECHNOLOGY ADVANCEMENTS TO IMPROVE CREW PRODUCTIVITY IN SPACE
Advances in technologies that will improve crew productivity and comfort on the Space Station are reviewed. These technologies include the development of computer tools to optimize the crew work place in the Space Station (e.g., solid modeling and interior layout evaluation programs) as well as advances in Station equipment to minimize or eliminate tedious and/or time-intensive tasks. These latter advances include automated inventory management and equipment controls, galley oven, housekeeping and trash compactor technologies, and personal hygiene improvements in the waste management system and full body shower. A third area of advancement is the development of job aids and procedural improvements for the everyday operation and maintenance of Station equipment and experiments. These advances include EVA space suit and glove design and procedural aids such as an operations and maintenance information system. B.J.

A88-15284
DESIGN AND DEVELOPMENT OF A COMPUTER-ASSISTED GROUND CONTROL TECHNIQUE FOR SPACE STATION ROBOTICS
Recent design activities for the International Space Station have included studies of the operations and productivity of the U.S. Laboratory module. A major finding was that the most limited resource on the Station will be crew time. A ground-controlled robot has been proposed that will help alleviate these constraints and allow around-the-clock U.S. Laboratory operations. However, the ground control of a mechanism in earth orbit imposes command and feedback delays because of the distance and communications network involved. A unique predictive display for use by the ground operator in the presence of varying time delays has been developed and tested and has reduced the 'move-and-wait' task times normally associated with delayed feedback teleoperations, minimized operator training, and reduced downlink bandwidth required. Author

A88-15340
IMMERSION SUIT INSULATION - THE EFFECT OF DAMPENING ON SURVIVAL ESTIMATES
refs
The possible effect of wetting the clothing worn underneath helicopter-passenger survival suits on estimated cold-water survival times was investigated using immersion suit leakage values from realistic testing of four different immersion suits. The realistic scenario of either a 2- or 4-h flight (with the undergoing becoming wet from sweating), coupled with a capsize procedure and a subsequent 20-min swim (overriding vital survival actions, was evaluated to predict the cumulative loss of insulation and proportionate decrease in survival time. It was found that undergarment wetting from sweating contributes the smallest part to the potential reduction in survival time and that the watertight integrity of a suit is by far the most important criterion to be satisfied. The suit with the enhanced inner neck-seal fitted with a thin neoprene face-seal performed best. I.S.

A88-15524#
DYNAMIC ANALYSIS OF ROBOTIC MANIPULATORS FOR SPACECRAFT APPLICATIONS
This paper deals with the dynamic analysis of multi-DOF three-dimensional manipulators. A general dynamic analysis program is developed (covering kinematic and dynamic aspects) and implemented for digital computation, and some verifying examples are presented. The program gives either (1) an instantaneous analysis of all forces and moments acting throughout the mechanism for specified link positions, velocities, and accelerations, or (2) the time-varying forces and moments for a time-specified workpath. The analysis can be applied to a zero-gravity situation or to a gravity or acceleration field of any magnitude and direction. Author

A88-15816# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NASA'S TELEROBOTICS R & D PROGRAM - STATUS AND FUTURE DIRECTIONS
NASA's teleroobotics technology program is described as well as the process for the transfer of this technology to the Space Station, and some of the implications of the technology for station design and operations, including those for international cooperation. A diagram is presented of the NASREM control hierarchy with the Office of Aeronautics and Space Technology telerobot testbed architecture superimposed. In telerobotics, the following areas were identified as possible subjects for developing data to support international standards: (1) task boards, (2) system performance measures on task boards, (3) human performance measures on task boards with teleoperation, and (4) autonomous-telerobotic teleoperated performance comparisons. K.K.
54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

A88-15817# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE FLIGHT TELEROBOTIC SERVICER (FTS) - A FOCUS FOR AUTOMATION AND ROBOTICS ON THE SPACE STATION
(IAF PAPER 87-25)
The concept, fundamental design principles, and capabilities of the FTS, a multipurpose telerobotic system for use on the Space Station and Space Shuttle, are discussed. The FTS is intended to assist the crew in the performance of extravehicular tasks; the telerobot will also be used on the Orbital Maneuvering Vehicle to service free-flyer spacecraft. The FTS will be capable of both teleoperation and autonomous operation; eventually it may also utilize ground control. By careful selection of the functional architecture and a modular approach to the hardware and software design, the FTS can accept developments in artificial intelligence and newer, more advanced sensors, such as machine vision and collision avoidance.

A88-15819#
TELERobOTS AND ORBITAL LABORATOrIES - AN END-TO-END ANALYSIS AND DEMONSTRATION
(IAF PAPER 87-27)
Concepts for a Laboratory Experiment Manipulator system consisting of an onboard mobile manipulator and a computer-assisted operator control station are discussed, with application to the International Space Station. A unique predictive control for data evaluation is considered as a solution to the problem of robot remote control in the presence of time delay. Correction factors for the calibration of the robot predictor model have been incorporated such as geometric distortion and spherical aberration caused by the video optics. The onboard manipulator concept has been demonstrated experimentally using an industrial robot, with operator joystick command capability and delayed video feedback included to simulate the Space Station Teleoperation system.

A88-15830#
EUROPEAN EVA REQUIREMENTS AND SPACE SUIT DESIGN
(IAF PAPER 87-41)
EVA activities associated with operations of the Columbus space station and the Hermes manned reusable spacecraft require space suits for ESA astronauts characterized by high mobility and dexterity, exceptional protection against radiation, thermal loads, and micrometeoroids, and good communications equipment. Such suits must also minimize donning/doffing time and prebreathing requirements. Attention is presently given to operational performance criteria that must be met by these suits in the course of EVA concerned with Orbit Replaceable Units on such ESA spacecraft as the enhanced Eureca platform, as well as to the anthropometric constraints of suit geometry.

A88-15850#
MAN TENDED FREE FLYER INTERIOR EQUIPMENT FOR MANNED AND AUTOMATED OPERATION
(IAF PAPER 87-75)
The man tended free flyer (MTFF), part of the European Space Station program Columbus, is an orbiting laboratory operated by AI systems and robots. The MTFF is visited semiannually by astronauts aboard Hermes. In effect, the MTFF interior equipment has to be accessible to both man and machine. Germany has undertaken a robotics technology experiment (Rotex) to be flown on the Spacelab D-2 mission to verify robot technology for MTFF. Rotex operation will begin with functional verification involving the calibration of sensors, plant parameter verification, and the measurement of static and dynamic performance. The handling of a biological experiment, assembly of a truss structure, and the capture of a free-flying object are among the handling tasks to be performed.

A88-15854#
SELECTED ADVANCED TECHNOLOGY STUDIES FOR THE U.S. SPACE STATION
(IAF PAPER 87-79)
Results of three of the most significant studies completed as part of Work Package 1 of the U.S. Space Station are reported. In particular, water reclamation techniques have been developed using multifiltration methods and reverse osmosis with both longitudinal hollow fibers and spiral wound sheet structures. In the course of another study, methods of on-orbit pressurized module repair have been tested using the Neutral Buoyancy Test Facility at the Marshall Space Flight Center (MSFC). The discussion also covers the development and fabrication of a full scale flight weight, flight quality prototype pressurized module.

A88-16067# Massachusetts Inst. of Tech., Cambridge.
DESIGN OF A FORCE REFLECTING HAND CONTROLLER FOR SPACE TELEMANIPULATION STUDIES
(Contract NAGW-21)
(IAF PAPER 87-ST-01)
The potential importance of space telemanipulator systems is reviewed, along with past studies of master-servomechanism manipulation using a generalized force reflecting master arm. Problems concerning their dynamic interaction with the human operator have been revealed in the use of these systems, with marked differences between 1-g and simulated weightless conditions. A study is outlined to investigate the optimization of the man machine dynamics of master-servomechanism, and a set of specifications is determined for the apparatus necessary to perform this investigation. This apparatus is a one degree of freedom force reflecting hand controller with closed loop servo control which enables it to simulate arbitrary dynamic properties to high bandwidth. Design of the complete system and its performance is discussed. Finally, the experimental adjustment of the hand controller dynamics for smooth manual control performance with good operator force perception is described, resulting in low inertia, viscously damped hand controller dynamics.

Author
ARTIFICIAL GRAVITY - A COUNTERMEASURE FOR ZERO GRAVITY


Current knowledge on artificial gravity is presented with emphasis placed on the unique characteristics of such an environment and their effects on crew performance and vehicle habitability. A parametric optimization of the vehicle size and operation is performed. The following set of 'optimum' parameter values is obtained: a cost of 15.8 billion dollars, a radius of 80 feet, a rotation rate of 4.8 rpm, and a g-value of 0.62. Consideration is also given to the problems of adaptation, retention of adaptation, and simultaneous adaptation to both nonrotating and rotating environments.

The Solar Plant Growth Facility, conceptually designed as a reusable life science facility, supports investigations pertaining to future biological life support systems. A laboratory model offering various types of higher plants (lettuce, mung, and soy beans) were carried out to investigate the effects of particular illumination conditions (60 min day⁻1/35 min night cycle in LEO) on the biological specimen. Total biomass production showed a decrease of up to 50 percent for mung beans and about 25 percent for soy beans.

SPACE SUIT SYSTEMS - TECHNICAL AND PHYSIOLOGICAL CONSTRAINTS


The major issues relevant to the design of a space suit system are discussed with emphasis placed on technical and physiological constraints. It is noted that prebreathing, required to prevent decompression sickness, is strongly affected by the change in nitrogen partial pressure and atmospheric composition the astronaut experiences prior to EVA. Technical solutions are presented together with a graph of spacecraft cabin pressure versus suit enclosure pressure.

RADIATION PROBLEMS WITH THE SPACE STATION SCENARIO AND THE NECESSARY SURVEILLANCE FOR ASTRONAUTS


Radiation problems in the typical orbits of Space Shuttle flights are discussed as well as problems with radiation surveillance in space radiation fields. A graph is presented of the LET spectrum of the D-1 mission (altitude 324 km, inclination 57 deg) and related quality factors. It is believed that the maximum stay in Space Station orbits might be limited to 20-30 days. An independent group focusing on an on- and off-line radiation surveillance for astronauts is expected to be established in the crew training center of the DFVLR.

A DEVICE FOR MEASURING THE PARTIAL PRESSURE OF OXYGEN IN CAPILLARY BLOOD UNDER SPACE FLIGHT CONDITIONS


A device allowing the pO2 in liquid biological microsamples to be rapidly and simply determined under the conditions of weightlessness is proposed. The polarographic principle is used for pO2 determination, and the heated measuring electrode has a time of operation of 15-20 sec. The present method requires a quantity of only 10-20 microliters of blood, and specimens go directly from the subject to the measuring chamber. The accuracy of the device is demonstrated by comparison of measurements with those obtained using stationary devices.

A SYSTEMS ENGINEERING VIEW OF THE HUMAN IN SPACE


A model of the human as an 'engineered' system provides a starting point for determining human requirements and performance on an equivalent basis with technological systems. The human as an engineered system with performance requirements is defined to consist of four subsystems: cognitive, psychological, biomechanical, and biomedical. It is suggested that the treatment of the psychological subsystem as one that modulates the efficiency and quality of human performance offers a particular approach for examining and characterizing psychological effects.

THE SOLAR PLANT GROWTH FACILITY - AN APPROACH TOWARDS FUTURE BIOLOGICAL LIFE SUPPORT SYSTEMS

G. TRAXLER (Oesterreichische Raumfahrt- und Systemtechnik GmbH, Vienna, Austria) and HEIDEMARIE HURTTL (Wien, Universitaet, Vienna, Austria) IAF, International Astronautical Congress, 38th, Brighton, England, Oct. 10-17, 1987. 6 p. refs

The Solar Plant Growth Facility, conceptually designed as a reusable life science facility, supports investigations pertaining to future biological life support systems. A laboratory model offering various types of higher plants (lettuce, mung, and soy beans) were carried out to investigate the effects of particular illumination conditions (60 min day⁻1/35 min night cycle in LEO) on the biological specimen. Total biomass production showed a decrease of up to 50 percent for mung beans and about 25 percent for soy beans.

Providing Artificial Gravity - Physiologic Limitations to Rotating Habitats


The medical rationale for artificial gravity is examined and past investigations of optimal rotation velocity and habitat radius are reviewed. The artificial gravity sleeper, a proposed countermeasure for long duration space flight, is also discussed. The physiologic changes and potential concerns due to long duration habitation in zero gravity are discussed with emphasis placed on the renal/fluid shift, cardiovascular deconditioning, osteoporosis, immune system changes, and reproductive capability.

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT
A88-16168**  National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.  
HUMAN FACTOR DESIGN OF HABITABLE SPACE FACILITIES  
IAF PAPER 87-544  
Current fundamental and applied habitability research conducted as part of the U.S. space program is reviewed with emphasis on methods, findings, and applications of the results to the planning and design of the International Space Station. The discussion covers the following six concurrent directions of habitability research: operational simulation, functional interior decor research, spacecraft privacy requirements, interior layout and configuration analysis, human spatial habitability model, and analogous environments research.  
V.L.  
A88-16167#  NASA-STD-3000, MAN-SYSTEM INTEGRATION STANDARDS - THE NEW SPACE HUMAN ENGINEERING STANDARDS  
IAF PAPER 87-550  
Various aspects of the process used to develop NASA-STD-3000, Man-System Integration Standards (MSIS) are reviewed, as are the documents, the database, and a videotape that are currently available from NASA. The MSIS provides the specific information needed to ensure proper integration of the man-system interface requirements with those of other aerospace disciplines. In addition to the requirements, the MSIS provides design considerations and examples which help the user understand the rationale behind the requirements. The implementation and maintenance of MSIS are also discussed.  
V.L.  
A88-16168#  SPACEHAB MODULE DESIGN PROJECT UTILIZES ENGINEERING SERVICES FOR HUMAN FACTORS CONSIDERATION  
IAF PAPER 87-551  
The use of state-of-the-art computer graphics simulation for the purpose of preliminary product, vehicle, and subsystem design and analysis is discussed with reference to the design of a pressurized Spacehab module which fits in the first quarter of the Space Shuttle payload bay. The use of flight simulator type real-time computer graphics is shown to provide a cost-effective and innovative way of designing vehicles, operations, and equipment by providing an environment for the consideration of human factors, mechanisms, and robotics design requirements. Details of the Spacehab module design are given.  
V.L.  
A88-16169#  IMPORTANCE OF HUMAN FACTORS IN THE CONCEPTION OF HERMES SPACECRAFT  
IAF PAPER 87-552  
The habitability of the Hermes spacecraft is evaluated using CAD evaluations (human body simulations) and neutral buoyancy experiments (two subjects suited with simulated EVA pressurized equipment in a water tank). Particular attention is given to the volume and arrangement for different airlocks and the cabin layout. The three airlock arrangements studied are: (1) a cylinder, (2) a cylinder modified by the addition of two vertical planes, and (3) a truncated half cylinder. The data reveal that the first airlock arrangement, a cylinder with a 1.6 m diameter, is most ergonomic. New designs for the cockpit, locker, life volume, and airlock are proposed.  
I.F.  
A88-16170#  LOW-COST PROTOTYPES FOR HUMAN FACTORS EVALUATION OF SPACE STATION CREW EQUIPMENT  
DONALD NIXON, CHRIS MILLER, JOE KENNEDY, BRAD SKEPNER (Space Projects Group, Santa Monica, CA), and TOM TAYLOR (Spacehab, Inc., Washington, DC) IAF, International Astronautical Congress, 38th, Brighton, England, Oct. 10-17, 1987. 9 p. refs  
IAF PAPER 87-553  
The development of inexpensive prototypes for human factor evaluation of Space Station crew equipment is demonstrated with several examples. These include testing of a multipurpose wardrobe table, intended for crew meals, meetings, and work applications; portable/wearable workstation, which will provide Space Station crew members with a compact, portable, and versatile facility with communications, data, and audio-visual management and interface capabilities; and passive leg restraint. Consideration is also given to the prototype fabrication/flight-test costs.  
I.S.  
A88-16172*#  National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.  
ACTIVATION OF A CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM (CELS) BREADBOARD FACILITY - WHEAT GROWTH STUDIES  
IAF PAPER 87-557  
NASA's Controlled Ecological Life Support System (CELS) will include subsystems for biomass production, food processing, and waste management in space. This paper discusses the CELSS Breadboard program, which is a research project for integration and evaluation of concepts and techniques of the CELSS facility, with special attention given to the Biomass Production Chamber (BPC). The design of the BPC and of its subsystems for nutrient delivery, atmospheric control, and computer control are discussed together with the subsystem control and monitoring parameter requirements. Results from preliminary wheat-growth tests in the BPC are included.  
I.S.  
A88-16176*#  California Univ., Davis.  
ARTIFICIAL GRAVITY - THE EVOLUTION OF VARIABLE GRAVITY RESEARCH  
IAF PAPER 87-539  
The development of a space life science research program based on the use of rotational facilities is described. In-flight and ground centrifuges can be used as artificial gravity environments to study the following: nongravitational biological factors; the effects of 0, 1, and hyper G on man; counter measures for deconditioning astronauts in weightlessness; and the development of suitable artificial gravity for long-term residence in space. The use of inertial fields as a substitute for gravity, and the relations between the radius of the centrifuge and rotation rate and specimen height and rotation radius are examined. An example of a centrifuge study involving squirrel monkeys is presented.  
I.F.  
A88-16182#  SPACE BIOLOGIST'S INFLIGHT SAFETY CONSIDERATIONS  
IAF PAPER 87-570  
Safety constraints arising in the preparation of biological experiments for manned space laboratories are related to instrumentation, and to biological, chemical, and radioactive hazards. A more standardized application of safety rules by different
space centers is suggested as well as an improved understanding between investigators and safety engineers. In addition, The Space Station/Columbus Utilization Preparation Program encourages the use of off-the-shelf hardware on future Spacelab missions. K.K.

A88-16187# CREWMAN RESCUE EQUIPMENT IN MANNED SPACE MISSIONS - ASPECTS OF APPLICATION
The application of survival suits to earth-to-orbit transport vehicles, permanently orbiting space stations, and interplanetary spacecraft is discussed. Crewman activities during various emergencies are described along with the role of the suit. The features of different types of survival suits are examined. C.D.

A88-16309 MODELLING AND SIMULATION OF DISTRIBUTED FLEXIBILITY IN A SPACEBORNE MANIPULATOR
The modal impedance, assumed-mode, and fictitious joint-introduction approaches to the characterization of distributed flexibility are evaluated for the case of an in-plane, two-degrees-of-freedom manipulator. General, multipurpose software for the geometric, kinematic, and dynamic analysis of rigid multibody mechanical systems is used. The introduction of fictitious joints is used to solve problems associated with simulation, kinematic inversion, and closed-loop analysis. O.C.

A88-16310 FEASIBILITY OF TIME DELAY COMPENSATION FOR A SPACE TELEOPERATION TASK

In order to enhance the level of performance that is degraded when time delay is introduced by long communication links into a remote manipulator system (RMS), the time delay may be compensated for by presenting the operator with a predicted view of the system on a visual display. This method is presently applied to a satellite-grasping task involving the two control problems of instability within the control loop due to time delay, and time delay located on the reference input, which induces a tracking error. Digital simulations of the RMS in which an autopilot is substituted for the operator have demonstrated the method's efficiency. O.C.

A88-16312 CONTROL OF IN-ORBIT SPACE MANIPULATION

An account is given of the primary applications of robotics, telemanipulation, and servicing technologies, in the context of special space constraints and critical manipulator control problems. Attention is given to such aspects of control as electrical system architecture, proprioceptive and exteroceptive sensors, and man-machine task sharing. The progress made to date with terrestrial manipulator control systems is evaluated. The focus of these technology development efforts is the emerging set of robot/multibody systems requirements associated with ESA's Hermes reusable manned orbiter. O.C.
The feasibility of using photosynthetic microalgae (cyanobacteria) as a subsystem component for the closed ecological life support system program, with particular emphasis on algae, suggesting that the efficiency of the closed system could be significantly improved using this recycling process. Author


Concepts of a Closed Ecological Life Support System (CELSS) anticipate the use of photosynthetic organisms (higher plants and algae) for air revitalization. The rates of production and uptake of carbon dioxide and oxygen between the crew and the photosynthetic organisms are mismatched. An algal system used for gas exchange only will have the difficulty of an accumulation or depletion of these gases beyond physiologically tolerable limits (in a closed system the mismatch between assimilatory quotient (AQ) and respiratory quotient (RQ) is balanced by the operation of the waste processor). The results are given of a study designed to test the feasibility of using environmental manipulations to maintain physiologically appropriate atmospheres for algae and mice in a gas closed system. Specifically, the atmosphere behavior of this system is considered with algae grown on nitrate or urea and at different light intensities and optical densities. Manipulation of both allow operation of the system in a gas stable manner. Operation of such a system in a CELSS may be useful for reduction of buffer sizes, as a backup system for higher plant air revitalization and to supply extra oxygen to the waste processor or during crew changes. Author


Protein isolates obtained from green algae cultivated under controlled conditions was characterized. Molecular weight determination of fractionated algal proteins using SDS-polyacrylamide gel electrophoresis revealed a wide spectrum of molecular weights ranging from 15,000 to 220,000. Isoelectric points of dissociated proteins were in the range of 3.95 to 6.20. Algal protein composition of protein isolate compared favorably with FAO standards. High content of essential amino acids leucine, valine, phenylalanine and lysine make algal protein isolate a high quality component of closed ecological life support system diets. To optimize the removal of algal lipids and pigments supercritical carbon dioxide extraction (with and without ethanol as a co-solvent) was used. Addition of ethanol to supercritical carbon dioxide resulted in more efficient removal of algal lipids and produced protein isolate with a good yield and protein recovery. The protein isolate extracted by the above mixture had an improved water solubility. Author


The feasibility of using photosynthetic microalgae (cyanobacteria) as a subsystem component for the closed ecological life support system program, with particular emphasis on algae, suggesting that the efficiency of the closed system could be significantly improved using this recycling process. Author
on the manipulation of the biomass (protein/carbohydrate) was addressed. Using factors which retard growth rates, but not photosynthetic electron flux, the partitioning of photosynthetically derived reducants may be dictated predictably in the space environment. Cold shock treatment of fairly dense cultures markedly increases the glycogen content from 1 to 35 percent (dry weight), and presents a useful technique to change the protein/carbohydrate ratio of these organisms to a more nutritionally acceptable form.

Author

N88-12258* # Keio Univ., Yokahama (Japan).

**SUNLIGHT SUPPLY AND GAS EXCHANGE SYSTEMS IN MICROALGAL BIOREACTOR**


Avail: NTIS HC A08/MF A01 CSCL 06K

The bioreactor with sunlight supply system and gas exchange systems presented has proved feasible in ground tests and shows much promise for space use as a closed ecological life support system device. The chief conclusions concerning the specification of total system needed for a life support system for a man in a space station are the following: (1) Sunlight supply system - compactness and low electrical consumption; (2) Bioreactor system - high density and growth rate of chlorella; and (3) Gas exchange system - enough for O2 production and CO2 assimilation.

Author

N88-12259* # National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**A REVIEW OF RECENT ACTIVITIES IN THE NASA CELSS PROGRAM**


Avail: NTIS HC A08/MF A01 CSCL 06K

A CELSS (Controlled Ecological Life Support System) is a device that utilizes photosynthetic organisms and light energy to regenerate waste materials into oxygen and food for a crew in space. The results of studies with the CELSS program suggest that a bioregenerative life support system is a useful and effective method of regenerating consumable materials for crew sustenance. The data suggests that the operation of a CELSS in space is practical if plants can be made to behave predictably in the space environment. Much of the work centers on the biological components of the CELSS system. Ways of achieving high efficiency and long term stability of the components of the system are examined. Included are explorations of the conversion of nonedible cellulose to edible materials, nitrogen fixation by biological and chemical methods, and methods of waste processing. A description is provided of the extent to which a bioregenerative life support system can meet the constraints of the space environment, and the degree is assessed to which system efficiency and stability can be increased during the next decade.

Author

N88-12260* # National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**A MODULAR BLSS SIMULATION MODEL**


Avail: NTIS HC A08/MF A01 CSCL 06K

A bioregenerative life support system (BLSS) for extraterrestrial use will be faced with coordination problems more acute than those in any ecosystem found on Earth. A related problem in BLSS design is providing an interface between the various life support processors, one that will allow for their coordination while still allowing for system expansion. A modular model is presented of a BLSS that interfaces system processors only with the material storage and transport reservoirs acting as the principal buffers in the system and thus minimizing difficulties with processor coordination. The modular nature of the model allows independent development of the detailed submodels that exist within the model framework. Using this model, BLSS dynamics were investigated under normal conditions and under various failure modes. Partial and complete failures of various components such as the waste processors or the plants themselves, drive transient responses in the model system, allowing the examination of the effectiveness of the system reservoirs as buffers. The results from simulations help to determine control strategies and BLSS design requirements. An evolved version could be used as an interactive control aid in a future BLSS.

Author

N88-12261* # Mitsubishi Heavy-Industries Ltd., Nagoya (Japan).

**PRELIMINARY EXPERIMENTAL RESULTS OF GAS RECYCLING SUBSYSTEMS EXCEPT CARBON DIOXIDE CONCENTRATION**


Avail: NTIS HC A08/MF A01 CSCL 06K

Oxgen concentration and separation is an essential factor for air recycling in a controlled ecological life support system (CELSS). Furthermore, if the value of the plant assimilatory quotient is not coincident with that of the animal respiratory quotient, the recovery of oxygen from the concentrated CO2 through chemical methods will become necessary to balance the gas contents in a CELSS. Therefore, oxygen concentration and separation equipment using Salocine and O2 recovery equipment, such as Sabatier and Bosch reactors, were experimentally developed and tested.

Author

N88-12262* # Hitachi Ltd., Tokyo (Japan).

**VAPOR COMPRESSION DISTILLER AND MEMBRANE TECHNOLOGY FOR WATER REVITALIZATION**


Avail: NTIS HC A08/MF A01 CSCL 06K

Water revitalization for a space station can consist of membrane filtration processes and a distillation process. Water recycling equipment using membrane filtration processes was manufactured for ground testing. It was assembled using commercially available components. Two systems for the distillation are studied: one is absorption type thermopervaporation cell and the other is a vapor compression distiller. Absorption type thermopervaporation, able to easily produce condensed water under zero gravity, was investigated experimentally and through simulated calculation. The vapor compression distiller was studied experimentally and it offers significant energy savings for evaporation of water.

Author

N88-12263* # Science Univ. of Tokyo, Chiba (Japan).

**FUNDAMENTAL STUDY ON GAS MONITORING IN CELSS**


Avail: NTIS HC A08/MF A01 CSCL 06K

A gas spectrometer and computer system was developed for conducting a fundamental study on gas monitoring in a Controlled Ecological Life Support System. Respiration and metabolism of the hamster and photosynthesis of the Spirulina were measured in a combination system consisting of a hamster chamber and a Spirulina cultivator. They are connected through a membrane gas exchanger. Some technical problems were
examined. In the mass spectrometric gas monitoring, a simultaneous multisample measurement was developed by employing a rotating exchange valve. Long term precise measurement was obtained by employing an automatic calibration system. The membrane gas sample probe recorded for the use for long term measurement. The cultivation rate of the Spirulina was effectively changed by controlling CO2 and light supply. The experimental results are helpful for improving the hamster-spirulina system.

N88-12264* # Niigata Univ. (Japan). Dept. of Civil Engineering. ITIE APPLICABILITY OF THE CATALYTIC WET-OXIDATION TO CELSS

The wet oxidation catalysis of Au, Pd, Pt, Rh or Ru on a ceramic honeycomb carrier was traced in detail by 16 to 20 repetitive batch tests each. As a result, Pt or Pd on a honeycomb carrier was shown to catalyze complete nitrogen gasification as N2. Though the catalysts which realize both complete nitrogen gasification and complete oxidation could not be found, the Ru + Rh catalyst was found to be most promising. Ru honeycomb catalyzed both nitrification and nitrogen gasification.

N88-12265* # Mitsubishi-Kasei Inst. of Life Sciences, Tokyo (Japan). Lab. of Biogeochemistry and Sociogeochemistry. A LARGE-SCALE PERSPECTIVE ON ECOSYSTEMS

Interactions between ecological elements must be better understood in order to construct an ecological life support system in space. An index was devised to describe the complexity of material cyclings within a given ecosystem. It was then applied to the cyclings of bioelements in various systems of material cyclings including the whole Earth and national economies. The results showed interesting characteristics of natural and man-made systems.

N88-12266* # California Univ., Davis. Plant Growth Lab. DESIGN OF AN ELEMENTAL ANALYSIS SYSTEM FOR CELSS RESEARCH

The results of experiments conducted with higher plants in tightly sealed growth chambers provide definite evidence that the physical closure of a chamber has significant effects on many aspects of a plant’s biology. One of these effects is seen in the change in rates of uptake, distribution, and re-release or nutrient elements by the plant (mass balance). Experimental data indicates that these rates are different from those recorded for plants grown in open field agriculture, or in open growth chambers. Since higher plants are a crucial component of a controlled ecological life support system (CELSS), it is important that the consequences of these rate differences be understood with regard to the growth and yield of the plants. A description of a system for elemental analysis which can be used to monitor the mass balance of nutrient elements in CELSS experiments is given. Additionally, data on the uptake of nutrient elements by higher plants grown in a growth chamber is presented.

N88-12267* # National Aerospace Lab., Tokyo (Japan). Space Technology Research Group. AN OVERVIEW OF JAPANESE CELSS RESEARCH ACTIVITIES

Development of Controlled Ecological Life Support System (CELSS) technology is inevitable for future long duration stays of human beings in space for lunar base construction and for manned Mars flight programs. CELSS functions can be divided into 2 categories, Environmental Control and Material Recycling. Temperature, humidity, total atmospheric pressure and partial pressure of oxygen and carbon dioxide, necessary for all living things, are to be controlled by the environment control function. This function can be performed by technologies already developed and used as the Environment Control Life Support System (ECLLS) of Space Shuttle and Space Station. As for material recycling, matured technologies have not yet been established for fully satisfying the specific metabolic requirements of each living thing including human beings. Therefore, research activities for establishing CELSS technology should be focused on material recycling technologies using biological systems such as plants and animals and physico-chemical systems, for example, a gas recycling system, a water purifying and recycling system and a waste management system. Japanese research activities were conducted and will be continued accordingly.

N88-12268* # Commissariat a l’Energie Atomique, Cadarache (France). Service de Radioagromonie. STUDY OF THE RELATIONSHIP BETWEEN PHOTOSYNTHESIS, RESPIRATION, TRANSPERSION, AND MINERAL NUTRITION IN WHEAT [ETUDE DES RELATIONS ENTRE PHOTOSYNTHÈSE, RESPIRATION, TRANSPERSION ET NUTRITION MINÉRALE CHEZ LE BLE]

The growth of wheat (triticae aestivum) was studied in an enclosed controlled environment for a period of 70 days. The exchange of gases (photosynthesis, respiration), water (transpiration) and the consumption of mineral elements (nitrogen, phosphorus, potassium) were continuously measured. The dynamical relations observed in the different physiological functions, under the influence of growth and in response to environmental modifications are presented. The influence of carbon dioxide content during growth (normal or double percentage) was made clear.

N88-12269* # Wisconsin Univ., Madison. Dept. of Horticulture. UTILIZATION OF POTATOES IN BIOREGENERATIVE LIFE SUPPORT SYSTEMS

Data on the tuberization, harvest index, and morphology of 2 cvs of white potato (Solanum tuberosum L.) grown at 12, 16, 20, 24 and 28 C, 250, 400 and 550 micromol/s/m photosynthetic photon flux (PPF), 350, 1000 and 1600 microliter 1 sup -1 CO2 is presented. A productivity of 21.9 g/m day sup -1 of edible tubers from a solid stand of potatoes grown for 15 weeks with continuous irradiation at 400 micromol/s/m, 16 C and 1000 microliter 1 sup -1 CO2 was obtained. This equates to an area of 34.3 sq m being required to provide 2800 kcal of potatoes per day for a human diet. Separated plants receiving side lighting have produced 32.8 g/m day sup -1 which equates to an area of 23.6 sq m to provide 2800 kcal. Studies with side lighting indicate that...
and inedible parts of plants; (2) food consumption and production protein, carbohydrate, fat, fiber, and lignin production in the edible models. The biochemistry stoichiometry was developed for: (1) Avail: NTlS HC AOB/MF A01

SIMULATION MODEL
Ames Research Center, Moffett Field, Calif.
Regenerative Life Support Systems in Space p 139-146 Sep. 1987

RUMMEL
MASS BALANCES FOR A BIOLOGICAL LIFE SUPPORT SYSTEM


Avail: NTIS HC A08/MT A01 CSCL 06K

Conditions are optimized for maximum yield and quality of wheat to be used in a controlled environment life support system (CELSS) in a Lunar or Martian base or a spacecraft. With yields of 23 to 57 g/sq m/d of edible biomass, a minimum size for a CELSS would be between 12 and 30 sq m per person, utilizing about 600 W/sq m of electrical energy for artificial light. Temperature, irradiance, photoperiod, carbon dioxide levels, humidity, and wind velocity are controlled in growth chambers. Nutrient solutions (adjusted for wheat) are supplied to the roots via a recirculating system that controls pH by adding HNO3 and controlling the NO3/NH4 ratio in solution. A rock-wool plant support allows direct seeding and densities up to 10,000 plants sq m. Densities up to 2000 plants/sq m appear to increase seed yield. Biomass production increases almost linearly with increasing irradiance from 400 to 1700 micromol/sq m/s of photosynthetic photon flux, but the efficiency of light utilization decreases over this range. Photoperiod and temperature both have a profound influence on floral initiation, spikelet formation, stem elongation, and fertilization.

Author

N88-12270*# Alberta Research Council, Edmonton (Canada). Dept. of Biotechnology.
THE EFFECT OF RADIATION ON THE LONG TERM PRODUCTIVITY OF A PLANT BASED CELSS

B. G. THOMPSON (New York Univ., New York.) and B. H. LAKE
Avail: NTIS HC A08/MT A01 CSCL 06K

Mutations occur at a higher rate in space than under terrestrial conditions, primarily due to an increase in radiation levels. These mutations may affect the productivity of plants found in a controlled ecological life support system (CELSS). Computer simulations of plants with different ploidies, modes of reproduction, lethality thresholds, viability thresholds and susceptibilities to radiation induced mutations were performed under space normal and solar flares conditions. These simulations identified plant characteristics that would enable plants to retain high productivities over time in a CELSS.

Author

N88-12272*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
MASS BALANCES FOR A BIOLOGICAL LIFE SUPPORT SYSTEM SIMULATION II report
TYLER VOLK (New York Univ., New York.) and JOHN D. RUMMEL
In its Controlled Ecological Life Support System: Regenerative Life Support Systems in Space p 139-146 Sep. 1987
Avail: NTIS HC A08/MT A01 CSCL 06K

Design decisions to aid the development of future space based biological life support systems (BLSS) can be made with simulation models. The biochemistry stoichiometry was developed for: (1) protein, carbohydrate, fat, fiber, and lignin production in the edible and inedible parts of plants; (2) food consumption and production of organic solids in urine, feces, and wash water by the humans; and (3) operation of the waste processor. Flux values for all components are derived for a steady state system with wheat as the sole food source. The large scale dynamics of a materially closed (BLSS) computer model is described in a companion paper. An extension of this methodology can explore multifood systems and more complex biochemical dynamics while maintaining whole system closure as a focus.

Author
working diagram window and of sequential manipulation subtasks. The proposed automated task visual interface to the machine. Today's scientific workstations add: a symbiosis containing context of dexterous manipulation and teleoperation. This paper the beam profile in the other window. DOE

V. PAXSON, V. JACOBSON, E. THEIL, M. LEE, and S.
ACCELERATOR CONTROL

To dynamically allocate tasks to the man and the machine. DOE


which can be run independently or linked together. This toolbox workstation. The system is designed as a set of building blocks

beam scraping, the operator activates the Working Diagram and Beam Position tools. The operator points to the new tune on the

workstation. The system is designed as a set of building blocks

these workstations, an operator interface for an accelerator control

programs needed for the task at hand. Each program runs in a

one window, the effects are then shown in the other windows. DOE

we discuss such a system currently being developed on a Sun-3

system can be built which is powerful, flexible, and easy to learn. DOE

For example, to change the tune of the machine while monitoring

the linear and nonlinear effects. The final section of the report places these results within the context of the multitask problem, and indicates the direction of future research which will yield a quantitative description of vehicle performance in a rapidly changing environment. DOE

Oak Ridge National Lab., Tenn.

ARCHITECTURE FOR DYNAMIC TASK ALLOCATION IN A
MAN-ROBOT SYMBIOTIC SYSTEM

Presented is a methodological approach to the dynamic allocation of tasks in a man-machine symbiotic system in the context of dexterous manipulation and teleoperation. This paper addresses a symbiosis containing two partners working toward controlling a single manipulator arm for the execution of a series of sequential manipulation subtasks. The proposed automated task allocator uses knowledge about the allocation policies of the problem, the available resources, and the tasks to be performed to dynamically allocate tasks to the man and the machine. DOE

California Univ., Berkeley. Lawrence Berkeley Lab.

A SCIENTIFIC WORKSTATION OPERATOR-INTERFACE FOR
ACCELERATOR CONTROL
V. PAXSON, V. JACOBSON, E. THEIL, M. LEE, and S.

Research in human factors has demonstrated that people use computers more efficiently and effectively if they have a highly visual interface to the machine. Today's scientific workstations provide sufficient power to implement such interfaces. By using these workstations, an operator interface for an accelerator control system can be built which is powerful, flexible, and easy to learn. We discuss such a system currently being developed on a Sun-3 workstation. The system is designed as a set of building blocks (e.g., Working Diagram, Twiss Plot, Beamline, Orbit Correction) which can be run independently or linked together. This toolbox approach gives the operator the ability to execute precisely those programs needed for the task at hand. Each program runs in a separate window and communicates with other running programs via a common data base. When the operator makes a change in one window, the effects are then shown in the other windows. For example, to change the tune of the machine while monitoring beam scraping, the operator activates the Working Diagram and Beam Position tools. The operator points to the new tune on the working diagram window and sees the effects it would have on the beam profile in the other window. DOE


OPERATOR MULTIPLE-TASKING STUDY FOR REMOTELY
K. S. HAALAND and D. D. SWORDE Apr. 1987 100 p

This report provides the equations of evolution of an encounter involving a teleoperated vehicle. The global model contains interconnected submodels describing the conventional external primitives of the encounter (base states), suddenly occurring events (feature states), and a dynamic description of the remote operator (the generalized operator model). This model is phrased as a set of stochastic differential equations that can accommodate both linear and nonlinear effects. The final section of the report places these results within the context of the multitask problem, and indicates the direction of future research which will yield a quantitative description of vehicle performance in a rapidly changing environment. DOE

Naval Postgraduate School, Monterey, Calif.

A SIMULATION STUDY OF A SPEED CONTROL SYSTEM FOR
AUTONOMOUS ON-ROAD OPERATION OF AUTOMOTIVE
VEHICLES M.S. Thesis
MICHAEL J. DOLEZAL Jun. 1987 270 p

The study of human driving of automotive vehicles is an important aid to the development of viable autonomous vehicle navigation and control techniques. Observation of human behavior during driving suggests that this activity involved two distinct levels, the conscious and the unconscious. The behavior of a driver while stopping his vehicle at a stop sign can be conscious or unconscious, depending on the driver's skill level and the driving conditions. The driver's behavior involves a difficult process of estimating the distance to the stop sign and the velocity of the vehicle. Using these estimates, the driver then takes the necessary control actions to stop the vehicle. This research attempts to mimic the driver's conscious and unconscious behavior through mathematical modeling and computer simulation. DOE

Naval Submarine Medical Research Lab., Groton, Conn.

PERFORMANCE AND PREFERENCE WITH VARIOUS VDT
(VIDEO DISPLAY TERMINAL) PHOSPHORS Interim Report
S. M. LURIA, DAVID F. NERI, and CHRISTINE SCHLICHTING
24 Apr. 1987 20 p

Subjects searched for target letters and symbols in VDT displays produced with phosphors of different colors: green, amber, yellow, red, blue, and white. There were no significant differences in search time, but there were significant differences in the number of errors made with different phosphors. Yellow produced the fewest errors and white the most. Speed and accuracy did not correlate with the preference ratings for the various phosphors. DOE

Performance, Inc., Houston, Tex.

AN ASSESSMENT OF CLINICAL CHEMICAL SENSING
TECHNOLOGY FOR POTENTIAL USE IN SPACE STATION
HEALTH MAINTENANCE FACILITY
31 Aug. 1987 308 p

A Health Maintenance Facility is currently under development for space station application which will provide capabilities equivalent to those found on Earth. This final report addresses the study of alternate means of diagnosis and evaluation of impaired tissue perfusion in a microgravity environment. Chemical data variables related to the dysfunction and the sensors required to measure these variables are reviewed. A technology survey outlines the ability of existing systems to meet these requirements. How the candidate sensing system was subjected to rigorous testing is explored to determine its suitability. Recommendations for follow-on activities are included that would make the commercial system more appropriate for space station applications. Author

National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.

SPACE SUIT EXTRAVEHICULAR HAZARDS PROTECTION
DEVELOPMENT
JOSEPH J. KOSMO Aug. 1987 29 p

Presented is an overview of the development of the integral thermal/micrometeoroid garment (ITMG) used for protection of a space-suited crewmember from hazards of various extravehicular environments. These hazard conditions can range from thermal extremes, meteoroid and debris particles, and radiation conditions in near-earth orbits and free space to sand and dust environments encountered on lunar and planetary surfaces. Representative ITMG

DEVELOPMENT
JOSEPH J. KOSMO Aug. 1987 29 p

Presented is an overview of the development of the integral thermal/micrometeoroid garment (ITMG) used for protection of a space-suited crewmember from hazards of various extravehicular environments. These hazard conditions can range from thermal extremes, meteoroid and debris particles, and radiation conditions in near-earth orbits and free space to sand and dust environments encountered on lunar and planetary surfaces. Representative ITMG
materials cross-section layups are identified and described for various space suit configurations ranging from the Gemini program to planned protective requirements and considerations for anticipated Space Station EV operations. Author

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SPACE BIOLOGY

includes exobiology; planetary biology; and extraterrestrial life.

A88-14294* Hawaii Univ., Honolulu.
ORGANIC MATTER ON ASTEROID 130 ELEKTRA
D. P. CRUIKSHANK (Hawaii, University, Honolulu) and R. H. BROWN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Science (ISSN 0036-8075), vol. 238, Oct. 9, 1987, p. 183, 184. refs (Contract NGL-12-001-057)
Infrared absorption spectra of a low-albedo water-rich asteroid appear to show a weak 3.4-micrometer carbon-hydrogen stretching mode band, which suggests the presence of hydrocarbons on asteroid 130 Elektra. The organic extract from the primitive carbonaceous chondritic Murchison meteorite shows similar spectral bands. Author

A88-15438* California Univ., Los Angeles.
ISOTOPIC CHARACTERISATION OF KEROGEN-LIKE MATERIAL IN THE MURCHISON CARBONACEOUS CHONDRITE
JOHN F. KERRIDGE (California, University, Los Angeles), SHERWOOD CHANG, and RUTH SHIPP (NASA, Ames Research Center, Moffett Field, CA) Geochimica et Cosmochimica Acta (ISSN 0016-7037), vol. 51, Sept. 1987, p. 2527-2540. refs (Contract NGR-05-007-289; NAG9-27; NAGW-347)
Data on isotopic composition of C, H, and N in insoluble organic fraction from the Murchison CM chondrite were used to discriminate between different theories for the origin of prebiotic organic material in the early solar system. Considerable isotopic variability was found among the samples and attributed to kerogen-like organic fraction. Three to four different isotopic components, two of them of polycyclic aromatic nature, were tentatively identified. Aliphatic moieties in the kerogen-like material, most of the polycyclic aromatic network, and extractable amino acids were found to carry a highly D-enriched component believed to have originated in an interstellar molecular cloud. A least part of the polycyclic aromatic fraction may also represent interstellar material. I.S.

A88-16199# DETECTION OF LIFE IN OTHER PLANETARY SYSTEMS
The general requirements that an aperture-synthesis interferometer would have in order to be able to detect planetary systems of nearby stars are examined in a quantitative way. The aperture interferometry technique is reviewed, and the use of it to solve the central problem of suppressing the diffracted and scattered light from a star in order to detect a nearby planet is examined. Some practical considerations involved in the realization of such an interferometer are addressed. C.D.

A88-16324 DISCOVERY OF ORGANIC GRAINS IN COMET WILSON
D. A. ALLEN (Anglo-Australian Observatory, Epping, Australia) and D. T. WICKRAMASINGHE (Australian National University, Canberra) Nature (ISSN 0028-0836), vol. 329, Oct. 15, 1987, p. 615, 616. refs
The detection of a spectral emission feature similar to, but distinct from, the features from organic grains seen in Comet Halley is reported for the Comet Wilson. This comet appears to be making its first visit to the solar neighborhood; thus, the observed emission should come from grains which are the most pristine yet encountered. The differences in emission from the grains on Halley and Wilson may then reflect either local conditions in their respective birthplaces and/or their diverse histories. C.D.
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