

AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 334)

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 1990 in

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



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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 254 reports, articles and other documents announced during February 1990 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 on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. 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 1990 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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AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 334)

MARCH 1990

51

LIFE SCIENCES (GENERAL)

A90-13607#

EFFECT OF SPACE FLIGHTS AND HYPOKINESIA ON PLASMA INSULIN LEVELS AND INSULIN RECEPTORS IN RAT LIVER

L. MACHO, E. SVABOVA, M. FICKOVA, S. ZORAD (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia), L. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p. refs (IAF PAPER 89-564) Copyright

Hypokinesia is introduced as a model for simulation of the effects of animal stay in microgravity and other space flight conditions. The plasma insulin levels and insulin binding to liver cell membrane and to isolated adipocytes in rats exposed to hypokinesia were investigated. The simulation of the effects of microgravity by immobilization of animals in special cages for 1 and 7 days showed only a slight decrease in plasma insulin levels in 7-day hypokinetic animals as compared to control rats. It was found that binding of insulin to receptors of liver cell membranes in rats exposed to hypokinesia for 1 or 7 days is not significantly different from controls, however in isolated adipocytes, an important decrease of total binding capacity and number of insulin receptors was found in rats exposed to hypokinesia for 1 day period. For 7- and 21-day hypokinetic animals, the values of binding capacity for insulin and number of receptors in adipocytes were not very different from those in controls. The determination of insulin binding in adipocytes from adrenalectomized or dexamethasone treated rats exposed to hypokinesia indicated that glucocorticoids have a regulatory role in decrease of insulin receptors during short-term hypokinesia. C.E.

A90-13617#

PROSPECTS OF STUDIES IN SPACE PHYTOBIOLOGY

E. L. KORDIUM, P. G. SIDORENKO, D. A. KLIMCHUK, G. M. MARTIN, S. I. ZHADKO (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs (IAF PAPER 89-578) Copyright

Fundamental and important application problems in space phytobiology research are analyzed. The problems considered include the following: mechanisms of gravi-, photo-, and chemotropisms under gravitational and orbital flight conditions; structural/functional organization and reproduction/differentiation of various types of cells of vegetative and generative organs in plant ontogenesis as affected by microgravity; the role of calcium ions in gravireception, dynamics of intracellular ionized calcium content, and localization under microgravity; physical/chemical organization of cell membranes and their transport characteristics under microgravity; and mechanisms of adaptation to microgravity on cellular, subcellular, and membrane levels. An adequate system for analyzing space biological problems is still needed. The possibilities of growing several generations of higher plants in orbital

flights and of using plant cell cultures to produce medicinal and other useful substances in space cell biotechnologies are investigated. C.E.

A90-13634#

CELL MECHANISMS OF ADAPTATION TO MAIN FACTORS OF SPACE FLIGHT

E. L. KORDIUM, E. M. NEDUKHA, I. A. POLULIAKH, A. F. POPOVA, K. M. SYTNIK (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs (IAF PAPER 89-606) Copyright

Cytological and biochemical research was conducted on unicellular and multicellular plants growing under conditions of short-term and long-term orbital flights, and flight factors such as microgravity were simulated. These investigations were used to evaluate previously proposed mechanisms for the adaptation of plant forms to these space conditions on the cellular, subcellular, and membrane levels. An increased activity of hydrolytic enzymes was found which indicates the accelerated development and aging of organisms under the effect of orbital flight factors. B.J.

A90-13635#

BEHAVIOUR OF SINGLE-CELL ORGANISMS EXPOSED TO HYPERGRAVITY

H. PLANEL, G. RICHOLLEY, C. CARATERO, R. TIXADOR, A. CARATERO (Toulouse III, Universite, France) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 11 p. refs (IAF PAPER 89-607)

The paper shows the results of investigations carried out in two single cell organisms, *Paramecium t.* and *Tetrahymena p.*, exposed to different gravitational levels. In *paramecium*, hypergravity resulted in a decrease in cell growth rate. The results depend on g level and angular speed of the centrifuge; furthermore the responses depend also on small short fluctuations in g levels, due to the swimming of the cells inside the culture tubes. In contrast, the proliferation of *Tetrahymena* is stimulated by hypergravity. It can be pointed out that *paramecium* and *Tetrahymena* are both free swimming cells, belonging to the same group of Ciliates. Author

A90-13636#

POLARITY OF ROOT STATOCYTES IN SPACE AND IN SIMULATED MICROGRAVITY

G. LORENZI, G. PERBAL (Paris VI, Universite, France), M. ALEXANDRE, A. ISAMBERT, and D. DEPEYRE (Paris, Ecole Centrale, France) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs (IAF PAPER 89-608) Copyright

Roots of *lens culinaris L. cv. Verte du Puy* were germinated and grown at 1 g on the ground, on a 1-g centrifuge in space, in simulated microgravity on a slow rotating clinostat (0.9 rpm) and at microgravity in space. At 1 g, amyloplasts were sedimented on endoplasmic reticulum, whereas in microgravity and on the clinostat they were located preferentially in the center and in the proximal part of the statocyte. While in cells differentiated at 1 g on ground, the nuclear membrane was almost in contact with the plasmalemma lining the proximal cell wall, in statocytes of roots grown on the clinostat there was a distance on 0.47 micron (horizontal

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clinorotation) and of 0.76 micron (vertical clinorotation) between these membranes. However, in microgravity, the nucleus was most displaced, 0.87 micron from the proximal cell wall. Experiments with Cytochalasin B indicated that the displacement of this organelle at low-gravity could be induced by a relaxation of the cytoskeleton. Author

A90-13637# IMPORTANCE OF THE 1G CONTROLS IN INTERPRETING THE RESULTS OF AN EXPERIMENT ON PLANT GRAVITROPISM (BIORACK, D1 MISSION)

D. DRISS-ECOLE and G. PERBAL (Paris VI, Universite, France) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. refs (IAF PAPER 89-609) Copyright

The effects of microgravity on mitotic activity, cell differentiation, and statocyte polarity in lentil seedlings roots was investigated (Biorack, Spacelab D1 Mission, Oct-Nov 1985). Comparison of the microgravity sample and flight control demonstrated that microgravity increased mitotic activity and cell elongation, and affected the polarity of statocytes. The samples grown first in microgravity and then subjected to a 3-h centrifugation confirm the action of near 0 g on mitotic activity and cell elongation and show that the location of the nucleus within the statocytes is dependent upon gravity. The specimens must be fixed in space, since even a short period of exposure to gravity has an effect on the mitotic activity of the root and on the polarity of the statocytes. Author

A90-13638# RESPONSE OF UNICELLULAR ORGANISMS TO THE CONDITIONS IN LOW EARTH ORBIT

HORST-DIETER MENNIGMANN (Frankfurt, Universitaet, Frankfurt am Main, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 11 p. refs (IAF PAPER 89-610) Copyright

Results of experiments on unicellular microorganisms conducted in spacecraft in low earth orbit are presented to show that the behavior of unicellular organisms in the microgravity environment differs from their behavior on earth. Depending on the organism studied, differences have been observed, among others, in the cell wall structure, functions, growth rate, yield of biomass, and production and consumption of specific substances. While some experiments suggest that the cells are affected by special radiation conditions, most of the experiments indicate that the differences are due to the reduction in gravity. V.L.

A90-13639# STUDY OF ACTIVATION OF HUMAN PERIPHERAL BLOOD MONONUCLEAR CELLS AFTER A SPACE FLIGHT

L. SCHAFFAR, B. FERRUA, S. MANIE, M. LIMOUSE (Nice, Universite, France), I. KONSTANTINOVA (Instiut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. Research supported by CNES. refs (IAF PAPER 89-611) Copyright

The effects of a space flight on the major biological processes of T lymphocyte proliferation were analyzed in three cosmonauts after a long duration mission (26 to 151 days). Interleukin-1 secretion by peripheral blood monocytes from cosmonauts did not significantly differ after landing from preflight values. Also, interleukin-2 receptor was normally expressed on T lymphocytes after the flight. However, a significant increase of interleukin 2 production was clearly observed in two cosmonauts after landing. These results indicate that the ability of human lymphocytes and monocytes to be in vitro activated is not affected after a long duration space mission. Author

A90-13640# GRAVITATIONAL BIOLOGY WITHIN THE GERMAN MICROGRAVITY PROGRAM - CURRENT STATUS AND FURTHER PURSUITS

K. KREUZBERG, P. BERGWELER, U. FRIEDRICH, and H.-U. HOFFMANN (DLR, Cologne, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p. (IAF PAPER 89-612)

The scientific objectives of the German microgravity program include research on unicellular organisms with respect to the effect of gravity on cell polarity, growth, and differentiation, as well as the geotaxis mechanism; the gravisensing and graviperception mechanism of plants; and the adaptation of animals to microgravity and changes in the development and differentiation of nerve and bone cells under microgravity. A broad spectrum of flight opportunities for short-term missions and long-term missions (e.g., Eureka and Spacelab) and the development of corresponding flight hardware and experimental facilities will become available to German investigators over the next few years. Major progress concerning the mechanism of graviperception in gravitropism resulted from experiments in the Texus sounding rocket program. B.J.

A90-13903

ADVANCES IN COMBUSTION TOXICOLOGY. VOLUMES 1 & 2 GORDON E. HARTZELL, ED. (Southwest Research Institute, San Antonio, TX) Lancaster, PA, Technomic Publishing Co., Inc., 1989, p. Vol. 1, 334 p.; vol. 2, 327 p. No individual items are abstracted in this volume.

Copyright

Problems in combustion toxicity (CT) are examined in a collection of reviews and technical papers published during the period 1983-1987. Topics addressed include biological studies of combustion atmospheres, the effect of heating rate on the CT of evolved products, the CT of polyvinyl chloride, the CT of nonmetallic electrical tubing, a bioassay test for the incapacitating effects of exposure to combustion atmospheres, the acute inhalation CT of smoke from five halogenated polymers, the CT of acrolein and CO, a radiant-furnace fire model for evaluating acute smoke CT, and the evaluation of smoke CT using concentration-time products. Consideration is given to numerical modeling of fire-gas CT, pulmonary-tissue reactions to smoke injury, CT of thermal-decomposition products from composites, a CT evaluation of fire gases from experimental fires in a building, and risk-oriented evaluation of fire-gas CT based on laboratory-scale experiments using the DIN 53436 method. T.K.

A90-14446

DEPENDENCE OF THE AMPLITUDE OF KINESTHETIC EVOKED POTENTIALS ON THE VELOCITY AND ACCELERATION OF THE MOTION OF A MONKEY'S HAND [ZAVISIMOST' AMPLITUDY KINESTETICHESKIKH VYZVANNIYKH POTENTSIALOV OT SKOROSTI I USKORENIIA DVIZHENIYA RUKI U OBEZ'IAN]

E. IU. GOLOV and V. A. FEDAN (Nauchno-Issledovatel'skaia Laboratoriia Biologicheskii Aktivnykh Veshchestv Gidrobiontov, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 308, no. 2, 1989, p. 494-496. In Russian. refs Copyright

A90-14631

EVIDENCE FOR ANOXYGENIC PHOTOSYNTHESIS FROM THE DISTRIBUTION OF BACTERIOCHLOROPHYLLS IN THE BLACK SEA

D. J. REPETA, D. J. SIMPSON, H. W. JANNASCH (Woods Hole Oceanographic Institution, MA), and B. B. JORGENSEN (Aarhus Universitet, Denmark) Nature (ISSN 0028-0836), vol. 342, Nov. 2, 1989, p. 69-72. Research supported by NSF. refs Copyright

Results are reported from analyses of photosynthetic pigments in samples of suspended particulate matter collected from two stations in the western basin of the Black Sea. The data demonstrate high concentrations of a bacteriochlorophyll at the chemocline, and thus the potential for anoxygenic photosynthesis as a component of primary production in the carbon cycle of the Black Sea. More than 95 percent of the pigments in the

bacteriochlorophyll maximum are accounted for by a series of aromatic carotenoids and bacteriochlorophylls-e, including a previously unreported geranyl ester of 4-i-butyl bacteriochlorophyll-e. The distribution of pigments is characteristic of the obligate phototrophs *Chlorobium phaeobacteroides* and *C. phaeovibriodes*. Total depth-integrated bacteriochlorophyll at one station exceeded total chlorophyll-a in the overlying oxygenated portion of the euphotic zone. C.D.

A90-15051

LIFE SCIENCES AND SPACE RESEARCH XXIII(5) - GRAVITATIONAL BIOLOGY; PROCEEDINGS OF THE TOPICAL MEETING AND WORKSHOPS XVII AND XVIII OF THE 27TH COSPAR PLENARY MEETING, ESPOO, FINLAND, JULY 18-29, 1988

H. OSER, ED. (ESA, Microgravity Office, Paris, France), G. HORNECK, ED. (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), A. GOGOLI, ED. (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), G. A. UBBELS, ED. (Netherlands Institute for Developmental Biology, Utrecht), J. WETZIG, ED. (Mainz, Universitaet, Federal Republic of Germany) et al. Meeting and Workshops sponsored by COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics. *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, 301 p. For individual items see A90-15052 to A90-15085.

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Papers on gravitational biology are presented, including results from spaceflight and simulation experiments and studies of the relationships between gravity and developmental biology, embryology, neurovestibular research, and biorhythms. Specific topics include microgravity and mammalian musculoskeletal systems, plant orientation and growth under various gravitational conditions, the calcium gradient in plant cells with polarized growth in microgravity, the effects of HZE particles on plant seeds, and a Space Shuttle experiment on aggregation of red cells and thrombocytes in heart disease and hyperlipidaemia. Additional topics include free flow electrophoresis in the Space Shuttle program, mammalian cell cultivation in space, the geotropic sensitivity of hornets, the amphibian egg as a model system for studying gravitational effects, early development in the mouse under microgravity, the effect of gravito-inertial force on vestibular nystagmus in man observed in a centrifuge, dorsal light response under varying acceleration, the biological clock of *Neurospora* in microgravity, and gravitational biology and the circadian timing system. R.B.

A90-15052

MICROGRAVITY AND MUSCULOSKELETAL SYSTEM OF MAMMALS

E. A. IL'IN and V. S. OGANOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 11-19. refs

Copyright

Data and findings concerning the effects of weightlessness on bones and muscles of white rats flown on Cosmos biosatellites and Spacelab-3 are reviewed. It is found that the magnitude and sign of functional changes in muscles depend on their biomechanical profile. In five to seven day flights, muscle contractility changes are mainly associated with a diminished activity of excitation-contraction coupling, while in long-term flights those changes are produced by changes in myosin populations specific for myofibers of different functional profile. Osteoporosis and bone demineralization are very mild at early flight stages up to 1 week. As a result, decrease in bone mechanical strength may be caused by changes in physicochemical parameters of the collagen crystal system. Noticeable osteoporosis develops in flights of up to 3 weeks, primarily produced by osteogenesis inhibition

and responsible for a decrease in bone strength. Adaptive changes in muscle functions of specific skeletal compartments may play a role in different bone responses to weightlessness. C.E.

A90-15053

EVALUATION OF EXPERIMENTS INVOLVING THE STUDY OF PLANT ORIENTATION AND GROWTH UNDER DIFFERENT GRAVITATIONAL CONDITIONS

A. J. MERKYS, R. S. LAURINAVICIUS, D. V. SVEGZDIENE, D. P. RAKLEVICIENE, A. V. JAROSIUS (AN LSSR, Institut Botaniki, Vilnius, Lithuanian SSR) et al. (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 23-32. refs

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The effect of gravity on the phylogenesis of plants is examined. The effects of microgravity on the spatial orientation, morphogenesis, cellular growth, and generative development of plants are discussed. Results are presented from spaceflight experiments on plant ontogenesis, showing structurally modified, but normally functioning development. Data are on integral and cellular growth of the axial organs of seedlings, and the morphological structure and developmental rates of plants during prolonged growth in space. The relationship between the direction of the predominant gravitational vector and plant growth and phylogenesis is considered. R.B.

A90-15054

PLANT CELL IN THE PROCESS OF THE ADAPTATION TO SIMULATED MICROGRAVITY

E. L. KORDIUM (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 33-36. refs

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Results are presented from the study of structural and functional rearrangements in the organelles of meristematic, differentiating, and differentiated cells of 7- and 14-day old pea roots under microgravity. It is found that the organelles in a cell population are heterogeneous with respect to the degree of the rearrangements. Under changes in functional load, increased reactivity during cell growth and rearrangements is observed. The results suggest that microgravity does not prevent the development of certain adaptative reactions at the cellular level. R.B.

A90-15055

FORMATION AND GROWTH OF CALLUS TISSUE OF ARABIDOPSIS UNDER CHANGED GRAVITY

A. J. MERKYS, R. S. LAURINAVICIUS, P. F. KENSTAVICIENE, and G. S. NECITAILO (AN LSSR, Institut Botaniki, Vilnius, Lithuanian SSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 37-40.

Copyright

Results are presented from the study of morphological alterations in a cell population during the formation of *Arabidopsis* callus tissue on a clinostat and on the orbital station Salyut-7. The gravity environment in space does not prevent the process of cell dedifferentiation and formation of callus tissue. The callus grown in space is more dense and has less meristematic centers than the callus grown on a vertical clinostat. Also, the clinostat cells display a higher proliferative activity and have a larger average size and nuclei area, compared with the cells grown in space. R.B.

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A90-15056

CALCIUM GRADIENT IN PLANT CELLS WITH POLARIZED GROWTH IN SIMULATED MICROGRAVITY

K. M. SYTNIK, O. T. DEMKIV, E. L. KORDIUM, E. M. NEDUKHA, and L. A. DANEVICH (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 41-44. refs

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The gravity response mechanisms of plant cells characterized by apical growth is studied, including the initiation of cell polarity. Chlorotetracycline, a fluorescent calcium probe, was used to determine the calcium distribution gradient in root hair and apical cells. It is found that irradiation by red light leads to a sharp decrease in the $Ca(2+)$ gradient in cells. It is shown that darkness does not considerably alter the pattern of calcium influx and distribution during clinostatting. The results confirm that the $Ca(2+)$ ion has a functional role in apical growth and suggest that gravity plays a part in the redistribution or activation of ion channels in the plasmalemma. R.B.

A90-15057

BIOLOGICAL EFFECTS OF GALACTIC RADIATION HZE PARTICLES IN EXPERIMENTS ON THE ORBITAL STATION SALYUT 7

A. T. MILLER and L. V. NEVZGODINA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 47-51. refs

Copyright

Consideration is given to the extent of radiation damage to lettuce (*Lactuca sativa*) seeds flown on the orbital station Salyut 7 for 66 to 457 days. It is found that a single HZE particle hitting a seed has little effect on subsequent plant growth. Various morphological anomalies in primordial leaves and roots show a correlation with the location of the HZE particle track. Light and electron microscopy show the presence of channels in dry and soaked seeds. It is suggested that these channels are related to the LET of the incident particle. The implications of the study for space flight radiation hazards are noted. R.B.

A90-15058

EFFECTS OF PROLONGED EXPOSURE OF LETTUCE SEEDS TO HZE PARTICLES ON ORBITAL STATIONS

L. V. NEVZGODINA, E. N. MAKSIMOVA, and E. V. KAMINSKAIA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 53-58. refs

Copyright

The effects of HZE particles on lettuce (*Lactuca sativa*) seeds flown on the orbital stations Salyut 6 and 7 for periods between 40 and 457 days are examined. The frequency of aberrant cells is used to estimate the dependences of biological damage on flight duration, physical parameters, and the passage of an HZE particle through the cell. The location of tracks of individual HZE particles with atomic numbers of six or more and LET of 200 keV/micron is determined. A much higher number of aberrant cells and cells containing multiple chromosome aberrations was observed in seeds that were hit by HZE particles. R.B.

A90-15059

GRAVITY AND THE MEMBRANE-SOLUTION INTERFACE - THEORETICAL INVESTIGATIONS

A. SCHATZ and A. LINKE-HOMMES (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 61-64. refs

Copyright

The theory of concentration and potential variations at interfaces is applied to different membrane-solution systems to calculate density variations. The theory is modified to take care of the finite ion volumes in electrolytes. The model is a phospholipid membrane with a surface charge density of -4.824×10^{-6} (As/sq cm) in contact with KCl, NaCl, and $CaCl_2$ solutions and mixtures. Maximal density variations of about 0.04 (g/cu cm) were found in surface layers between the membrane and the solutions. The extension of the layers is in the range of 1 to 6 nm. The results are of interest in connection with the effects of gravity on biological organisms in space flight. C.E.

A90-15061

PLANT CELL PLASMA MEMBRANE STRUCTURE AND PROPERTIES UNDER CLINOSTATTING

IU. A. POLULAKH, S. I. ZHADKO, D. A. KLIMCHUK, V. A. BARABOI, A. N. ALPATOV (AN USSR, Institut Botaniki; Research Institute of Roentgeno-Radiology and Oncology, Kiev, Ukrainian SSR) et al. (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 71-74. refs

Copyright

Chemiluminescence, fluorescence probes, chromatography, and freeze-fracture studies are used to examine the structural and functional organization of the plasma membrane of seedling pea roots under normal conditions and clinostatting. Changes in plasmalemma microviscosity and phosphatidylcholine and phosphatidylethanolamine content are discussed. Tables of variations in phospholipid and fatty acid contents are given. The results suggest that changes in lipid peroxidation lead to plasma membrane destruction. These changes display phase characteristics, however, and promote a renewal of membrane lipid content. R.B.

A90-15062

POTENTIAL SITES FOR THE PERCEPTION OF GRAVITY IN THE ACCELLULAR SLIME MOLD PHYSARUM POLYCEPHALUM

I. BLOCK and W. BRIEGLEB (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 75-78. refs

Copyright

Gravisensitivity of the acellular slime mold *Physarum polycephalum* has been established in simulated and real near-weightlessness experiments. Like most of the unicellular organisms, it does not possess a specialized gravireceptor. Nevertheless, the slime mold *Physarum polycephalum* turned out to be gravisensitive, showing at least four responses to a changing gravistimulus. The microplasmidia used in the experiments showed that mitochondria are prime candidates for the gravity perception, compared to nuclei, morphologic polarity, and the contractile elements themselves. During the impediment of respiration, the zero-g reaction is inhibited and the regulation is reduced. The regulated response phenomena to a light stimulus strongly

resemble the behavior under zero-g exposure. In the blue-light reaction, a flavin of the mitochondrial matrix seems to be involved in the light perception. The contraction rhythm and modulations are coupled to rhythmic changes in the energy and Ca(2+) levels in mitochondria. C.E.

A90-15063**ULTRASTRUCTURAL AND GROWTH INDICES OF CHLORELLA CULTURE IN MULTICOMPONENT AQUATIC SYSTEMS UNDER SPACE FLIGHT CONDITIONS**

A. F. POPOVA, K. M. SYTNIK, E. L. KORDIUM (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR), G. I. MELESHKO, V. N. SYCHEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 79-82. refs

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Chlorella cells cultivated in a three-component aquatic system in space and under normal conditions are compared, focusing on the cells' submicroscopic organization. Compared to the control cells, the cells cultivated in space have a lower amount of reserve polysaccharides in their chloroplasts. The space cells also display increases in cell vacuolization and mitochondrion volume, disturbed cytokinesis, and altered configurations of plasmalemma evaginations and invaginations. Also, the space-cultivated cells were found to be more susceptible to infection by bacteria. R.B.

A90-15064**LONG CLINOSTATION INFLUENCE ON THE LOCALIZATION OF FREE AND WEAKLY BOUND CALCIUM IN CELL WALLS OF FUNARIA HYGROMETRICA MOSS PROTONEMA CELLS**

E. M. NEDUKHA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 83-86. refs

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Results are presented from a study to determine the localization of free and weakly-bound calcium and pectinases in *Funaria hygrometrica* moss protonema cells cultivated by long-duration clinostatting. An electroncytochemical study of control cells cultivated at 1 g is also conducted. It is found that cytochemical reaction product deposit was more intense in the cells cultivated on the clinostat. The results suggest that the increase of free calcium concentrations under conditions of clinostatting is related to the hydrolysis of pectinic substances and the breaking of methoxy groups of pectins. Consideration is given to possible mechanisms for the disturbance of the calcium balance of plant cells and the role of cell walls in the homeostasis of cells grown under simulated microgravity. R.B.

A90-15068* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

THIN FILM BIOREACTORS IN SPACE

M. HUGHES-FULFORD (NASA, Johnson Space Center, Houston, TX; USVA, Medical Center; California, University, San Francisco, CA) and H. W. SCHELD (Phyto Resource Research, Inc., College Station, TX) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 111-117. refs

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Studies from the Skylab, SL-3 and D-1 missions have demonstrated that biological organisms grown in microgravity have changes in basic cellular functions such as DNA, mRNA and protein synthesis, cytoskeleton synthesis, glucose utilization, and cellular

differentiation. Since microgravity could affect prokaryotic and eukaryotic cells at a subcellular and molecular level, space offers an opportunity to learn more about basic biological systems with one important variable removed. The thin film bioreactor will facilitate the handling of fluids in microgravity, under constant temperature and will allow multiple samples of cells to be grown with variable conditions. Studies on cell cultures grown in microgravity would make it possible to identify and quantify changes in basic biological function in microgravity which are needed to develop new applications of orbital research and future biotechnology. Author

A90-15070**DEVELOPMENTAL BIOLOGY IN SPACE - WHY AND HOW?**

G. A. UBBELS (Netherlands Institute for Developmental Biology, Utrecht) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 131-134. refs

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The need to study the effect of weightlessness on embryonic development is examined. The facilities provided by Space Lab for developmental biological experiments are described. Future embryological research in microgravity, such as the study of different animal species, is discussed. I.F.

A90-15071**INSECTS AS TEST SYSTEMS FOR ASSESSING THE POTENTIAL ROLE OF MICROGRAVITY IN BIOLOGICAL DEVELOPMENT AND EVOLUTION**

I. VERNOS, M. CARRATALA, J. GONZALEZ-JURADO, J. R. VALVERDE, M. CALLEJA (Madrid, Universidad Autonoma; CSIC, Instituto de Investigaciones Biomedicas, Spain) et al. (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 137-146. Research supported by the Comision Nacional de Investigacion del Espacio. refs

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It is argued that insects, and more specifically *Drosophila melanogaster*, are very appropriate systems for testing the involvement of the physical parameters altered in space on biological development and evolution. The main potential effects of gravity on living systems at the organismal and cellular level are examined, taking experimental data into account. It is shown that cell size is of critical importance for understanding such effects. C.D.

A90-15072**GEOTROPIC SENSITIVITY OF HORNETS**

JACOB S. ISHAY, EYAL ROSENZWEIG, OFER ROSENZWEIG, and SAMUEL BERKE (Tel Aviv University, Israel) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 147-155. refs

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Oriental Hornet workers, *Vespa orientalis* (Hymenoptera: Vespinae) were measured for their responses to changes in the direction of the gravitational field and this under both static and kinetic (centrifugal) conditions. The hornets can build a comb (oriented toward the gravitational force) when their multifaceted eyes are covered. Building activity is undertaken in the dark as well as by hornets that had been blinded or had eclosed in the dark and had never seen any light. If the frons plate of hornets is damaged, there is no or little building, and the comb direction is distorted. Hornets eclosing from and developing in combs subjected

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to centrifugal spinning build combs whose direction is affected both by rotation and by the resultant of the gravitational and centrifugal forces. Author

A90-15073

A STEP IN EMBRYONIC AXIS SPECIFICATION IN XENOPUS LAEVIS IS SIMULATED BY CYTOPLASMIC DISPLACEMENTS ELICITED BY GRAVITY AND CENTRIFUGAL FORCE

STEVEN D. BLACK (Duke University, Durham, NC) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 159-168. refs

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A90-15074* Indiana Univ., Bloomington.

THE AMPHIBIAN EGG AS A MODEL SYSTEM FOR ANALYZING GRAVITY EFFECTS

G. M. MALACINSKI and A. W. NEFF (Indiana University, Bloomington) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 169-176. refs

(Contract NAG2-323)

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Amphibian eggs provide several advantageous features as a model system for analyzing the effects of gravity on single cells. Those features include large size, readily tracked intracellular inclusions, and ease of experimental manipulation. Employing novel gravity orientation as a tool, a substantial data base is being developed. That information is being used to construct a three-dimensional model of the frog (*Xenopus laevis*) egg. Internal cytoplasmic organization (rather than surface features) are being emphasized. Several cytoplasmic compartments (domains) have been elucidated, and their behavior in inverted eggs monitored. They have been incorporated into the model, and serve as a point of departure for further inquiry and speculation. Author

A90-15075* Indiana Univ., Bloomington.

SUBCELLULAR COMPONENTS OF THE AMPHIBIAN EGG - INSIGHTS PROVIDED BY GRAVITATIONAL STUDIES

A. W. NEFF, J. D. RITZENTHALER, and J. F. ROSENBAUM (Indiana University, Bloomington) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 177-186. refs

(Contract NAG2-323)

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The variability in the response of *Xenopus laevis* eggs to a given force environment is studied. The roles of cytoplasmic organelle, the yolk platelets, and cytoskeletal components in varying in cytoplasmic mobility are examined. The data reveal that the packing of yolk platelets is not a major factor in causing cytoplasmic mobility differences and microtubules may affect cytoplasmic mobility. I.F.

A90-15076

FERTILIZATION OF FROG EGGS ON A SOUNDING ROCKET IN SPACE

G. A. UBBELS, J. NARRAWAY (Netherlands Institute for Developmental Biology, Utrecht), and W. BERENDSEN (Utrecht, Rijksuniversiteit, Netherlands) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research*

(ISSN 0273-1177), vol. 9, no. 11, 1989, p. 187-197. Research supported by ESA and SRON. refs

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The fertilization of *Xenopus* frog eggs in an automatic experiment container on Texus-17 is studied. The container is a 79.5 x 19.0 x 33.1 mm block with electronics on top. The contents of the six compartments for the fertilization experiment and the preparation of the eggs are described. The experimental data reveal that fertilization of the frog eggs under microgravity is possible and the automatic container is applicable for future fertilization experiments. I.F.

A90-15077

EARLY DEVELOPMENT IN THE MOUSE - WOULD IT BE AFFECTED BY MICROGRAVITY?

E. LEHTONEN (Helsinki, University, Finland) and M. H. L. SNOW (University College, London, England) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 201-208. Research supported by the Academy of Finland, Medical Research Council of England, and Sigrid Juselius Foundation. refs

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The effects of microgravity on mouse embryogenesis are studied. The stages of mouse embryogenesis are discussed. Particular attention is given to compaction and polarization during cleavage, the establishment of the radial axis, the embryonic-abembryonic axis, the dorso-ventral axis, and the anterior-posterior axis, implantation, and the rotation of the embryo. It is noted that from early in development the mouse embryo cells are well oriented in time and space and that gravity may have a role in early development; however, early embryo development is dependent on cell interaction and in normal gravity the embryo regulates its own development and may be independent of gravity. I.F.

A90-15080

DORSAL LIGHT RESPONSE AND CHANGES OF ITS RESPONSES UNDER VARYING ACCELERATION CONDITIONS

S. WATANABE, A. TAKABAYASHI, S. TAKAGI (Nagoya University, Japan), R. VON BAUMGARTEN, and J. WETZIG (Mainz, Universitaet, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 231-240. refs

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Results are presented from experiments conducted on the functions of the gravity sensors in goldfish. A rotary illumination device was used to study the dorsal light response that von Holst (1935) proposed as a model for postural adjustment in fish. The threshold of the gravity sensors under changes of the gravito-inertial force level produced by a linear sled is determined from postural adjustment responses. The light-dependent behavior of intact and labyrinthectomized goldfish was studied under hypogravity conditions during parabolic aircraft flight. The results suggest that the valvula cerebelli is the most likely candidate for the neural center of the dorsal light response. R.B.

A90-15081

LIGHT MICROSCOPIC ANALYSIS OF THE GRAVIRECEPTOR IN XENOPUS LARVAE DEVELOPED IN HYPOGRAVITY

W. BRIEGLER, J. NEUBERT, A. SCHATZ, and B. KRUSE (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988)

Advances in Space Research (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 241-244. refs

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The effect of hypogravity on the early differentiation of gravity receptors in the vestibular endorgan of *Xenopus* embryos and young larvae developed on ground or aboard a spacecraft (D1 Spacelab Shuttle Mission) were investigated using light-microscope and TEM analyses. It was found that the expression of crystals in the saccus endolymphaticus was statistically greater in the *Xenopus* embryos developed in hypogravity than it was in the embryos developed on ground. I.S.

A90-15082* University of Southern Illinois, Carbondale.

THE BIOLOGICAL CLOCK OF NEUROSPORA IN A MICROGRAVITY ENVIRONMENT

JAMES S. FERRARO (Southern Illinois University, Carbondale, IL), CHARLES A. FULLER (California, University, Davis), and FRANK M. SULZMAN (NASA, Div. of Life Sciences, Washington, DC) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 251-260. refs

(Contract NAG2-361; NAG2-452; NAG2-349; NAS9-15975)

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The effects of simulated microgravity (via the use of a slowly rotating clinostat), altered orientation (via alterations in the vector of a 1-g force), and hypergravity (via centrifugation) on the circadian rhythm of conidiation in *Neurospora crassa* were investigated. It was found that the clinostat, while capable of producing some of the microgravity effects seen in space (Sulzman, 1984), did not produce major repeatable results. Similarly, alterations of the vector of a 1-g gravity load were not adequate simulations of space flight on the conidiation rhythm. The results on the acute and chronic exposures to hypergravity demonstrated that chronic exposure of *Neurospora* to a 3-g force had no damping effect. On the other hand, an acute 10-min exposure to this hypergravity (the lift-off conditions) was found to cause significant damping on the circadian rhythm of conidiation. This effect was eliminated by a brief light pulse given 36 hrs after the exposure to 3 g. I.S.

A90-15083 Hamburg Univ. (Germany, F.R.).

THE EXPRESSION OF A CIRCADIAN RHYTHM IN TWO STRAINS OF CHLAMYDOMONAS REINHARDII IN SPACE

DIETER MERGENHAGEN and ELKE MERGENHAGEN (Hamburg, Universitaet, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 261-270. Research supported by BMFT, ESA, and NASA.

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The effect of microgravity on the circadian rhythm of *Chlamydomonas* was investigated in two strains flown on the D1 mission: a wild-type strain with a circadian period of 25-26 hrs and a mutant strain with a 18-20-hr rhythm. The parameter used as a measure of the circadian oscillation was the accumulation rate of cells in an illuminated area of the test cuvette, which was measured by photocells. The endogenous circadian rhythm of the photoaccumulation response of cells was found to persist in both strains. However, the amplitude was about twice as high in space as on the ground, indicating that a larger fraction of cells was able to contribute to the expression of the rhythm in space. I.S.

A90-15084

RHYTHMIC BIOLOGICAL SYSTEMS UNDER MICRO-G CONDITIONS

A. JOHNSON and T. EIDESMO (Allmennvitenskapelige Hogskolen, Trondheim, Norway) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on

Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 273-281. refs

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This paper reviews the important effects of gravity and microgravity on biological systems and examines basic mechanisms of these effects. The effect of microgravity on convection, (which is known to be drastically reduced in space) as a possible major mechanism is discussed. Model simulations of microgravity condition are presented. Particular attention is given to a comparison of clinostat and microgravity conditions for gravitropical systems of plants which can show sustained oscillations. It is suggested that microgravity may affect the coupling between individual oscillators in a multioscillatory system. I.S.

A90-15085* California Univ., Davis.

GRAVITATIONAL BIOLOGY AND THE MAMMALIAN CIRCADIAN TIMING SYSTEM

CHARLES A. FULLER, DEAN M. MURAKAMI (California, University, Davis), and FRANK M. SULZMAN (NASA, Div. of Life Sciences, Washington, DC) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 283-292. refs

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Using published reports, this paper compares and contrasts results on the effects of altered gravitational fields on the regulation in mammals of several physiological and behavioral variables with the circadian regulation of the same variables. The variables considered include the temperature regulation, heart rate, activity, food intake, and calcium balance. It is shown that, in rats, the homeostatic regulation of the body temperature, heart rate, and activity becomes depressed following exposure to a 2 G hyperdynamic field, and recovers within 6 days of 1 G condition. In addition, the circadian rhythms of these variables exhibit a depression of the rhythm amplitude; a recovery of this condition requires a minimum of 7 days. I.S.

A90-15438* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EFFECT OF IODINE DISINFECTION PRODUCTS ON HIGHER PLANTS

D. JANIK, B. MACLER, R. D. MACELROY (NASA, Ames Research Center, Moffett Field, CA), Y. THORSTENSON (California, University, Berkeley), and R. SAUER (NASA, Johnson Space Center, Houston, TX) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 117-120. refs

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Iodine is used to disinfect potable water on United States spacecraft. Iodinated potable water will likely be used to grow plants in space. Little is known about the effects of iodine disinfection products on plants. Seeds of select higher plants were germinated in water iodinated using the Shuttle Microbial Check Valve, and water to which measured amounts of iodine was added. Percent germination was decreased in seeds of most species germinated in iodinated water. Beans were most affected. Germination rates, determined from germination half-times, were decreased for beans germinated in iodinated water, and water to which iodide was added. Development was retarded and rootlets were conspicuously absent in bean and several other plant species germinated in iodinated water. Iodide alone did not elicit these responses. Clearly iodine disinfection products can affect higher plants. These effects must be carefully considered for plant experimentation and cultivation in space, and in design and testing of closed environmental life support systems. Author

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A90-15440* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PRODUCTIVITY AND FOOD VALUE OF AMARANTHUS CRUENTUS UNDER NON-LETHAL SALT STRESS

BRUCE A. MACLER and ROBERT D. MACELROY (NASA, Ames Research Center, Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 135-139. Research supported by the U.S. National Research Council. refs

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Experiments were carried out to analyze the effects of increasing salinity stress on growth, photosynthesis, and carbon allocation in the crop plant *Amaranthus*. Plants were germinated and grown in Hoagland's solution with NaCl concentrations of 0 to 1.0 percent. The limits of total salinity in the plant growth medium are investigated. For *Amaranthus cruentus*, germination, vegetative growth, flowering, seed development and yield were normal at salinities from 0 to 0.2 percent. Inhibition of these phases increased from 0.2 to 0.4 percent salinity and was total above 0.5 percent with 1 percent salinity was lethal to all developmental phases. Onset of growth phases were not affected by salinity. Plants could not be adapted by gradually increasing salinity over days or weeks. Water uptake increased, while photosynthetic CO₂ uptake decreased with increasing salinity on a dry weight basis during vegetative growth. Protein levels were unchanged with increasing salinity. Leaf starch levels were lower at salinities of 0.5 percent and above, while stem starch levels were not affected by these salinities. The evidence supports salt inhibition arising from changes in primary biochemical processes rather than from effects on water relations. While not addressing the toxic effects of specific ions, it suggests that moderate salinity per se need not be a problem in space systems. C.E.

A90-15442

CARBON CYCLING BY CELLULOSE-FERMENTING NITROGEN-FIXING BACTERIA

S. B. LESCHINE and E. CANALE-PAROLA (Massachusetts, University, Amherst) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 149-152. refs

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The most abundant organic materials on earth are plant polysaccharides such as cellulose and hemicelluloses. Inasmuch as vast quantities of these polymers are present in anaerobic environments (e.g., in soils and sediments), anaerobic microorganisms that ferment plant polysaccharides play a central role in carbon cycling on the planet as a source of CO₂ and, indirectly, of CH₄. Cellulose-fermenting bacteria from soil and pond sediment were isolated in a medium (incubated in N₂) which lacked a source of combined nitrogen. The isolates had the ability to utilize atmospheric N₂ as the nitrogen source for cell growth. Nitrogenase (the enzyme which catalyzes the reduction of N₂ to ammonia) was demonstrated by means of the acetylene reduction test in these isolates and in several previously described anaerobic cellulolytic bacteria isolated from various natural environments. Thus, cellulose-fermenting bacteria that fix N₂ may be widespread and may play a role in nitrogen cycling as well as in carbon cycling on a global scale. Knowledge of the physiology and ecology of these organisms is crucial to detailing the mechanisms producing local sources and sinks of atmospheric gases, interpreting data obtained using space-based sensors, and understanding the effects of atmospheric warming on fermentations as major sources of CO₂ and CH₄ Author

A90-15446

GAS BUBBLE COALESCENCE IN REDUCED GRAVITY CONDITIONS

B. G. THOMPSON (Alberta Research Council, Biotechnology Dept.,

Edmonton, Canada) and W. S. C. BROOKS (SED Systems, Inc., Saskatoon, Canada) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 179-184.

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The effects of low gravity, as produced by a reduced gravity aircraft, the KC135, on the formation and coalescence of gas bubbles were examined over a range of gas-liquid ratios and with various medium constituents. These effects will influence design considerations of fermentors operating in reduced gravity conditions. Author

A90-15478* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE LIFE SCIENCES PROGRAM AT THE NASA AMES RESEARCH CENTER - AN OVERVIEW

JOAN VERNIKOS-DANELLIS and JOSEPH C. SHARP (NASA, Ames Research Center, Moffett Field, CA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-1 to S-4. refs

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The research projects planned for the Life Sciences program have a goal of answering basic questions concerning the nature of life itself and its evolution in the universe from basic elements, as well as the search for extraterrestrial intelligence. The program also includes studies of the evolution and development of life on the planet earth, and the global changes occurring today that affect life on the earth. The paper describes the simulation models developed to study the effects of space, the flight projects of the program, and the biomedical program, which currently focuses on the physiological changes in the human body that are associated with space flights and the interactions among these changes. I.S.

A90-15479

PERIODIC ACCELERATION STIMULATION IN A WEIGHTLESSNESS ENVIRONMENT (PAS-WE) - A NEW SCIENCE?

RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-5 to S-7. refs

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This paper examines the possibility of applying periodic acceleration to stimulate physiological processes affected in a human body by the exposure to weightlessness. While it is known that a continuous exposure of animals to increased G may result in a disease of stress (the so-called 'chronic acceleration sickness'), the risk of the chronic acceleration sickness can be greatly reduced by adapting the animals by either slowly increasing the levels of G over a series of several week-long exposures or by applying short-duration daily exposures at the desired level of G. This paper outlines in detail procedures for an experimental study with human subjects where this latter type of adaptation regimen is used in conjunction with the bedrest to determine the optimal schedule of G exposures for stimulating all physiological parameters known to be affected by weightlessness. Preliminary results of a G-tolerance study are presented. I.S.

A90-15482

CHANGES IN KIDNEY RESPONSE TO ADH UNDER HYPOGRAVITY - RAT MODELS AND POSSIBLE MECHANISMS

L. N. IVANOVA, A. I. GRIGOR'EV, N. N. MELIDI, and E. I. SOLENOV (AN SSSR, Institut Tsitologii i Genetiki, Novosibirsk; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada,

Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-16 to S-18. refs

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Mechanisms involved in the response of the kidney water/salt metabolism to ADH in hypogravity were investigated in homozygous and heterozygous (HZ) rats exposed to space flights. In HZ rats the secretion of ADH was suppressed by free access to a 4-percent sucrose solution. Estimates of the ADH response were based on an increase in urine osmolality produced by an injection of synthetic arginine-vasopressin. The results obtained suggest that changes in the intrarenal osmotic gradients and in the aggregate state of the ADH receptors that take place as a result of the decreased ADH blood level due to hypogravity might be the cause of the inadequate response to ADH, observed in space-crew members during readaptation to the earth's gravity. I.S.

A90-15483

THE EFFECT OF SUSPENSION ON NICOTINIC ACETYLCHOLINE RECEPTOR NUMBER AND AFFINITY AT THE RAT NEUROMUSCULAR JUNCTION

JOYCE E. ROYLAND and L. J. WEBER (Oregon State University, Newport) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-19, S-20. refs

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Mechanisms involved in the post-spaceflight muscle atrophy were investigated in rats subjected to tail suspension for one, three, or eight weeks. The number of nicotinic acetylcholine receptors (Bmax) and the receptor affinity constant (Kd) were examined in the unloaded phasic gastrocnemius and tibialis anterior and the tonic soleus, as well as the loaded plastic triceps brachii, using a specific nicotinic-acetylcholine-receptor ligand, alpha-bungarotoxin. It was found that, compared to unsuspended controls, the Kd value was significantly decreased only in the soleus after three weeks of suspension. The Bmax value was increased in the triceps brachii after three weeks of suspension and in the gastrocnemius after an eight-week suspension. I.S.

A90-15484

BIOCHEMICAL AND HISTOCHEMICAL OBSERVATIONS OF VASTUS MEDIALIS FROM RATS FLOWN IN COSMOS 1887 (EXPERIMENT K608)

X. J. MUSACCHIA, J. M. STEFFEN, and R. FELL (Louisville, University, KY) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-21, S-22. refs

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Biochemical, histochemical, and metabolic changes affected in the vastus medialis (VM) of rats by a 12 day-long space flight were investigated. Results indicated that the exposure to microgravity for 12 days led to a decrease in the fiber area of the muscle and decreases in the concentration of RNA and the activity of lactate dehydrogenase, compared with ground controls. Protein concentrations in the VM of space-flight exposed rats were similar to those of controls. I.S.

A90-15485* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DECREASED SWELLING PRESSURE OF RAT NUCLEUS PULPOSUS ASSOCIATED WITH SIMULATED WEIGHTLESSNESS

ALAN R. HARGENS and MUBASHAR MAHMOOD (NASA, Ames Research Center, Moffett Field; California, University, La Jolla) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-23, S-24. Research supported by the Cosmos 1887 Rodent Parts Program. refs

Copyright

Data are presented on the effects of actual and simulated weightlessness on the swelling pressure of nucleus pulposus in

rats exposed to 12.5 days of flight aboard Cosmos 1887 or to seven days of tail suspension, respectively. The flight-exposed rats were adapted to normal gravity for over 50 hrs prior to sacrifice and tissue harvesting. In the experiments with flight-exposed rats, swelling pressures were 690, 675, and 622 mm Hg for flight rats, synchronous controls, and vivarium controls, respectively. In experiments with simulated weightlessness, swelling pressures were 295, 610, and 527 mm Hg for tail-suspended rats, cage controls, and vivarium controls, respectively, suggesting that fluid moves into the disc during seven days of simulated weightlessness. I.S.

A90-15486

NORMALISATION OF BONE CELLULAR RESPONSES OCCURS BETWEEN 7 AND 14 DAYS OF SIMULATED WEIGHTLESSNESS IN RATS

L. VICO and C. ALEXANDRE (Saint-Etienne, Universite, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-25, S-26. Research supported by DRET. refs

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Wistar rats were exposed to simulated weightlessness by being subjected to tail suspension for 7 days or 14 days, and the results of a histomorphometric analysis on tibial proximal metaphyses from these rats were compared. It was found that the longitudinal bone growth was depressed twofold greater in rats exposed to a 14-day suspension than in those after 7-day suspension. At the level of the primary spongiosa, the depressed longitudinal bone growth rate was associated with decreased trabecular bone volume for rats exposed to 7-day suspension and with decreased trabecular thickness in both groups of rats. At the level of the secondary spongiosa, the 7-day suspended rats were more affected than the 14-day suspended rats, indicating a more severe disequilibrium in the bone cell population of rats exposed to only 7-day-long tail suspension. I.S.

A90-15487

MODIFICATIONS OF BONE ATROPHY SEEN WITH HINDLIMB SUSPENSION BY EXERCISE AND DOBUTAMINE

S. BLOOMFIELD, B. GIRTEN, S. WEISBRODE, E. EVELAND, and L. KAZARIAN (Ohio State University, Columbus; USAF, Aerospace Medicine Research Laboratory, Wright-Patterson AFB, OH) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-27, S-28.

(Contract AF PROJECT 2312V6)

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The effects of an endurance-training or dopamine treatment on the microgravity-induced bone atrophy were investigated in rats assigned to either 11 weeks of exercise training or sedentary conditions. Animals from both groups were then randomly assigned to either hind-limb suspension or control groups, and half of each group was treated with dopamine. It was found that 14 days of hind-limb suspension produced significant decreases in cortical bone area, resulting at least in part from a decreased formation at the periosteal surface. The vigorous training protocol followed in this study also produced a net loss of bone in nonsuspended rats, but appeared to maintain bone area in suspended trained rats (the former effect, however, might be explained by a significant loss of body weight in trained rats). Dobutamine did effectively prevent the loss of cortical bone due to suspension in nontrained rats. In trained rats, however, dobutamine appeared to counteract the maintenance of bone. I.S.

A90-15488

THE EFFECT OF MICROGRAVITY ON THE REPRODUCTIVE FUNCTION OF MALE RATS

L. V. SEROVA, L. A. DENISOVA, and O. V. BAIKOVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational

51 LIFE SCIENCES (GENERAL)

Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-29, S-30. refs
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The effect of a 14-day tail suspension on the condition of the male-rat reproductive system was investigated and compared with the effect of a 7-day flight aboard Cosmos-1667. It was found that, while the space flight had no effects on either the testis tissue, spermatozoa, or offsprings of flight males, the tail-suspended rats exhibited a reduction of the testis and epididymis mass and a sharp fall in the spermatozoa number; many cells, particularly spermatides, were found in different stages of degeneration. It is suggested that the cause for the changes observed in tail-suspended rats was related to an anatomical dislocation of the organs due to the shift into the abdominal cavity, resulting in depressed spermatogenesis. I.S.

A90-15489* Emory Univ., Atlanta, GA.

PLASMA STRESS HORMONES IN RESTING RATS - EIGHTY FOUR DAY STUDY

VOJIN POPOVIC and CLEGG HONEYCUTT (Emory University, Atlanta, GA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-31, S-32. refs
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The effects of a repeated mild stress of handling and placing rats temporarily into unfamiliar cages on the blood-plasma concentration of the stress hormones (corticosterone, ACDH, and prolactin) were investigated in male Sprague-Dawley rats subjected to this type of stress once every week during a period of three months. Results showed that repeated mild stress of handling (as well as repeated blood sampling) did not affect the plasma stress-hormone concentrations in these animals. I.S.

A90-15491* Arizona Univ., Tucson.

EFFECTS OF SIMULATED WEIGHTLESSNESS AND SYMPATHECTOMY ON MAXIMUM VO₂ OF MALE RATS

C. R. WOODMAN, C. S. STUMP, S. M. BEAULIEU, Z. RAHMAN, L. A. SEBASTIAN (Arizona, University, Tucson) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-35, S-36. refs
(Contract NAS2-392)
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The effects of simulated weightlessness (hind-limb suspension) and chemical sympathectomy (by repeated injections with guanethidine sulfate) on the maximum oxygen consumption (VO₂ max) of female rats were investigated in rats assigned for 14 days to one of three groups: a head-down hind-limb suspension, a horizontal suspension with hind limbs weight bearing, or the caged control. The VO₂ max values were assessed by having rats run on a treadmill enclosed in an airtight chamber. The hind-limb-suspended sympathectomized rats were found to exhibit shorter run times and lower mechanical efficiencies, compared to their presuspension values or the values from saline-injected suspended controls. On the other hand, the suspended sympathectomized rats did not demonstrate a decrease in the VO₂ max values that was observed in saline-injected controls. I.S.

A90-15494

STUDIES OF SPACE ADAPTATION SYNDROME IN EXPERIMENTS ON PRIMATES PERFORMED ON BOARD OF SOVIET BIOSATELLITE 'COSMOS-1887'

I. B. KOZLOVSKAIA, E. A. IL'IN, M. G. SIROTA, V. I. KOROL'KOV, B. M. BABAEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN

0031-9376), vol. 32, Feb. 1989, p. S-45 to S-48. refs
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The effects of microgravity on the vestibular functions, motor control, and cardiovascular systems of primates are examined. Gaze fixation reaction data reveal that under microgravity hypermetria occurs. The movement amplitude fluctuates around 40 deg before the flight and in flight increases steadily peaking on the 6th day of flight; an increase in saccade velocity is also detected. The vestibular nerve fibers responses to canal and visual stimulation are studied. It is observed that the transition to microgravity results in distinct alteration of neuronal dynamic sensitivity. It is concluded that canal and otolithic stimuli in microgravity result in the increase in dynamic stability of the vestibular system. I.F.

A90-15497

CONTINUING STUDIES OF 'CELLS' FLIGHT HARDWARE

J. DUKE, J. MOORE, and D. MONTUFAR-SOLIS (Texas, University, Houston) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-57, S-58. refs
Copyright

This paper describes the features of the ESA's Biorack, a modular cell culture facility designed for the Spacelab, which will make it possible to study on the cellular level the effects of a spaceflight and weightlessness separately. Also described are preliminary studies for an experiment (CELLS) which was selected as a Biorack experiment. Biorack contains a freezer; a cooler; a glovebox; and two incubators, each with a 1-g centrifuge, making it possible to separate the results of the spaceflight from those of microgravity. In the CELLS experiment, small high-density cultures of embryonic limb mesenchymal cells will be exposed to microgravity aboard the spacecraft, fixed daily during the mission, and examined on return for any effects of microgravity on cartilage differentiation. I.S.

A90-15498

SKELETAL MUSCLE ANTIOXIDANT ENZYME LEVELS IN RATS AFTER SIMULATED WEIGHTLESSNESS, EXERCISE AND DOBUTAMINE

B. GIRTEN, C. OLOFF, P. PLATO, E. EVELAND, A. J. MEROLA (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB; Ohio State University, Columbus) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-59, S-60. refs
(Contract AF PROJECT 2312V6)
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The effects of exercise training of rats prior to a 14-day-long hypokinesia/hypokynamia (H/H) hind-limb suspension, and of dobutamine injections during the suspension, on the levels of oxidative and antioxidant enzymes in skeletal muscles of the animals were investigated. The results obtained demonstrated that the H/H suspension of rats resulted in decreased oxidative-enzyme levels as well as in the decreased activity of two antioxidant enzymes that are necessary to prevent uncontrolled free-radical reactions that cause tissue damage. It was found that both the exercise training and the injections of dobutamine helped to prevent large decreases of these enzymes. I.S.

A90-15499* California Univ., Davis.

TEMPERATURE REGULATION IN RATS EXPOSED TO A 2 G FIELD

LINDA M. ISHIHAMA, DEAN M. MURAKAMI, and CHARLES A. FULLER (California, University, Davis) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) Physiologist, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-61, S-62.
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The regulation of body temperature involves both homeostatic and circadian control systems. Both systems are influenced by exposure to hyperdynamic fields and demonstrate acute responses that eventually recover to an adapted level. This experiment examined both the homeostatic and circadian responses of body temperature to a separate environmental challenge (high frequency light/dark cycles) during exposure to a 2 G hyperdynamic field.

Author

A90-15500

EFFECT OF INCREASED ACCELERATION ON LUNG EXPANSION IN DOGS - PRONE VS. SUPINE BODY POSITIONS

S. J. LAI-FOOK, L. V. BROWN, S. GANESAN, V. S. MAUDGALYA, and C. F. KNAPP (Kentucky, University, Lexington) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-63, S-64. refs

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The effect of body position on the extent of lung expansion under increased acceleration was investigated in dogs positioned in a centrifuge in such a way that, between 2G and 3G centrifugal acceleration, the resultant force due to acceleration was in a direction either ventral-to-dorsal (+Gx, supine position) or dorsal-to-ventral (-Gx, prone position). To assess the extent of lung expansion, the pleural liquid pressure under increased acceleration in prone and supine body positions was measured using the rib capsule technique described by Weiner-Kronish et al. (1985). It was found that the net effect of high acceleration was to expand the lung in the supine position and to contract the lung in the prone position. The mechanisms responsible for these effects are discussed. I.S.

A90-15633

PREVENTION OF RADIATION SICKNESS, INDUCED BY LOW-LEVEL IONIZING RADIATION, BY REPEATED INJECTIONS WITH INCREASING DOSES OF CHEMICAL RADIOPROTECTORS [PROFILAKTIKA LUCHEVOI BOLEZNI, VYZVANNOI IONIZIRUIUSHCHIM IZLUCHENIEM MALOI MOSHCHNOSTI, POVTORNOI IN'EKTSIEI VOZRASTAUSHCHIKH DOZIROVOK KHIMICHESKIKH RADIOPROTEKTOROV]

V. S. BARKAIA, R. A. TORUA, and ZH. V. ELISTRATOVA (AMN SSSR, Nauchno-Issledovatel'skii Institut Eksperimental'noi Patologii i Terapii, Sukhumi, Georgian SSR) *Radiobiologiya* (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 638-643. In Russian. refs

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The feasibility of protecting mice, Guinea pigs, and monkeys from radiation sickness induced by irradiation with gamma rays from Cs-137 (16-25.5 hrs at the dose 0.0079-0.0094 Gy/min) with chemical radioprotectors was demonstrated by administering a combination containing sodium nitrite, cystaphos, and mexamine to irradiated animals. Data are presented on clinical observations, the condition of blood-forming and intestinal issues, and survival of animals treated with repeated injections of these chemicals in low or high doses. It is shown that repeated injections of this mixture helped to maintain reserves of actively dividing cells in the bone marrow, spleen, and intestine. I.S.

A90-15634

RADIOPROTECTIVE PROPERTIES OF A CO(III) BIOMPLEX [IZUCHENIE RADIOZASHCHITNYKH SVOISTV BOKOMPLEKSA CO(III)]

IU. N. ISLAMOV, A. B. AKBAROV, P. A. KHAKIMOV, N. KH. SHADIEVA, and M. N. ISLAMOV (Sredneaziatskii Meditsinskii Pediatricheskii Institut, Tashkent, Uzbek SSR) *Radiobiologiya* (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 644-647. In Russian. refs

Copyright

The radioprotective potency of a coordination complex of Co(III)

with an alpha-amino acid was investigated in experiments with rats and mice irradiated with doses of 5 and 8.5 Gy, respectively. The extent of radioprotection was assessed using hematological indices, the values of the erythrocyte and leukocyte electroconductivity, the average lifetime of the animal, and the survival rate. Results showed that the preparation could be either therapeutic or protective depending on the animal species and the radiation dose. I.S.

A90-15635

RADIOPROTECTIVE EFFECTS OF ATP AND ADP ON MEMBRANE-BOUND ENZYMES [RADIOMODIFITSIRUIUSHCHEE DEISTVIE ATF I ADF NA MEMBRANOSVIAZANNYE FERMENTY]

K. SH. NADAREISHVILI, D. V. CHIKVASHVILI, and M. G. BERIDZE (AN GSSR, Institut Fiziologii, Tbilisi, Georgian SSR) *Radiobiologiya* (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 648-651. In Russian. refs

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The radioprotective effects of ATP and ADP (1 mM/kg injected 15 min before irradiation) on the activity of some key membrane-bound enzymes, including microsomal Na,K-ATPase, Ca(2+)-ATPase, and n-nitrophenylphosphatase and mitochondrial Mg(2+)-ATPase and HCO₃(-)-ATPase, in the brain and heart tissues of rats irradiated at a dose of 7 Gy (1.125 Gy/min) were investigated. The results confirmed previous reports concerning the radioprotective action of ADP. The reactions of various enzymes to irradiation and to both phosphates were found to vary, the differences being attributed to the activity of natural compensatory systems present in different cells and tissues. I.S.

A90-15636

INCREASING THE RADIORESISTANCE OF MICE WITH IVASTIMUL [POVYSHENIE RADIATSIONNOI USTOICHIVOSTI MYSHEI PRI POMOSHCHI IVASTIMULA]

D. ROTKOVSKA, A. VACEK, and A. BARTONICKOVA (Ceskoslovenska Akademie Ved, Biofyzikalni Ustav, Brno, Czechoslovakia) *Radiobiologiya* (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 652-654. In Russian. refs

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The radioprotective effect of a lyophilized preparation from unicellular algae of the chlorella type, termed ivastimul (IS), was investigated in mice irradiated by gamma rays (Co-60, 20 min at 0.43 Gy/min or 5 hr at 0.05 Gy/min), using the survival rate and hematological indices as parameters of radioprotection. Results indicated that, at lethal doses, the IS preparation injected 24 hours prior to irradiation at a dose 800 mg/kg acted as a protector, increasing significantly the survival rate of animals. At sublethal doses, IS was found to speed up the restoration of cell populations in the bone marrow and spleen. I.S.

A90-15637

ACCUMULATION OF THE BIOLOGICAL EFFECTS OF MICROWAVES AS DISPLAYED IN THE BEHAVIOR, THE PHYSICAL EFFICIENCY, THE BODY-MASS INCREASE, AND THE CONDITION OF CEREBRAL NEURONS [KUMULIATSIIA BIOLOGICHESKIKH EFEKTOV MIKROVOLN I EE OTRAZHENIE V Povedenii, Rabotosposobnosti, Priroste Massy Tela i Sostoianii Neironov Golovnogo Mozga]

N. B. SUVOROV, M. V. MEDVEDEVA, N. N. VASILEVSKII, V. V. UR'IASH, and ZH. G. ALEKSANDROVA (AMN SSSR, Nauchno-Issledovatel'skii Institut Eksperimental'noi Meditsiny, Leningrad, USSR) *Radiobiologiya* (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 660-666. In Russian. refs

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A90-15638

CHARACTERISTICS OF THE RESPONSE OF ANIMALS BELONGING TO VARIOUS TYPOLOGICAL GROUPS TO HIGH-FREQUENCY AND MICROWAVE ELECTROMAGNETIC RADIATION [OSOBENOSTI REAKTSII ZHIVOTNYKH RAZLICHNYKH TIPOLOGICHESKIKH GRUPP NA VOZDEISTVIE ELEKTROMAGNITNYKH IZLUCHENII VYSOKOCHASTOTNOGO I SVERKHVYSOKOCHASTOTNOGO DIAPAZONA]

V. N. NIKITINA, N. B. SUVOROV, N. A. MINKINA, and E. S. SHAPOSHNIKOVA (Nauchno-Issledovatel'skii Institut Gigieny Truda i Profzabolevani; AMN SSSR, Nauchno-Issledovatel'skii Institut Eksperimental'noi Meditsiny, Leningrad, USSR) Radiobiologiya (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 676-679. In Russian. refs
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A90-15639

PREDICTING THE POSTRADIATIVE RADIOSENSITIVITY OF MAMMALS AND MAN ACCORDING TO THE LD50 CRITERION AFTER ACUTE EXTERNAL IRRADIATION [PROGNOZ POSTLUCHEVOI RADIOCHUVSTVITEL'NOSTI MLEKOPITAIUSHCHIKH I CHELOVEKA PO KRITERIIU LD50 POSLE OSTROGO VNESHNEGO OBLUCHENIIA]

G. M. AVETISOV and V. P. VOLODIN (Institut Biofiziki, Moscow, USSR) Radiobiologiya (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 686-690. In Russian. refs
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A90-15640

EFFECT OF IONIZING RADIATION ON THE BINDING OF MUSCIMOL BY SYNAPTIC MEMBRANES OF THE RAT BRAIN [DEISTVIE IONIZIRUIUSHCHEI RADIATSII NA SVIAZYVANIE MUSTSIMOLA SINAPTICHESKIMI MEMBRANAMI MOZGA KRYSY]

V. I. KUZNETSOV, M. M. IURINSKAIA, O. V. KOLOMYTKIN, and I. G. AKOEV (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Radiobiologiya (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 705, 706. In Russian.
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A90-15641

EFFECT OF ULTRAHIGH-DOSE IONIZING RADIATION ON THE CONTENT OF CATHECHOLAMINE MEDIATORS IN VARIOUS REGIONS OF THE RAT BRAIN [VLIANIE IONIZIRUIUSHCHEGO OBLUCHENIIA V SVERKHVYSOKOI DOZE NA SODERZHANIE KATEKHOLAMINOVYKH MEDIATOROV V RAZLICHNYKH OTDELAKH GOLOVNOGO MOZGA KRYSY]

E. N. GONCHARENKO, A. A. ORLOVSKII, S. V. ANTONOVA, and L. M. ROZHDESTVENSKII (Institut Biofiziki; Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Radiobiologiya (ISSN 0033-8192), vol. 29, Sept.-Oct. 1989, p. 709-711. In Russian. refs
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A90-16047

BIOPHYSICAL PRINCIPLES OF THE EFFECTS OF COSMIC RAYS AND RADIATION FROM ACCELERATORS [BIOFIZICHESKIE OSNOVY DEISTVIA KOSMICHESKOI RADIATSII I IZLUCHENII USKORITELEI]

A. M. UGOLEV, ED. Leningrad, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Volume 60), 1989, 256 p. In Russian. No individual items are abstracted in this volume.

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Results are presented on studies investigating the characteristics and the biological effects of high-energy cosmic rays and radiation from heavy-particle accelerators. Attention is given to the analysis of biological experiments in space, the physical characteristics of the nuclear-active component of cosmic rays, the ultrahigh-energy component of cosmic radiation simulated by the Serpukhov proton accelerator, the biological effects of high-energy hadrons in experiments using accelerators, the

microdosimetric analysis of radiation-induced effects, and the biophysical interpretation of hadron effects. Special consideration is given to the characteristics of cosmic rays affecting space crews; simulating the effects of cosmic rays at ground sources and on biosatellites; and the biological effects of protons, heavy ions, and galactic cosmic rays. A generalized kinetic model of cell radiation damage is presented. I.S.

A90-16057

NEUROCHEMISTRY OF HIBERNATION IN MAMMALS [NEIROKHIMIIA ZIMNEI SPIACHKI MLEKOPITAIUSHCHIKH]

NIKOLAI N. DEMIN, TAMARA KH. SHORTANOVA, and EMIRBEK Z. EMIRBEKOV Leningrad, Izdatel'stvo Nauka, 1988, 137 p. In Russian. refs

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Data are presented on biochemical processes active in the mammalian brain during hibernation and to role of neuromediators and neuromodulators in these processes. Special attention is given to the content changes of cerebral proteins, ribonucleic acids, low-molecular-weight nitrogen metabolites, lipids, and energy substrates that take place during hibernation, and to changes that take place in the membrane structures of the brain. It is emphasized that the natural reversible hypobiosis during hibernation is different from the passive torpor induced by low temperatures in cold-blooded animals. I.S.

A90-16284* California Univ., San Francisco.

ANATOMICAL STUDY OF THE FINAL COMMON PATHWAY FOR VOCALIZATION IN THE CAT

GERT HOLSTEGE (California, University, San Francisco) Journal of Comparative Neurology (ISSN 0021-9967), vol. 284, 1989, p. 242-252. refs

(Contract NCC2-491)

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Results are presented of an anatomical study of the neuronal pathways in the cat, via which the periaqueductal gray (PAG) produces excitation of motoneurons involved in vocalization. It is shown that a specific cell group in the lateral part of the caudal PAG and in the tegmentum just lateral to it projects bilaterally to the nucleus retroambiguus (NRA) in the caudal medulla oblongata. Neurons in the NRA in turn project, via a contralateral pathway through the ventral funiculus of the spinal cord, to the motoneuronal cell groups innervating intercostal and abdominal muscles. In the brainstem, the NRA neurons project to the motoneuronal cell groups innervating mouth-opening and perioral muscles as well as to motoneurons innervating the pharynx, soft palate, and tongue. These results indicate that the projections from PAG via NRA to vocalization motoneurons form the final common pathway in vocalization. I.S.

A90-16286* Wright State Univ., Dayton, OH.

8-OH-DPAT SUPPRESSES VOMITING IN THE CAT ELICITED BY MOTION, CISPLATIN OR XYLAZINE

JAMES B. LUCOT and GEORGE H. CRAMPTON (Wright State University, Dayton, OH) Pharmacology, Biochemistry and Behavior (ISSN 0091-3057), vol. 33, no. 3, 1989, p. 627-631. refs

(Contract NCC2-229)

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Vomiting was suppressed in cats pretreated with 8-OH-DPAT and then challenged with an emetic stimulus; motion, xylazine or cisplatin. The antiemetic effect is likely due to stimulation of postsynaptic serotonin-1A receptors. The most parsimonious explanation is that it acts at a convergent structure, presumably at or near the vomiting center. If so, 8-OH-DPAT may block emesis elicited by virtually any other stimulus. A supplementary experiment revealed that lorazepam suppressed motion sickness at a dose that produced ataxia, but did not suppress xylazine-induced emesis. These results do not support the possibility that the antiemetic effects of 8-OH-DPAT were the result of anxiolytic activity. Author

A90-16420* Stanford Univ., CA.

GROWTH RATE STUDY OF CANAVALIN SINGLE CRYSTALS

R. C. DEMATTEI and R. S. FEIGELSON (Stanford University, CA)
Journal of Crystal Growth (ISSN 0022-0248), vol. 97, no. 2, Sept.
1989, p. 333-336. Research supported by NSF. refs
(Contract NAG8-489)
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The dependence on supersaturation of the growth rate of single crystals of the protein canavalin is studied. In the supersaturation ranges studied, the rate-limiting step for growth is best described by a screw dislocation mechanism associated with interface attachment kinetics. Using a ln-ln plot, the growth-rate data is found to fit a predictive relationship of the form $G = 0.012 \times$ the supersaturation to the 6.66, which, together with the solubility curves, allows the growth rate to be estimated under a variety of conditions. S.A.V.

A90-16532* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SPACE STATION ACCOMMODATION OF LIFE SCIENCES IN SUPPORT OF A MANNED MARS MISSION

BARRY D. MEREDITH, KELLI F. WILLSHIRE, JANE A. HAGAMAN (NASA, Langley Research Center, Hampton, VA), and RHEA M. SEDDON (NASA, Johnson Space Center, Houston, TX) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 95-106.
(AAS PAPER 87-233) Copyright

Results of a life science impact analysis for accommodation to the Space Station of a manned Mars mission are discussed. In addition to addressing such issues as on-orbit vehicle assembly and checkout, the study also assessed the impact of a life science research program on the station. A better understanding of the effects on the crew of long duration exposure to the hostile space environment and to develop controls for adverse effects was the objective. Elements and products of the life science accommodation include: the identification of critical research areas; the outline of a research program consistent with the mission timeframe; the quantification of resource requirements; the allocation of functions to station facilities; and a determination of the impact on the Space Station program and of the baseline configuration. Results indicate the need at the Space Station for two dedicated life science lab modules; a pocket lab to support a 4-meter centrifuge; a quarantine module for the Mars Sample Return Mission; 3.9 man-years of average crew time; and 20 kilowatts of electrical power. C.E.

N90-12150# National Inst. of Standards and Technology, Gaithersburg, MD. Center for Fire Research.

SYNERGISTIC EFFECTS OF NITROGEN DIOXIDE AND CARBON DIOXIDE FOLLOWING ACUTE INHALATION EXPOSURES IN RATS

BARBARA C. LEVIN, MAYA PAABO, LANE HIGHBARGER, and NANCY ELLER May 1989 45 p Presented at Society of Toxicology Annual Meeting, Atlanta, GA, Feb. 1989 Sponsored in part by the Society of the Plastics Industry, Inc., New York, NY (PB89-214779; NISTIR-89/4105) Avail: NTIS HC A03/MF A01 CSCL 06P

All fires occurring in air produce carbon dioxide (CO₂). Fire involving nitrogen-containing products will also generate nitrogen dioxide (NO₂), a pulmonary irritant. In Fischer 344 male rats, the LC50 (30 minute exposure plus 14 day post-exposure observation period) for NO₂ was 200 ppm (with 95 percent confidence limits of 43 to 51 percent); whereas, the LC50 for NO₂ in the presence of 5 percent CO₂ was 90 ppm (with 90 percent confidence limits ranging from 70-120 ppm). Exposure to NO₂ increased the methemoglobin (MetHb) levels in the arterial blood. At the end of the 30 minute exposures, the MetHb levels were 2-3 times higher in the animals exposed to the combination of NO₂ (200 ppm) and CO₂ (5 percent) than in those exposed to NO₂ only. Deaths from NO₂ were all post-exposure and occurred earlier in the presence of NO₂ plus 5 percent CO₂ than in the absence of the CO₂. The time of death was concentration-dependent when both gases were present. At death, evidence of hemorrhage and extensive edema was observed in the lungs. The mean lung wet weight/body weight

ratio from rats exposed to 200 ppm NO₂ with and without 5 percent CO₂ was 3-4 times that of non-exposed rats. More edema was noted with NO₂ and CO₂ than with NO₂ alone. GRA

N90-12151*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE RODENT RESEARCH ANIMAL HOLDING FACILITY AS A BARRIER TO ENVIRONMENTAL CONTAMINATION

P. D. SAVAGE, JR., G. C. JAHNS, B. P. DALTON, R. P. HOGAN, and A. E. WRAY (General Electric Co., Moffett Field, CA.) Sep. 1989 11 p Presented at the 19th Intersociety Conference on Environmental Systems, San Diego, CA, 24-26 Jul. 1989 (NASA-TM-102237; A-89183; NAS 1.15:102237) Avail: NTIS HC A03/MF A01 CSCL 06C

The rodent Research Animal Holding Facility (RAHF), developed by NASA Ames Research Center (ARC) to separately house rodents in a Spacelab, was verified as a barrier to environmental contaminants during a 12-day biocompatibility test. Environmental contaminants considered were solid particulates, microorganisms, ammonia, and typical animal odors. The 12-day test conducted in August 1988 was designed to verify that the rodent RAHF system would adequately support and maintain animal specimens during normal system operations. Additional objectives of this test were to demonstrate that: (1) the system would capture typical particulate debris produced by the animal; (2) microorganisms would be contained; and (3) the passage of animal odors was adequately controlled. In addition, the amount of carbon dioxide exhausted by the RAHF system was to be quantified. Of primary importance during the test was the demonstration that the RAHF would contain particles greater than 150 micrometers. This was verified after analyzing collection plates placed under exhaust air ducts and rodent cages during cage maintenance operations, e.g., waste tray and feeder changeouts. Microbiological testing identified no additional organisms in the test environment that could be traced to the RAHF. Odor containment was demonstrated to be less than barely detectable. Ammonia could not be detected in the exhaust air from the RAHF system. Carbon dioxide levels were verified to be less than 0.35 percent. Author

N90-12152* Lockheed Engineering and Sciences Co., Washington, DC.

USSR SPACE LIFE SCIENCES DIGEST, ISSUE 24

LYDIA RAZRAN HOOKE, ed., RONALD TEETER, ed., P. LYNN DONALDSON, ed., VICTORIA GARSHNEK, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, DC.) Washington NASA Nov. 1989 112 p
(Contract NASW-4292)

(NASA-CR-3922(28)-ISSUE-24; NAS 1.26:3922(28)-ISSUE-24)
Avail: Issuing Activity CSCL 06C

This is the twenty-fourth issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 39 journal papers or book chapters published in Russian. In addition, reviews of two recent Soviet books are translated. The abstracts in this issue have been identified as relevant to 25 areas of space biology and medicine: adaptation, aviation medicine, biological rhythms, cardiovascular and respiratory systems, cytology, developmental biology, endocrinology, equipment and instrumentation, genetics, habitability and environment effects, hematology, human performance, immunology, life support systems, man-machine systems, mathematical modeling, metabolism, microbiology, morphology, musculoskeletal system, neurophysiology, operational medicine, psychology, radiobiology, and space medicine. Author

N90-12153* Lockheed Engineering and Sciences Co., Washington, DC.

USSR SPACE LIFE SCIENCES DIGEST, ISSUE 22

LYDIA RAZRAN HOOKE, ed., RONALD TEETER, ed., P. LYNN DONALDSON, ed., VICTORIA GARSHNEK, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, DC.) Washington NASA Aug. 1989 137 p
(Contract NASW-4292)

(NASA-CR-3922(26)-ISSUE-22; NAS 1.26:3922(26)-ISSUE-22)
Avail: Issuing Activity CSCL 06C

51 LIFE SCIENCES (GENERAL)

This is the twenty-second issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 56 journal papers or book chapters published in Russian and of a Soviet monograph reviewing the literature on chronobiology. The complete contents of two issues of the Soviet Journal Space Biology and Aerospace Medicine are covered. Selected abstracts are illustrated with figures and tables from the original. A special feature presents a translation of an interview with two Mir cosmonauts. The abstracts in this issue have been identified as relevant to 29 areas of space biology and medicine. These areas are: adaptation, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, developmental biology, endocrinology, enzymology, equipment and instrumentation, genetics, gravitational biology, habitability and environmental effects, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, psychology, radiobiology, reproductive system, and space biology and medicine. Author

N90-12154* Lockheed Engineering and Sciences Co., Washington, DC.

USSR SPACE LIFE SCIENCES DIGEST, ISSUE 23

LYDIA RAZRAN HOOKE, ed., P. LYNN DONALDSON, ed., RONALD TEETER, ed., VICTORIA GARSHNEK, ed., and JOSEPH ROWE, ed. (Library of Congress, Washington, DC.) Washington NASA Aug. 1989 123 p

(Contract NASW-4292)

(NASA-CR-3922(27)-ISSUE-23; NAS 1.26:3922(27)-ISSUE-23)

Avail: Issuing Activity CSCL 06C

This is the twenty-third issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 47 journal papers or book chapters published in Russian and of five Soviet monographs and one book review. Selected abstracts are illustrated with figures and tables from the original. A special feature provides a translation of a discussion on biomedical support of manned flights to Mars. The abstracts in this issue have been identified as relevant to 32 areas of space biology and medicine. These areas are: adaptation, aviation medicine, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, cytology, developmental biology, endocrinology, enzymology, equipment and instrumentation, gastrointestinal system, genetics, group dynamics, habitability and environmental effects, hematology, human performance, immunology, life support systems, man-machine systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, psychology, radiobiology, and reproductive system. Author

N90-12155# Cincinnati Univ., OH. Dept. of Microbiological and Molecular Genetics.

GENETIC ENGINEERING OF ENHANCED MICROBIAL

NITRIFICATION Environmental Research Brief, Aug. 1983 -

1988 Sep.

MICHAEL CARSIOTIS and SUNIL KHANNA Jun. 1989 10 p

(Contract EPA-CR-810888)

(PB89-208334; EPA/600/M-89/011) Avail: NTIS HC A02/MF

A01 CSCL 06C

Experiments were conducted to introduce genetic information in the form of antibiotic or mercuric ion resistance genes into *Nitrobacter hamburgensis* strain X14. The resistance genes were either stable components of broad host range plasmids or transposable genes on plasmids presumably unable to replicate in strain X14. Four methods for plasmid transformation as well as conjugation with various donor strains of *Escherichia coli* failed. The *leuB* gene containing DNA was restriction-mapped and the 1.3 kilobase pair gene was subcloned into a vector suitable for use in DNA sequencing. To date, a tentative sequence comprising about 1300 bases was obtained. Although the primary goal of developing a procedure for introducing genetic material into a nitrifying organism is not yet achieved, the results achieved have produced useful information on the genomic organization of *Nitrobacter* as well as a plasmid-borne library of genes from that

organism. Future experiments can be made with this library in order to provide additional basic information on *Nitrobacter's* genome. GRA

N90-12156# North Carolina State Univ., Raleigh.

MEMBRANE FUSION: THE ROLE OF POLYPHOSPHATIDYLINOSITOL Final Report, Mar. 1986 - Mar. 1989

WENDY F. BOSS and JEFFREY J. WHEELER 24 Jul. 1989 5 p

(Contract DAAL03-86-G-0035)

(AD-A211289; ARO-23767.7-LS-F) Avail: NTIS HC A02/MF A01 CSCL 06/1

It was found that the presence of the phospholipid, lysophosphatidylinositol monophosphate (LPIP) correlates positively with the fusion potential of fusogenic carrot cells. There was no correlation with the presence of phosphatidylinositol monophosphate (PIP) and phosphatidylinositol bisphosphate (PIP2) and fusion. Nor was there evidence for the need for PIP or PIP2 turnover in order for the cells to be fusion permissive. LPIP was synthesized primarily from the phosphorylation of lysophosphatidylinositol. Lysolipids were found to decrease the phosphorylation of PI and PIP suggesting a mechanism for regulating the biosynthesis of the polyphosphoinositides which are key components of the signal transduction pathway in many animal cells. GRA

N90-12157# Duke Univ., Durham, NC.

BORON ANALOGUES OF AMINO ACIDS AND DERIVATIVES

Final Report, 1 Sep. 1987 - 30 Nov. 1988

BERNARD F. SPIELVOGEL, BARBARA RAMSAY SHAW, and ROBERT G. GHIRARDELLI 19 Jul. 1989 5 p

(Contract DAAL03-87-C-0029)

(AD-A211311; ARO-25263.1-CH) Avail: NTIS HC A01/MF A01 CSCL 06/15

The principal goal of this research was the synthesis and characterization of boron analogues of important biologically active molecules such as the amino acids. During this period of research syntheses were developed for amides of a variety of simple boron analogues of common amino acids such as saline. Peptides containing boron were completed. Synthetic approaches were developed for boron analogues of phosphonates. Collaborative studies on the biological activity of many of these compounds were carried out by Professor Iris H. Hall at the University of North Carolina. Significant antitumor and hypolipidemic activity were found in animal model studies. GRA

N90-12158# California Univ., Irvine.

SYNAPTIC PLASTICITY AND MEMORY FORMATION Final

Technical Report, Apr. 1986 - Mar. 1989

GARY LYNCH 30 May 1989 11 p

(Contract AF-AFOSR-0099-86; AF PROJ. 2312)

(AD-A211368; AFOSR-89-1141TR) Avail: NTIS HC A02/MF A01 CSCL 05/8

The purpose of the proposed research was to test and elaborate on an hypothesis regarding cellular mechanisms responsible for storing recognition memory in mammalian telencephalon. The encoding process proposed involves: (1) an unusual pattern of physiological activity in the relevant neural pathways, (2) influx of calcium into dendritic spines postsynaptic to the active axons, (3) activation of the calcium-sensitive protease, calpain, (4) partial degradation of spectrin, a cytoskeleton protein that regulates membrane surface chemistry and possibly spine shape, and (5) anatomical reorganization of postsynaptic structure resulting in a stable increase of postsynaptic potentials. Central to the hypothesis is the phenomenon of long-term potentiation (LTP) of synaptic transmission; much of the research conducted in the past three years has been aimed at characterizing the physiological and biochemical steps responsible for this remarkably persistent synaptic change and examining its role in memory storage. We have also hypothesized that excessive activation of the calpain system can lead to the neuronal degeneration that is associated with experimental age-related neuropathologies. GRA

N90-12159# Utah Univ., Salt Lake City.
INVESTIGATION OF RESONANT AC-DC MAGNETIC FIELD EFFECTS Final Report, May 1986 - Jul. 1989
 CARL H. DURNEY, JIRI JANATA, CATHERINE RAPPAPORT, MARK KAMINSKI, and CINDY BRUCKNER-LEA 10 Jul. 1989
 45 p
 (Contract N00014-86-K-0230; RR04108)
 (AD-A211612; UTEC-89-036) Avail: NTIS HC A03/MF A01
 CSCL 06/7

Recently reported observations by others indicate that a combination of a weak dc magnetic field and extra low frequency ac magnetic fields can produce resonant effects in biological systems. The study of resonant magnetic field effects consist of three parts: calculations aimed at identifying the basic mechanism underlying the resonance, measurements of the effects of combined dc and ac magnetic fields on the dc current through plain (containing no channels) planar phospholipid membranes, and measurements of the effects of combined dc and ac magnetic fields on the binding of metallochromic dyes and calmodulin to calcium. The calculations provided insight and a physical mechanism that explains both frequency and amplitude windows in an elementary model consisting of one charged particle in a viscous medium. The combined dc-ac magnetic fields did affect the dc current through planar phospholipid membranes, but not in every membrane, and not consistently at the same values of magnetic field strength and frequency. No effect of the magnetic fields were seen on the binding of metallochromic dyes and calmodulin to calcium. None of the measurements showed any resonant response like the cyclotron like resonance reported in the literature in diatoms and lymphocytes. GRA

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AEROSPACE MEDICINE

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

A90-13267#
TELESCIENCE TESTBED FOR PHYSIOLOGICAL EXPERIMENTS

MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), SATORU WATANABE, TADAAKI MANO, NOBUO MATUI (Nagoya University, Japan), FLEMMING BONDE-PETERSEN (Danish Aerospace Medical Centre of Research, Denmark) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 12 p.
 (IAF PAPER 89-034) Copyright

A telepresence system for studying human physiology was simulated using a water immersion laboratory (weightlessness simulator). Electrocardiography, blood pressure, skin flowmetry, blood analyses, and echocardiography were conducted by operators at a remote location. The quality of the data is evaluated, and their relevance for the critical issues concerning operational management of telepresence are addressed. C.D.

A90-13304#
THE NEXT 40 YEARS IN SPACE - ASPECTS OF HUMAN FACTORS IN SPACE RESEARCH

E. BECKERS, R. KOZLOWSKI, F. NOTTELMANN, and F. PARIS (Bochum, Ruhr-Universitaet, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 11 p. refs
 (IAF PAPER 89-091) Copyright

Problems involving the interrelation between the human being and the environment occurring on long-duration space flights are discussed. The causes and dynamics of stress on these flights are reviewed, as is the nature and limits of adaptation to long-duration space flight. The main tasks involved in the integration

of the human to a completely artificial environment are considered, as well as the demands of reintegration to the earth environment upon mission completion. C.D.

A90-13606#
BIOMEDICAL PAYLOAD OF THE FRENCH-SOVIET LONG DURATION FLIGHT - FIRST CONCLUSIONS

L. BRAAK, J. THOULOUSE, A. GUELL, D. VASSAUX (CNES, Paris, France), A. D. GRIGOR'EV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p.
 (IAF PAPER 89-563)

The French-Soviet flight of November 26 - December 21, 1988 enabled five biomedical experiments to be carried out, covering medical research into space. Two of them, 'Echography' and 'Minilab' relate to the study of the cardiovascular system while others, 'Physalie' and 'Viminal', are concerned with the central nervous and sensory motor systems. The last experiment 'Circe' covers the radioprotection area. Two ground-based experiments were added: 'Lymphocytes' for studying the immune system and 'Bone Densitometry' for studying bone mineral content. Most of the measurements were successful and data brought back by the crew were of sufficiently good quality for later scientific analysis. C.E.

A90-13608#
CHANGES IN CIRCADIAN RHYTHM OF MULTIPLE HORMONES AND THEIR RELATIONSHIP WITH INDIVIDUAL SUSCEPTIBILITY IN SIMULATED WEIGHTLESSNESS

KEJIA LIU, HONGYUAN SUN, JUN LU, GUANMING ZHANG, XIAOWU PAN (Institute of Space Medico-Engineering, Beijing, People's Republic of China) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. refs
 (IAF PAPER 89-565) Copyright

Whether or to what extent the circadian rhythm of human urinary melatonin (MLT), catecholamines (NE, E, and NE+E), glucocorticosteroids (17-OHCS, and cortisol) and cyclic nucleotides (cAMP and cGMP) would be affected by a 7-day head-down tilt of 6 deg (HDT) was investigated using 6 male volunteers aged 21 yrs. Cosinor analysis showed that they all did exhibit profound circadian variations of the mesor, amplitude, and acrophase during HDT. There were also internal dissociations. A wide extent of distress was registered during HDT, and the complaints were roughly classified into 3 ranks according to individual susceptibility. The calculation revealed that a definite correlation existed between endocrinal alterations and individual susceptibility. Author

A90-13609#
UNILATERAL CENTRIFUGATION OF THE OTOLITHS AS A NEW METHOD TO DETERMINE BILATERAL ASYMMETRIES OF THE OTOLITH APPARATUS IN MAN

J. WETZIG, M. REISER, E. MARTIN, N. BREGENZER, and R. J. VON BAUMGARTEN (Mainz, Universitaet, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs
 (Contract BMFT-01-QV-88075)
 (IAF PAPER 89-566)

Ten subjects were eccentrically rotated on a Barany chair. Setting of a luminous line to subjective vertical and ocular counterroll (OCR) were evaluated. Subjects consistently set the luminous line to an angle correlating to centrifugal force. Differences between 'inner' and 'outer' eye were evident for luminous line settings and OCR in some subjects. There appears to exist some agreement between asymmetries seen in setting of the line and motion sickness susceptibility in parabolic flight. Author

A90-13610*# National Aeronautics and Space Administration, Washington, DC.

LONG-TERM EXPOSURE TO ZERO-G AND THE GASTRO-INTESTINAL TRACT FUNCTION

PERCIAL D. MCCORMACK (NASA, Life Sciences Div., Washington, DC) IAF, International Astronautical Congress, 40th, Malaga,

Spain, Oct. 7-13, 1989. 10 p. refs
(IAF PAPER 89-569) Copyright

The gastrointestinal tract (GIT) function is described with emphasis placed on its important role to smooth, delay, and modify sudden fluid load stress applied to the fluid distribution control system in the body. Two basic components of the GIT are considered: stomach dynamics, which involves storage, mixing, and discharge of food into the intestine after addition of gastric juices; and absorption of water and electrolytes from the small intestine. A dynamic model of these components is described, along with performance characteristics computed consecutively for one g and zero g conditions. The main impact of the zero g condition appears to be through a change in osmotic driven transport across the gut wall. A dramatic change in transport characteristics is predicted with implication for many body systems (the immune system in particular) during long-term exposure to zero g. Experimental measurements in zero g are needed to evaluate these predictions. C.E.

A90-13612#

THE BASIC HEALTH CARE SYSTEM FOR THE CREW LUNAR BASE

MINORU TERAJ (Tokyo Metropolitan Institute of Technology, Hino, Japan) and KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p.
(IAF PAPER 89-573) Copyright

The basic health care system for the crew of the lunar base is presented, noting its two subsystems. The first is the daily health care system containing mainly the same care menu as in some biochemical and ordinary medical examinations on earth. The second system is a periodic medical inspection of the crew's bones and the determination of natural radioisotopes in the body. Both health care systems run automatically including complete examinations and data recordings. Examinations and data files of the results are controlled by computer. Daily examinations' results are compared with the filed data. In case of any discrepancy, a computerized message is sent for a close reexamination by a medical doctor or if a recheck of the same submenu is needed. The automatic health care systems and the life support monitoring system are kept in daily contact. C.E.

A90-13621#

PSYCHO-PHYSIOLOGICAL STUDIES DURING THE FLIGHT OF THE SECOND BULGARIAN COSMONAUT

A. ALEKSANDROV and G. RADKOVSKI IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989 3 p.
(IAF PAPER 89-586)

Results of the psychophysiological studies carried out during the flight of Bulgaria's second cosmonaut are presented and discussed. Three related experiments entitled Forecast, Investigation, and Free Time were conducted. The data were processed by two special configurations of hardware for psychophysiological research and biomedical studies. The psychophysiological hardware configuration Pleven-87 showed high functional reliability during the experiments onboard the Mir orbital station and made possible a quantitative assessment of the cosmonauts' mental functions during space flight. C.E.

A90-13622#

BINOCULAR DEPTH PERCEPTION AND ITS HYPERACUITY IN COMMON AND SPECIALLY SELECTED SUBJECTS

IGOR' A. SHEVELEV and SVETLANA A. KOLOSOVA (AN SSSR, Institut Vyssei Nervnoi Deiatel'nosti i Neirofiziologii, Moscow, USSR) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 4 p. refs
(IAF PAPER 89-588) Copyright

The differential thresholds of binocular depth (BDT) perception were studied in 542 specially selected and non-selected humans under usual conditions as well as under high illumination and prismatic BDT distortion. A low BDT fluctuating from 1.4 up to 36 arcsec is shown for specially selected observers with professional

light training. Statistically, the highest limit of normal BDT is equal to 11.7 arcsec, while for specifically trained group the BDT is equal to 10 arcsec. Acuteness of binocular depth vision and speed of BDT estimation are correlated. A negative correlation between BDT and age is indicated. Illustrations of binocular depth vision under modeled space flight deconditioning include high intensity of background illumination from 75,000 to 150,000 lx and prismatic distortion by the space scafander glass. C.E.

A90-13624#

A REPORT OF GROUND RESULTS FOR BRAIN FUNCTION EXPERIMENTS IN SPACE

LEI MEI (Institute of Space Medico-Engineering, Beijing, People's Republic of China) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs
(IAF PAPER 89-590) Copyright

A new encephalofluorograph technology (ET) for space application has been developed. Information about super-slow activities of the brain can be abstracted from the ordinary brain waves. Specific S spectral lines related to neurophysiological and neurochemical activities have been identified and characteristic spatial patterns have been determined. ET analyses described include 20-degrees head-lowered suspension experiments in rabbits; 2 G hypergravity experiments in rabbits; effects of antimotion sickness drugs on rabbits during suspension; and clinical observations on patients with brain circulation disorders. The results demonstrated the potential of ET application in space research. C.E.

A90-13625#

EFFECT ON THE CARDIAC FUNCTION OF REPEATED LBNP DURING A ONE MONTH HEAD DOWN TILT

P. ARBEILLE, D. LÉBOUARD, M. MASSABUAU, J. POTTIER, F. PATAT (Tours, Université, France) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 4 p. Research supported by CNES. refs
(IAF PAPER 89-593) Copyright

Cardiovascular assessment by ultrasound methods was performed during two long-duration head down tilt (HDT) experiments on 6 healthy volunteers. In a first one-month HDT session (1987), 3 of the 6 subjects had several daily lower body negative pressure (LBNP) test, whereas the three remaining subjects stayed at rest without LBNP. In a second one-month HDT session (1988), the last three subjects were LBNP tested and the first three were not. Different countermeasures (LBNP, isotonic or isometric exercise) have been proposed to minimize the effects of weightlessness on the cardiovascular system and to reduce the cardiovascular deconditioning after the flight. The decrease of the left ventricle diastolic volume and the cardiac output under LBNP has been clearly demonstrated during zero g ground simulation. During long term flight, the LBNP test as well as isotonic or isometric exercise has been used intensively as a countermeasure and a significant reduction of the cardiovascular function has been observed. The LBNP maneuver can be considered as an efficient countermeasure to prevent cardiac disadaptation induced by HDT position and probably microgravity. C.E.

A90-13626#

MEDICAL RESULTS OF THE FLIGHT OF THE SECOND PRIME CREW ON THE ORBITAL STATION MIR

O. G. GAZENKO, A. I. GRIGORIEV, S. A. BUGROV, V. V. BOGOMOLOV, A. D. EGOROV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 12 p. refs
(IAF PAPER 89-594) Copyright

An analysis of the medical results of the second prime crew flown aboard the Mir station, and in particular of Yuri V. Romanenko, who remained in orbit for 326 days, is presented. Data are reported which show that Romanenko retained good health and high work capacity throughout the flight. This achievement is credited to concerted efforts of the crew and mission control center, and to

adequate environment, work-rest cycle, and countermeasures, primarily regular and active exercise. C.D.

A90-13627#
ORTHOSTATIC INTOLERANCE POST SPACE FLIGHT - A MULTIFACTORIAL DISORDER?

ANTONIO GUELL (CNES, Toulouse, France) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p. refs

(IAF PAPER 89-595) Copyright

The mechanisms involved in the physiopathogeny of the orthostatic intolerance observed after space flight are examined. The decrease in plasma volume from short-term and from long-term weightlessness is addressed, and the causative factors are discussed. The role of the low-pressure venous system in producing orthostatic intolerance is considered, emphasizing the role of the limits of venous distension or the capability of veins to store more blood. Baroreception responsiveness is also briefly considered as a cause of orthostatic intolerance. C.D.

A90-13628*# National Aeronautics and Space Administration, Washington, DC.

EFFECTS OF BODY POSTURE ON THE INTERPRETATION OF BIOMEDICAL DATA OBTAINED FROM MANNED MISSIONS

ARNAULD NICOGLOSSIAN (NASA, Washington, DC), CAROLYN LEACH-HUNTOON, JOHN CHARLES, SAM POOL (NASA, Johnson Space Center, Houston, TX), and JOEL I. LEONARD (Lockheed Engineering and Sciences Co., Inc., Life Sciences Programs Office, Washington, DC) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs

(IAF PAPER 89-596)

The role that different body postures may have on the interpretation of inflight results is studied. The cardiovascular measurements taken in the upright position more closely approximated the findings from space flight in the short-duration missions. However, the supine position most approximated the long-duration missions. K.K.

A90-13629#
HEMODYNAMICS DURING HEAD DOWN TILTING AND LOWER BODY NEGATIVE PRESSURE AND PHARMACOLOGICAL INTERVENTIONS FOR COUNTERMEASURES

H. LOELLGEN, K. KOPPENHAGEN, G. STRAUCH, and K. HARDIECK (Municipal Hospital, Remscheid; Berlin, Freie Universitaet, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 3 p.

(IAF PAPER 89-597) Copyright

Pharmacological interventions assumed to counteract hemodynamic changes induced by head-down tilting (HDT) and lower body negative pressure (LBNP) are analyzed. Nitroglycerine was used for amelioration of HDT effects, dihydergotamine for attenuation of LBNP effects. Changes during HDT and after nitroglycerine were moderate and not significantly different from control. In contrast, there were significant changes during LBNP for hemodynamic parameters (decrease) and transcutaneously analyzed blood gases. These alterations could be counterbalanced by dihydergotamine in a significant way. The role of noninvasive approach to simulated weightlessness and reentry is discussed.

Author

A90-13630*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

BIOCHEMICAL CORRELATES OF NEUROSENSORY CHANGES IN WEIGHTLESSNESS

CAROLYN S. LEACH and MILLARD F. RESCHKE (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p. refs

(IAF PAPER 89-598) Copyright

The possible existence of a relationship between space motion sickness and chemical and biochemical variables measured in body fluids is studied. Clinical chemistry and endocrine measurements

from blood and urine samples taken before and after Space Shuttle flights were analyzed along with the occurrence of SMS during flight and provocative testing before flight. Significant positive correlations were observed with serum chloride and significant negative correlations with serum phosphate, serum uric acid, and plasma thyroid stimulating hormone. K.K.

A90-13631#
FLUID DISTRIBUTION PATTERN INDUCED BY INTRAVENOUS FLUID LOADING DURING HDT

F. BAISCH, G. BLOMQUIST, R. GERZER, M. HEER, A. HILLEBRECHT (DLR, Cologne, Federal Republic of Germany) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs

(IAF PAPER 89-599) Copyright

The hypothesis that prolonged HDT alters the systematic responses to superimposed acute changes in the magnitude and distribution of intravascular volume is tested. The study group included six normal male subjects with a mean age of 26 + or - 4.4 yrs. Studies were carried out before, during, and after a 10 day period of 6 deg head down tilt. HDT reduced plasma volume by 16 percent, body weight by 2.4 percent, and cardiac output by 13 percent. K.K.

A90-13632#
HORMONAL AND CARDIOVASCULAR CHANGES DURING LOWER BODY NEGATIVE AND POSITIVE PRESSURES

FLEMMING BONDE-PETERSEN (National Hospital, Copenhagen, Denmark) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p.

(IAF PAPER 89-600)

At least three different hormonal systems which actively maintain and regulate arterial blood pressure are identified: the catecholamine system, the renin-angiotensin system, and the arginin-vasopressin system. Results from the literature and the author's own experimental results show that the renin system plays a key role in the regulation of arterial pressure (and, eventually, in the etiology of arterial hypertension) especially during orthostatic hypotension. However, arginin-vasopressin and the catecholamines are also called upon in near-syncope conditions. During this latter condition, a vasovagal reflex released from the heart muscle sensors dominates over the sympathetic drive leading to a circulation collapse. In space conditions, the blood volume of man decreases and stays decreased for an extended period of time due to the regulatory mechanisms built into the physiological system. Because this situation cannot occur on earth, it is concluded that the weightlessness condition offers a unique opportunity to investigate the regulation of cardiovascular parameters. S.A.V.

A90-13633#
EXPERIMENTAL RESEARCH ON THE APPLICABILITIES OF CHINESE MEDICINE TO SPACE MEDICINE

RUIJUN ZHANG, JINKANG QIAN, ZHIZHEN SHI, JIANQUAN LAN, and BAOZHEN WANG (Institute of Space-Medico Engineering, Beijing, People's Republic of China) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p. refs

(IAF PAPER 89-601) Copyright

Ground-based experimental results are presented on the applicability of Chinese medicinal herbs as a countermeasure to space flight deconditioning. The main principle behind Chinese medical treatment is to keep the opposite aspects of the body's functional states in equilibrium (the 'Yin-Yang' balance). The Chinese medicinal herbs used are of natural origin and have minimal side effects. The herbs showed satisfactory results in protection against gamma irradiation and seasickness in human subjects. The herbs also alleviated headward blood stagnation in tilted rabbits and diminished bone loss in suspended rats. It is concluded that Chinese medicinal herb treatment shows promise in solving the medical problems encountered in manned space flight. S.A.V.

A90-13673*# Research Triangle Inst., Research Triangle Park, NC.

NASA SPINOFFS TO BIOENGINEERING AND MEDICINE

DORIS J. ROUSE, DANIEL L. WINFIELD, and S. CATHERINE CANADA (Research Triangle Institute, Research Triangle Park, NC) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 10 p.

(Contract NASW-4367)

(IAF PAPER 89-683) Copyright

The societal and economic benefits derived from the application of aerospace technology to improved health care are examined, and examples of the space-technology spinoffs are presented. Special attention is given to the applications of aerospace technology from digital image processing, space medicine and biology, microelectronics, optics and electrooptics, and ultrasonic imaging. The role of the NASA Technology Application Team in helping the potential technology users to identify and evaluate the technology transfer opportunities and to apply space technology in the field of medicine is discussed. I.S.

A90-13727#

YAW SENSORY REARRANGEMENT CHANGES PITCH RESPONSES

A. E. PETROPOULOS, C. WALL, III (Massachusetts Eye and Ear Infirmary, Boston), and C. M. OMAN (MIT, Cambridge, MA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 11 p. refs

(IAF PAPER ST-89-012)

The hypothesis is tested as to whether sensory rearrangement (adaptation) of the magnitude of the canal-ocular response using combined visual vestibular stimuli during yaw rotation about an earth vertical axis will also be transferred to the otolith-ocular responses elicited by pitch rotation about an earth horizontal axis. Previous studies demonstrated the nauseogenicity of the visual vestibular adaptation protocols, both in animals and in humans. As a further step, the relationship observed by Wall and Smith (1989) between the degree of vestibulo-ocular reflex gain change and the severity of subjective discomfort experienced during the adaptation protocols is investigated. S.A.V.

A90-13729#

SELECTIVE HYPERGRAVITY STIMULATION: ITS EFFECTS ON THE HUMAN BALANCE AND GAIT FUNCTIONS - A MODEL TO ASSESS, IN NORMAL GRAVITY CONDITIONS, SOME ASPECTS OF THE PERTURBATIONS INDUCED ON HUMAN BODY BY MICROGRAVITY CONDITIONS

M. LAZERGES (Toulouse III, Universite, France) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. Research supported by CNES and Matra, S. A. refs

(IAF PAPER ST-89-016) Copyright

The effects of the transition from hypergravity to normogravity on the reactions of muscle mechanoreceptors in humans were investigated. Hypergravity was selectively applied for 1/2 hr to the extensor muscles by means of two rubber extensible springs stretched from shoulders to feet, inducing continuous hyperactivity of the extensor muscles. The aftereffects of the selective hypergravity stimulation (SHS) were assessed by means of dynamic balance examinations, using the Bessou et al. (1988) method, and gait analyses, using the Bessou et al. (1989) method. It was found that, as a result of the SHS the efficiency of the dynamic balance function, measured 3 min after the hypergravity stimulus, was improved in comparison with control. The efficiency of the gait function was decreased immediately after the end of the SHS application; this aftereffect disappeared 3 min later. I.S.

A90-13735

THE TIME COURSE OF POSTFLIGHT SIMULATOR SICKNESS SYMPTOMS

DENNIS R. BALTZLEY, ROBERT S. KENNEDY, KEVIN S. BERBAUM (Essex Corp., Orlando, FL), MICHAEL G. LILIENTHAL (U.S. Navy, Naval Training Systems Center, Orlando, FL), and DANIEL W. GOWER (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, AL) Aviation, Space, and Environmental Medicine

(ISSN 0095-6562), vol. 60, Nov. 1989, p. 1043-1048. refs

(Contract N61339-86-D-0026; N61339-81-C-0105)

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Reports of posteffects following training sessions in Navy and Army flight simulators were obtained from pilots to determine the time course of recovery from simulator sickness. Results imply that posteffects may be a more serious problem than previously considered; 45 percent of all those queried reported having experienced symptoms of simulator sickness; 25 percent of the symptoms lasted more than 1 h after leaving the simulator; and 8 percent lasted more than 6 h. Postexposure symptoms were classified into the three categories: visuomotor, disorientation, and nausea. A safety risk may be posed particularly by the moderately high frequency of symptoms involving postural disequilibrium. Guidelines for coping with risks are discussed. Author

A90-13736

PROPRANOLOL AND THE COMPENSATORY CIRCULATORY RESPONSES TO ORTHOSTASIS AT HIGH ALTITUDE

CHARLES S. FULCO, ALLEN CYMERMAN, LAURIE A. TRAD (U.S. Army, Research Institute of Environmental Medicine, Natick, MA), JOHN T. REEVES (Colorado, University, Denver), PAUL B. ROCK (U.S. Army, Fitzsimons Army Medical Center, Aurora, CO) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1049-1055. refs

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The possibility that tachycardia, mediated by beta-adrenergic sympathetic stimulation, actually represents an essential response involved in the maintenance of cardiac output during orthostasis at high altitude was investigated in human subjects who were administered either 80 mg plopnanolol or placebo at sea level and during the first 15 days of a 19-d altitude sojourn and were tilt-tested at sea level and at high altitude. Heart rate, stroke volume, calf blood flow, and blood pressure were obtained during supine rest and after 12 min of 60-deg tilt. In untreated subjects, no difference was found between measurements at sea level and those at high altitude. Propranolol was found to cause reductions in heart rate and blood pressure values in each of the tested position. It is concluded that tachycardia, both at rest and during upright tilt at high altitude, is important, but not essential to maintain cardiac output. I.S.

A90-13738

REDUCED SYSTOLIC BLOOD PRESSURE ELEVATIONS DURING MAXIMUM EXERCISE AT SIMULATED ALTITUDES

J. KNUDTZON, K. MYHRE, W. RASCH, I. L. NESLEIN (Institute of Aviation Medicine, Oslo, Norway), A. BOGSNES (Bergen, Universitetet, Norway) et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1072-1076. refs

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A90-13739

WORK CAPACITY, EXERCISE RESPONSES AND BODY COMPOSITION OF PROFESSIONAL PILOTS IN RELATION TO AGE

J. A. LOEPPKY and U. C. LUFT (Lovelace Medical Foundation, Albuquerque, NM) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1077-1084. refs

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The relationships between the work capacity of a pilot and his age and body composition were investigated in 410 professional male pilots divided into age groups of 30, 39, 49, and 59 years and subjected to a progressive upright bicycle ergometer test. It was found that, while the amount of fat tissue increased linearly with age, the fat-free weight was not significantly different between groups. Aerobic work capacity fell at a rate of 0.25 ml/min per kg per year. A reversal of the age-related work-capacity decline was demonstrated for a subgroup of 10 pilots tested annually from age 31 to 47, which was attributed to regular physical exercising and changes in personal health habits motivated by medical prevention programs which incorporated self-assessment tests. I.S.

A90-13740**THE TIME REQUIRED FOR U.S. NAVY FIGHTER PILOTS TO SHIFT GAZE AND IDENTIFY NEAR AND FAR TARGETS**

AILENE MORRIS and LEONARD A. TEMME (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1085-1089. Research supported by the U.S. Navy. Copyright

The speed with which 163 U.S. Navy fighter pilots can shift their line of sight and discriminate high contrast acuity targets was measured. The targets were simultaneously projected onto two screens; one at 18 ft and one at 18 inches in front of the subject's eyes. Subjects were required to fixate first one screen and then as rapidly as possible, shift gaze to the other screen. The minimum exposure duration required to correctly resolve both targets was measured. For 65 subjects, the test target was 1.0 min of visual angle (mva); for 98 subjects the target was 2.0 mva. The major findings are: (1) both Far-to-Near and Near-to-Far mean times significantly slowed with ages; (2) there was no significant difference between the Far-to-Near and the Near-to-Far mean times with the oldest subject (44 years of age) excluded; (3) the within-subject standard deviation Far-to-Near increased with age and was significantly greater than the Near-to-Far standard deviation, which did not increase with age; and (4) there was a significant correlation between the mean Near-to-Far speeds and the night carrier landing performance of the aviators. Author

A90-13741**RECOVERY TO +1GZ AND +2GZ FOLLOWING +GZ-INDUCED LOSS OF CONSCIOUSNESS - OPERATIONAL CONSIDERATIONS**

JAMES E. WHINNERY (U.S. Navy, Naval Air Development Center, Warminster, PA), JOSEPH R. FISCHER (USAF, School of Aerospace Medicine, Brooks AFB, TX), and NATHAN L. SHAPIRO (OAO Corp., San Antonio, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1090-1095. refs

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The effect of potential in-flight recovery from +Gz-induced loss of consciousness (G-LOC) on human physiology was investigated in eight male subjects (not wearing anti-G suits and not performing anti-G straining maneuvers) exposed to +7 Gz with an onset rate of 6 G/sec until they became unconscious. Following the G-LOC, recovery to the usual +1 Gz level was compared to recovery to a +2 Gz level by comparing absolute, relative, and total incapacitation times. The experiments demonstrated that no measurable difference exists in the recovery from G-LOC, based on incapacitation times and tracking error when the Gz level is sustained at +2 Gz post G-LOC. I.S.

A90-13742**DEEP VEIN THROMBOSIS IN THE MILITARY PILOT**

RAYMOND P. STEINHAUSER and JOHN C. STEWART (USAF, Hospital Altus, Altus AFB, OK) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1096-1098. refs

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Three cases of lower-extremity deep vein thrombosis (DVT) involving active duty U.S. Air Force pilots (at the Altus, Oklahoma, base) are examined together with the etiology, diagnosis, and treatment of DVT. One of these cases was caused by stasis, one by trauma, and one had no identified cause. The results of this investigation indicate that pilots with a history of deep vein thrombosis may be returned to flying status. I.S.

A90-13744**PROBABLE BENDS AT 14,000 FEET - A CASE REPORT**

V. M. VOGEL (U.S. Navy, Naval Hospital, Corpus Christi, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1102, 1103. refs

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Decompression sickness has not previously been reported at altitudes below 16,000 ft (4,878 m), unless the patient had been

previously exposed to hyperbaric conditions (SCUBA). There are some underdocumented reports at lower altitudes. A suspected case of bends appearing at 14,000 ft (4,268 m) in a young student Naval aviator is reported. The patient's only predisposing factors were an old athletic injury repaired with a permanently retained screw (foreign body) and a regular exercise program. A short discussion of bends is included. Author

A90-13745**GALACTIC COSMIC RADIATION EXPOSURE AND ASSOCIATED HEALTH RISKS FOR AIR CARRIER CREWMEMBERS**

W. FRIEDBERG, D. N. FAULKNER, L. SNYDER (FAA, Civil Aeromedical Institute, Oklahoma City, OK), E. B. DARDEN, JR. (Oak Ridge Associated Universities, TN), and K. O'BRIEN (Northern Arizona University, Flagstaff, AZ) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1104-1108. refs

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The dose equivalent to air carrier crewmembers from Galactic cosmic radiation was estimated for each of 32 nonstop flights on a variety of routes to and from, or within, the contiguous United States. Flying times were from 0.4 to 13 hours. The annual dose equivalents received on the flights ranged from 0.2 to 9.1 mSv (20 to 910 mrem), or 0.4 to 18 percent of the recommended annual limit for occupational exposure of an adult. Some of the characteristics of Galactic and solar cosmic radiation are reviewed, and example calculations for estimating radiation-induced risks of fatal cancer, genetic defects, and harm to an embryo or fetus are provided. The estimated increased risk of dying from cancer because of Galactic radiation exposure received during 20 years of flying ranged from 0.1 to 5 in 1,000. For the adult U.S. population the risk of dying from cancer is about 220 to 1,000. Author

A90-13746**OCCUPATIONAL INJURIES SUFFERED BY FLIGHT ATTENDANTS WHILE ON BOARD**

R. IGLESIAS, G. GONZALEZ, and S. T. MORALES (Mexicana Airlines, Mexico City, Mexico) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1109-1111.

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Inflight occupational injuries suffered by flight attendants are an important cause of medical disabilities. Mexicana Airlines has made an evaluation of this problem from 1983 to 1987. The injuries most frequently observed were contusions, skin cuts, sprains, fractures, spine disorders, and severe barotitis. The anatomic regions commonly affected were the hands, feet, and spine. These injuries are responsible for 15,573 work days lost for the average of 1631 flight attendants. This study identified some unsafe actions and conditions in the flight attendants' working environment. The company has initiated an extensive training program to avoid unsafe actions and to eliminate certain unsafe conditions where possible. Author

A90-14425**THE EFFECT OF OCCUPATIONAL WORK LOAD ON THE FUNCTIONAL STATE OF NAVAL-AVIATION FLIGHT PERSONNEL [VLIANIE PROFESSIONAL'NOI NAGRUKKI NA FUNKSIONAL'NOE SOSTOIANIE LETNOGO SOSTAVA KORABEL'NOI AVIATSII]**

S. G. MEL'NIK, A. V. SHAKULA, and F. D. GLADKIKH Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), July 1989, p. 54-57. In Russian.

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Results are presented on several series of tests conducted on naval-helicopter pilots and navigators attached to long-term missions to determine the relationship between flight-connected work loads and the functional state of their cardiovascular and respiratory systems, as well as the reserve facilities of the organism. It was found that, at low latitudes, a 3-hr-long flight led to significant increases in the respiration frequency, a decrease in the breathing reserve of the subjects, and increases in arterial pressure and heart rate. These shifts failed to normalize after 58 hrs of rest

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(which was longer than the time allowed between two flight missions). At high latitudes, changes in these physiological parameters were more moderate and were found to return to normal levels after only 16 hours of rest, indicating that the long-lasting physiological shifts observed at low latitudes were caused by exposures to high temperatures during flight. I.S.

A90-15060

EXPERIMENT ON 'DISCOVERY' STS 51-C - AGGREGATION OF RED CELLS AND THROMBOCYTES IN HEART DISEASE, HYPERLIPIDAEMIA AND OTHER CONDITIONS

L. DINTENFASS (Sydney, University; Rachel Forster Hospital, Redfern, Australia) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 65-69. Research supported by Qantas Airways, Ltd., Rebecca Cooper Medical Research Foundation and CSIRO. refs

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The aggregation of red cells in the blood of patients with ischaemic heart disease, diabetes, hyperlipidemia, and cancer, and in two normal donors has been investigated. Reconstituted blood with IgC was also used. A 100-kg automated slit-capillary photoviscometer was set on the middeck of the Space Shuttle, while an analogous instrument was at the Kennedy Space Center. Anticoagulated blood obtained from donors was adjusted to haematocrit of 30 percent using native blood plasma. Blood was forced to flow in the slit formed by two parallel glass plates during the experiment performed at 25 C. Intermittent macrophotography and microphotography of red cell aggregates formed during stasis lasting 6 minutes were carried out. Results indicated that red cell aggregates do form at zero g, that they are smaller than the ones obtained at 1 g, and that their morphology is different. C.E.

A90-15078

INFLUENCE OF GRAVITOINERTIAL FORCE ON VESTIBULAR NYSTAGMUS IN MAN OBSERVED IN A CENTRIFUGE

J. T. MARCUS, W. BLES (TNO, Instituut voor Zintuigfysiologie, Soesterberg, Netherlands), and C. R. VAN HOLTEN (Royal Netherlands Air Force, Aviation Medicine Div., Soesterberg, Netherlands) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 213-222. refs

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The influence of gravity load on the vestibular system in man was investigated in a centrifuge operating on the free swing principle. The vertical vestibular nystagmus induced by acceleration to 3G was analyzed and compared with reference measurements during 1G. The data indicate that the effects of increased gravity load include a prolonged decay time constant of upbeat nystagmus and a subject-dependent persisting upbeat nystagmus. In an attempt to explain these findings, an extension of the velocity storage model is proposed, with gravity as a second stimulus function in addition to angular acceleration. Author

A90-15079

INFLUENCE OF PROPRIOCEPTIVE INFORMATION ON SPACE ORIENTATION ON THE GROUND AND IN ORBITAL WEIGHTLESSNESS

R. VON BAUMGARTEN, J. KASS, H. VOGEL, and J. WETZIG (Mainz, Universitaet, Federal Republic of Germany) (COSPAR, IAU, International Union of Physiological Sciences, and International Academy of Astronautics, Plenary Meeting and Workshops XVII and XVIII on Life Sciences and Space Research XXIII(5) - Gravitational Biology, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 11, 1989, p. 223-230. refs

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The effect of cervical position receptors on space orientation is studied. The relationship between otoliths and cervical position receptors is examined. Measurements of reflectory eye rotations after various stimulations for the D1 mission astronauts and for 19 subjects on the ground are analyzed. Subjective vertical and horizontal following stimulation are determined. The data reveal that stimulation of the neck receptors in weightlessness affects the perception of subjective vertical and horizontal and also has a slight influence on ocular torsion. I.F.

A90-15477

INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES COMMISSION ON GRAVITATIONAL PHYSIOLOGY, ANNUAL MEETING, 10TH, MONTREAL, CANADA, OCT. 9-14, 1988, PROCEEDINGS

ORR E. REYNOLDS, ED. (American Physiological Society, Bethesda, MD) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, 108 p. For individual items see A90-15478 to A90-15512.

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This volume discusses topics on gravitational physiology and its current concepts, recent space-flight results in gravitational physiology, and the effect of microgravity on the lung. Papers are presented on the NASA Ames Research Center's Life Sciences program, the possible mechanisms of changes in the kidney response to ADH under hypogravity, and the effect of microgravity on the reproductive function of male rats. Attention is also given to the effect of a transition from the supine to upright positions on the central hemodynamics in patients with a chest-pain syndrome, calcium homeostasis in prolonged hypokinesia, and microgravity-induced changes in human bone strength. Other papers are on immunocompetent cells producing humoral mediators of bone-tissue mineral metabolism during a space-flight simulation, temperature regulation in rats exposed to a 2-G field, central venous pressure in humans during short periods of weightlessness, and the significance of light and social cues in the maintenance of temporal organization in man. I.S.

A90-15480

INTERSEROSAL PRESSURES AND CIRCULATORY HOMEOSTASIS DURING CHANGES IN THE GRAVITATIONAL INERTIAL FORCE ENVIRONMENT

E. H. WOOD, J. BURSCH, and R. SEYFFER (Mayo Clinic, Rochester, MN; Kiel, Universitaet, Federal Republic of Germany) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-8 to S-11. Research supported by DARPA. refs

(Contract N66001-87-C-0079)

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This paper discusses the hydrostatic basis for the retinal and cerebral ischemic anoxia and the resulting losses of vision and the cognitive function occurring during sustained exposures to G acceleration. Data are presented showing that the increase of interserosal pressure gradients in response to the gravitational-inertial force environment provides homeostatic mechanisms for effective protection of cardiovascular, respiratory, and cognitive functions under the increased-G conditions. I.S.

A90-15481

RESPONSES TO CHANGED PERFUSION PRESSURE IN WORKING MUSCLES - FACTORS TO BE CONSIDERED IN EXERCISE TESTING IN SPACE FLIGHTS?

O. EIKEN (Karolinska Institutet, Stockholm, Sweden) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-12 to S-15. refs

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The effect of graded changes in the muscle-perfusion pressure on physiological responses of man to dynamic leg exercises was investigated. The muscle-perfusion pressure was reduced by

exposing working legs of human subjects (whose feet were strapped to the pedals of a cycle ergometer) to a supraatmospheric pressure of 50 mm Hg (leg positive pressure, LPP); the pressure was increased by exposing the legs to a subatmospheric pressure of -50 mm Hg (lower body negative pressure, LBNP). Results show that exercise-induced increases in the O₂ uptake and blood lactate concentration were both attenuated by LBNP and exaggerated by LPP. The changes in the blood lactate levels are attributed to the perfusion-pressure-dependent variation in the muscle blood flow, resulting in opposite changes in the share contributed by anaerobic metabolism to the energy release. I.S.

A90-15490**EFFECTS OF TRANSITION FROM SUPINE TO UPRIGHT POSITIONS ON CENTRAL HEMODYNAMICS IN PATIENTS WITH CHEST PAIN SYNDROME**

BERNARD J. RUBAL, DAVID S. GANTT, JULIO J. BIRD, and TED A. WILKENS (U.S. Army, Brooke Army Medical Center, Fort Sam Houston, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-33, S-34.

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The effect of a posture change from the supine to the upright positions on central hemodynamic of humans was investigated in nine male patients with chest pain syndrome (with four of the patients showing evidence of significant coronary artery disease). Simultaneous right atrial, right ventricular, and pulmonary artery pressures and/or left ventricular and aortic pressures were obtained using catheter-mounted multisensor micromanometers. Results are presented, demonstrating that an active transition from the supine to the upright position produces complex changes in the left and right heart pressures which may be attributed not only to hydrostatic changes but also to the transient effects of isometric and Valsalva strains. The morphology of the pressure waveforms exhibited significant differences between the supine and the upright positions. I.S.

A90-15492**CALCIUM HOMEOSTASIS IN PROLONGED HYPOKINESIA**

B. V. MORUKOV, O. I. ORLOV, and A. I. GRIGOR'EV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-37 to S-40. refs

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The effects of prolonged (120- and 182-day) head-down tilt on the calcium metabolism, its hormonal regulation, and renal calciuretic function of humans were investigated in 20 healthy subjects. It was found that the 182-day head-down tilt caused gradual increases in the blood contents of total and ionized calcium and parathyroid hormone, while the concentration of calcitonin increased only at an early stage of tilt and decreased thereafter. This resulted in a negative calcium balance, which was on the average 5.6 g per month. Measurements in biopsy samples from the iliac bone showed a calcium decrease and phosphorus increase. I.S.

A90-15493**MICROGRAVITY-INDUCED CHANGES IN HUMAN BONE STRENGTH**

G. P. STUPAKOV, V. S. KAZEIKIN, and B. V. MORUKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-41 to S-44. refs

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Variations in the spongy tissue strength of bones due to microgravity and countermeasures to prevent bone strength changes are studied. The mechanical properties of iliac bone samples from nine healthy males ranging from 27 to 42 years

after 370 days of bed rest are analyzed. In the first test group after 120 days of bed rest a decrease in rigidity and in deformation energy of 61.0 percent and 41.0 percent, respectively is noted. The use of countermeasures by this test group after 120 days of bed rest reveals a partial recovery of bone mechanical strength. The second test group, which employed countermeasures from day one, show a decrease in bone strength of 6.0 percent, an increase in rigidity of 12.0 percent, and deformation and energy of failure decreases of 24.0 and 12.0 percent, respectively. It is concluded that countermeasures may help to maintain spongy bone strength in simulated microgravity. I.F.

A90-15495 McGill Univ., Montreal (Quebec).**OTOLITH-SPINAL REFLEX TESTING ON SPACELAB-1 AND D-1**

D. G. D. WATT, L. M. TOMI, H. BETTER (McGill University, Montreal, Canada), and K. E. MONEY (DND, Defence and Civil Institute of Environmental Medicine, Downsview, Canada) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-49 to S-52. Research supported by the Medical Research Council of Canada, DND, and NASA. refs

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The responses of otolith organs to drop testing on land and in flight are studied using electromyographic (EMG) activity. It is observed that EMG response consists of two subcomponents. The two subcomponents can vary independently during prolonged exposure and the first subcomponent is not susceptible to voluntary control and the second subcomponent can be affected by mental set. The mean amplitudes of the first subcomponent of the EMG response to sudden falls in four Spacelab-1 crew members and five Spacelab D-1 crew members are analyzed during pre-, in-, and post-flight testing. It is observed that otolith-spinal reflex function varies during prolonged exposure to microgravity and the subject's preflight motor strategy affects the degree of variation. I.F.

A90-15496**IMMUNOCOMPETENT CELLS PRODUCING HUMORAL MEDIATORS OF BONE TISSUE MINERAL METABOLISM DURING SPACE FLIGHT SIMULATION**

A. T. LESNIAK, I. V. KONSTANTINOVA, N. V. BODZHNIKOV, and P. N. UCHAKIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-53 to S-56. refs

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The dynamics of production of humoral mediators activating resorption are studied. Sixty-one healthy males participated in the test; 15 were exposed to head down tilt (HDT) for 120 days, 10 subjects for 370 day, and 36 males performed routine daily activities. Data from fifteen patients with local osteoporosis are also examined. Supernatant resorbing activity in the leucocytes cultures of these subjects are analyzed. It is noted that the ability of mononuclears to produce mediators activating resorption increases with the duration of bed rest. I.F.

A90-15501* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

CHANGES OF MUSCLE FUNCTION AND SIZE WITH BEDREST

GARY A. DUDLEY (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL), PHILIP D. GOLLNICK (Washington State University, Pullman), VICTOR A. CONVERTINO, and PAUL BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist*, Supplement (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-65, S-66. refs

Copyright

The impact of a short-term head-down bedrest on the skeletal-muscle function of humans was investigated in healthy

males subjected (after five days of control period) to 30-day 6-deg head-down bed rest (BR) followed by a five-day recovery period. It was found that the head-down BR led to a decrease in force developed by the knee extensor muscle group during maximal voluntary efforts, with the average reduction of 21 percent across the speeds of concentric and eccentric muscle action. Significant decreases were also found in the cross-sectional areas of slow-twitch and fast-twitch muscle fibers of the vastus lateralis.

I.S.

A90-15502* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

CAROTID BAROREFLEX RESPONSE FOLLOWING 30 DAYS EXPOSURE TO SIMULATED MICROGRAVITY

V. A. CONVERTINO, D. F. DOERR, D. L. ECKBERG, J. M. FRITSCH, and J. VERNIKOS-DANELIS (NASA, Kennedy Space Center, Cocoa Beach, FL; NASA, Ames Research Center, Moffett Field, CA; Virginia, Medical College, Richmond) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-67, S-68.

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The mechanism of the carotid-baroreflex response to weightlessness was investigated in human subjects exposed to simulated microgravity (30 days of 6-day head-down bed rest followed by 5 days of recovery). Baroreceptor-cardiac reflex responses were elicited by a complex sequence of pressure changes delivered to a neck chamber device. The shape of the sigmoid baroreceptor-cardiac response curve was examined for alterations and the occurrence of resetting, as well as for a possible association of the impaired baroreflex function with hypotension during the postexposure orthostatic stress. It was found that the exposure to head-down bed rest caused a significant shift on the R-R interval axis, which paralleled reductions and elevations in baseline HR such that the baseline R-R (operational point) remained in the same position on the response curve. This shift in the location of the reflex relation indicates a significant resetting of the carotid baroreceptors, which may represent an appropriate adaptation which contributes to the maintenance of a constant resting arterial blood pressure before, during, and after bed rest, observed in these study.

I.S.

A90-15503

PLASMA ANF CONCENTRATIONS DURING HEAD-DOWN BED REST OF VARIOUS DURATION (FROM SEVERAL HOURS TO ONE MONTH) - ROLE OF LBNP COUNTERMEASURE

C. GHARIB, G. GAUQUELIN, G. GEELEN (Lyon I, Universite, France), PH. ARBEILLE, F. PAPAT (Tours, Universite, France) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-69 to S-72. Research supported by CNES and Foundation pour la Recherche Medicale. refs

(Contract DRET-87-056)

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The effects of short-term and long-term head-down bed rest (HDBR) on the blood content of atrial natriuretic factor (ANF) were investigated, along with the effect on the ANF secretion of LBNP, used as a countermeasure to prevent orthostatic intolerance. Results showed that the secretion of ANF into blood had a trend to decrease in response to the HDBR, probably in response to sodium loss; the use of LBNP led to an initial increase of the ANF secretion, followed by a gradual decrease.

I.S.

A90-15504

CENTRAL VENOUS PRESSURE IN HUMANS DURING SHORT PERIODS OF WEIGHTLESSNESS

PETER NORSK, NIELS FOLDAGER, FLEMMING BONDE-PETERSEN, BENNY ELMANN-LARSEN, and STAEHR TORBEN JOHANSEN (Rigshospitalet, Copenhagen; Royal Danish Air Force, Vaerlose, Denmark) (International Union of Physiological

Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-73 to S-76. Sponsorship: Danish Space Board. refs

(Contract DSB-1112-33/85)

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The effect of short-period exposures to weightlessness (parabolic maneuvers) on central venous pressure (CVP) was investigated in human subjects fitted with catheters inserted through a cubital vein. It was found that an acute onset of weightlessness in upright seated humans during parabolic flights led to significant increases in CVP, compared with both the supine and upright sitting positions at 1 G before the maneuver. These results indicate that CVP may elevate during the initial period of weightlessness in orbital flights.

I.S.

A90-15505

CARDIORESPIRATORY RESPONSES TO SIMULATED WEIGHTLESSNESS IN MAN

V. P. KATUNTSEV, V. E. KATKOV, V. M. BARANOV, and A. M. GENIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-77 to S-81. refs

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The effects of 7-day simulated weightlessness ('dry immersion' as described by Shulzhenko and Vil-Vilyams, 1976) on the cardiorespiratory parameters and the concentrations of gases and oxygen saturation of arterial blood were investigated in healthy human subjects. Results showed that, during the first 7 hrs of immersion, the major parameters of central circulation were consistently high. On day 2, the values for the central venous pressure, mean pulmonary pressure, heart rate, and cardiac indices decreased by 64.1, 37.3, 13.9, and 15.9 percent, respectively. These cardiorespiratory responses seem to be typical of the early stages of adaptation to fluid shifts in the cranial direction which occur in space flights.

I.S.

A90-15506

GRAVITATIONAL INFLUENCE ON SYSTEMIC ARTERIAL DYNAMICS USING A 3-ELEMENT WINDKESSEL MODEL

RICKY D. LATHAM, BERNARD J. RUBAL, and ROBERT S. SCHWARTZ (U.S. Army, Brooke Army Medical Center, Fort Sam Houston, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-82, S-83.

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The effects of 70-deg upright tilt on the systemic compliance (C), characteristic aortic input impedance (Zc), and peripheral resistance (R) is investigated experimentally in six sedated baboons equipped with catheter micromanometers and flowmeters. Details of the data acquisition and analysis (using a three-element Windkessel computer model) are discussed, and the results are presented in tables and graphs. Passive upright tilt is found to affect Zc and R more significantly than C; the computer model provided a good fit to the experimental data.

T.K.

A90-15507

REGIONAL AORTIC PRESSURE APPARENT PHASE VELOCITY IN THE BABOON DURING 70 DEGREE TILT

BARCLAY P. BUTLER, BERNARD J. RUBAL, RICKY D. LATHAM, and ROBERT S. SCHWARTZ (U.S. Army, Brooke Army Medical Center, Fort Sam Houston, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-84, S-85.

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The effects of 70-deg upright tilt on the regional vascular properties of the aorta are investigated experimentally in eight lightly anesthetized mature baboons equipped with

micromanometer catheters. Apparent phase velocity (APV) is determined by taking discrete Fourier transforms of pressure pulses measured simultaneously by separate micromanometers. The data are presented in tables and graphs and briefly characterized. No significant difference is found between supine and upright regional APV, although the most distal APV in the upright position is significantly greater than the proximal APV (p less than 0.05).

T.K.

A90-15508
HEMODYNAMICS OF LEG VEINS DURING A 30 DAYS BED REST - EFFECT OF LOWER BODY NEGATIVE PRESSURE (LBNP)

FRANCIS LOUISY and C. Y. GUEZENNEC (Centre d'Etudes et de Recherches en Medecine Aerospatiale, Paris, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-86, S-87.

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The effects of LBNP on the cardiovascular response to 30-day bed rest with -6-deg head-down tilt are investigated experimentally in six subjects. LBNP is administered to three subjects for 3 x 20 min during weeks 1-3, 4 x 20 min during days 1-4 of the fourth week, and 6 x 20 min during the last days of bed rest. Leg venous compliance measurements are obtained by strain-gage plethysmography before, during and after the bed-rest period; the results are presented in graphs and briefly discussed. The usefulness of -6-deg head-down bed rest as a model for simulating exposure to microgravity and the efficacy of LBNP in counteracting the adverse effects of microgravity on capacitance vessels are demonstrated.

T.K.

A90-15509
DIFFERENCE IN CARDIOVASCULAR RESPONSES TO BLOOD POOLING PATTERNS BETWEEN LBNP AND HEAD UP TILTING STIMULATED AFTER SUPINE CYCLING IN WOMEN

S. TORIKOSHI, K. YOKOZAWA (Tokyo Women's Christian University, Japan), J. NAGANO (Bunka Women's University, Japan), and Y. SUZUKI (Tokyo, University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-88, S-89.

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The effects of 40-deg head-up tilt (HUT) or LBNP on cardiovascular response after 20 min of mild supine cycle exercise are investigated experimentally in five female subjects. VO_2 , heart rate, arterial blood pressure, cardiac output, forearm blood flow, and leg volume are measured before, during, and after exercise, and the results are presented in graphs. It is found that the increase in leg volume (Δ LV) induced by HUT is greater than that induced by LBNP, and that Δ LV is significantly correlated to stroke volume, cardiac output, and total peripheral resistance. It is inferred that decreased venous return triggers the sympathetic nervous system to maintain arterial pressure.

T.K.

A90-15510
INCREASING CENTRAL BLOOD VOLUME WITH HEAD-DOWN TILTING WOULD INHIBIT WATER INTAKE DURING MILD PEDALING AT 25 C AND 35 C ROOM TEMPERATURES IN WOMAN

KIKUKO YOKOZAWA, SHIGEYO TORIKOSHI, JUNKO NAGANO (Tokyo Women's Christian University, Japan), and YOJI SUZUKI (Tokyo, University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-90, S-91.

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The effects of ambient temperature (25 or 35 C) on water intake (WI) and cardiovascular parameters during 1 h of 300-kpm/min exercise in 10-deg head-up or head-down tilt (HUT or HDT) are investigated experimentally in five female subjects.

The measurement techniques and experimental protocols are outlined, and selected results are presented in graphs. In HUT, WI after 50 min of exercise is significantly greater at 35 C than at 25 C; in HDT, on the other hand, there is no significant difference in WI at the two temperatures. WI is significantly correlated with stroke volume, indicating that an increase in central blood volume may inhibit WI.

T.K.

A90-15511
PILOT PERFORMANCE IS INCREASED AFTER ALTERNATING HYPO- AND HYPERGRAVITY STATES

J. SYKORA, I. SOLCOVA, O. PELCAK, and J. DVORAK (Ceskoslovenska Akademie Ved, Fyziologicky Ustav, Prague, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-92, S-93.

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The effects of repeated short exposures to weightlessness (in a transport aircraft performing Keplerian trajectories) on the performance of experienced pilots in aerobatic test maneuvers are investigated experimentally. Pilots perform the test maneuvers before and after either a rest period (controls) or exposure to alternating weightlessness and hypergravity (experimental group); performance data are presented in tables and briefly characterized. Performance on the second trial is found to be better than on the first in both the experimental and control groups; i.e., exposure to this type of weightlessness has no measurable adverse effects.

T.K.

A90-15512* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SIGNIFICANCE OF LIGHT AND SOCIAL CUES IN THE MAINTENANCE OF TEMPORAL ORGANIZATION IN MAN

C. M. WINGET, C. W. DEROSHIA (NASA, Ames Research Center, Moffett Field, CA), K. H. OGAWA, and D. C. HOLLEY (San Jose State University, CA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 10th, Montreal, Canada, Oct. 9-14, 1988) *Physiologist, Supplement* (ISSN 0031-9376), vol. 32, Feb. 1989, p. S-94, S-95. refs

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The effects of light:darkness (LD) cycles and social interaction on the response to long-term confinement (105 days) were investigated experimentally in three groups of three male subjects aged 20-24 years. Data from measurements of physiological parameters indicating changes in circadian rhythms are presented in graphs and analyzed; it is found that the LD-induced rhythm changes observed in previous studies of subjects isolated singly do not appear when subjects are confined in groups of three, suggesting a positive adaptive effect of social contact. In one subject who was transferred to a different group at day 84, hostile social interactions and poor circadian-rhythm entrainment were observed; the possible reasons for this response are considered.

T.K.

A90-16299
LIFE BEYOND GRAVITY

JAN ZIEGLER *Air and Space* (ISSN 0886-2257), vol. 4, Dec. 1989-Jan. 1990, p. 81-87.

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In anticipation of prospective Mars manned mission crews' need to maintain their physical health during several months of weightlessness, aerospace physicians have become concerned with the effect of microgravity conditions on bone and muscle tissues. Bones tend to become thinner and more porous; muscles slacken and atrophy to the point where full recovery of strength may take several months of postmission conditioning on earth. The first phase of a NASA research program will investigate the ability of crewmembers' inner ears to tolerate rotation in microgravity. A second phase will attempt to determine whether artificial gravity must be applied continuously or will suffice when used intermittently.

O.C.

A90-16535

EXERCISE STRATEGIES AND ASSESSMENT OF CARDIORESPIRATORY FITNESS IN SPACE

GEORGE D. SWANSON (Colorado, University, Denver) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 141-149. Research supported by the University of Colorado. refs
(AAS PAPER 87-236) Copyright

Assessing cardiorespiratory fitness in space will involve the use of specific exercise strategies as test work rate inputs. The purpose of this paper is to consider exercise test strategies and breath-by-breath gas exchange concepts for utilizing oxygen consumption time series in the assessment of cardiorespiratory fitness. A modeling approach is emphasized. Author

A90-16536

WORK ON HUMAN ADAPTATION TO LONG-TERM SPACE FLIGHT IN THE UK

P. A. HANSSON (Commercial Space Technologies, Ltd., London; Institute for Space Biomedicine, Sheffield, England) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 151-160. refs
(AAS PAPER 87-237) Copyright

Several studies on human adaptation to long-term space flight have been performed in the UK. All these studies aimed at servicing of polar platforms, space industrialization in polar orbit or GEO, interplanetary manned flights to Mars and beyond, and testing for man presence in GEO. The basic lines of investigation included: a biomedical research program using animals; a human health maintenance program based on experience in health care in the offshore oil industry, in Antarctica etc.; and a biophysics program based on free radical and HZE particle studies. C.E.

A90-16537

ASTRONAUT INTERDISCIPLINARY AND MEDICAL/DENTAL TRAINING FOR MANNED MARS MISSIONS

HAROLD E. FILBERT (Martin Marietta Corp., Denver, CO) and DONALD J. KLEIER (Colorado, University, Denver) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 161-170.
(AAS PAPER 87-238) Copyright

This paper presents a general discussion of the medical and dental needs of astronauts on a manned Mars mission and a study of tradeoffs in meeting those needs. The discussion is based on the concept of interdisciplinary astronaut training/skills for prolonged manned space missions. The authors focus on the advantages of at least two years of intensive training in general medical practice and dentistry, with emphasis on space medicine and remote practice skills for all astronauts assigned to the mission. Existing, federally-funded training programs and facilities to accomplish the task are cited. Author

A90-16538

AUTOMATION OF FITNESS MANAGEMENT FOR EXTENDED SPACE MISSIONS

TED D. WADE, PHILIP G. SMALDONE, and RICHARD G. MAY (Colorado, University, Denver) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 171-188. Research supported by the University of Colorado. refs

(AAS PAPER 87-239) Copyright

A design and rationale are proposed for a system to automate the management of counter-measures to effects of space on human fitness, incorporating modeling and feedback of goals and performance to refine a person's program of counter measures. Although essential biomedical knowledge is not yet available, the system could help generate that knowledge, and several problems in its development do not require the knowledge. As it developed, the system would be useful on earth and in space at steps along the way to a Mars mission. On interplanetary journeys, a nearly autonomous system could be essential. Author

A90-16625* National Aeronautics and Space Administration, Washington, DC.

SPACE PHYSIOLOGY AND MEDICINE (2ND EDITION)

ARNAULD E. NICOGLOSSIAN, ED. (NASA, Washington, DC), CAROLYN LEACH HUNTOON, ED., and SAM L. POOL, ED. (NASA, Johnson Space Center, Houston, TX) Philadelphia, PA, Lea and Febiger, 1989, 414 p. No individual items are abstracted in this volume.

Copyright

The fundamental biomedical issues involved in manned space flight are examined in review chapters contributed by leading U.S. experts. Sections are devoted to the history of manned space flight, the space environment, space-flight systems and procedures, physiological adaptation to space flight, health maintenance of space crewmembers, and medical problems of space flight. Extensive diagrams, drawings, graphs, photographs, and tables of numerical data are provided. T.K.

N90-12160# New York Univ., New York. Dept. of Psychology.

VISUAL MOTION PERCEPTION Interim Report, 1 Feb. 1988 - 31 Jan. 1989

GEORGE SPERLING 31 Jan. 1989 7 p
(Contract AF-AFOSR-0140-88; AF PROJ. 2313)
(AD-A210994; AFOSR-89-1021TR) Avail: NTIS HC A02/MF A01 CSDL 06/4

Two separate motion-computation systems and the derivation of the functional properties of each were explored. A dynamic stimulus was demonstrated that caused the first- and second-order motion perception systems to perceive motion in opposite directions, depending on viewing distance. Motion/texture interactions-stimuli were discovered that are accessible only to second order motion analysis and then only after their texture has first been extracted. It was also demonstrated that perceiving 3D structure from 2D visual inputs depends primarily on the first-order motion perception system. A new spatial interaction was also found in which a textured area surrounded by a similar high-contrast texture appears to be of lower contrast when surrounded by neutral gray. This remarkable phenomenon contradicts all current theories of lightness perception. GRA

N90-12161# Naval Health Research Center, San Diego, CA. Applied Physiology Dept.

DEMONSTRATION OF REPLICABLE DIMENSIONS OF HEALTH BEHAVIORS Interim Report

ROSS R. VICKERS, JR., TERRY L. CONWAY, and LINDA K. HERVIG 6 Oct. 1988 24 p
(AD-A211920; NHRC-88-41) Avail: NTIS HC A03/MF A01 CSDL 06/5

Appropriate health behaviors are necessary to ensure health and well-being, thereby keeping military personnel ready to perform their jobs which may demand exceptional efforts at key times. An understanding of factors influencing health behaviors would be more readily achieved if general dimensions could be identified to delineate sets of health behaviors that consistently co-occur. Prior research has suffered from the use of only brief lists of health behaviors, failure to systematically select health behaviors to represent hypothesized health behavior dimensions, and failure to replicate findings across samples. The present study was designed to extend prior efforts by determining the number of dimensions of health behavior that could be reliably identified in two samples of Navy personnel. A set of 40 health behavior items was chosen to represent four major dimensions of health behavior that prior work suggested were present in groups representing a wide range of social and demographic backgrounds. GRA

N90-12162# Illinois Inst. of Tech., Chicago.

COMPUTER GENERATION OF A TUTORIAL DIALOGUE Quarterly Progress Report, 1 Jun. - 31 Aug. 1989

MARTHA EVENS, JOEL MICHAEL, and ALLEN ROVICK 31 Aug. 1989 7 p
(Contract N00014-89-J-1952)

(AD-A211976) Avail: NTIS HC A02/MF A01 CSDL 12/5

The main focus was on the taping of human-to-human tutoring

sessions and the analysis of the transcripts of those sessions with regard to both language and content. The language analysis involves study of vocabulary, syntax, semantics, and discourse for use in the understanding of ill-formed input and the generation of responses. The analysis of content focuses on tutoring rules, modeling rules, and the underlying knowledge used by the tutor. The development of the lexical functional grammar rules and lexicon for the cardiovascular sublanguage, the development of a cardiovascular knowledge base for the tutoring system, a Prolog prototype for the tutor being built, and the initial plans for a tutoring system in Lisp to support the research in text generation are all being examined in detail. The context of the work is an attempt to build an intelligent version of a remarkably effective conventional tutoring program, CIRCSIM, designed and implemented in Basic. CIRCSIM is intended to tutor first year medical students in the complex negative feedback processes used by the human body to maintain blood pressure. GRA

N90-12163# Army Research Inst. of Environmental Medicine, Natick, MA.

THE EFFECT OF CAFFEINE ON ENDURANCE TIME TO EXHAUSTION AT HIGH ALTITUDE

CHARLES S. FULCO, PAUL B. ROCK, LAURIE A. TRAD, MADELINE S. ROSE, VINCENT A. FORTE, JR., PATRICIA M. YOUNG, and ALLEN CYMERMAN 27 Apr. 1989 43 p (AD-A212069) Avail: NTIS HC A03/MF A01 CSCL 06/15

Endurance time to exhaustion (ETX) is increased at high altitude (HA) but only after 2 weeks of continued exposure. The increase is thought to be related to a delayed depletion of muscle glycogen, secondary to HA-induced increases in the mobilization and utilization of free fatty acids (FFA). It was determined if caffeine (CAF), which stimulates FFA mobilization, could prolong ETX earlier in the HA exposure. Eight untrained men (17 to 24 yr) performed 2 ETX cycling bouts at 79 to 85 percent of their altitude-specific maximal oxygen consumption in each of 3 phases: at sea level (SL), after 1 h simulated exposure (acute), and after 2 weeks (chronic) at 4300 m. Subjects received either a CAF (4 mg/kg) or a placebo drink in a double-blind cross-over design 1 h prior to each ETX bout in each phase. Subjective ratings of perceived exertion (PE) and cardiac output (CO) were obtained during exercise. Daily caloric intake and composition were held constant. CAF did not alter ETX at SL but was increased by 54 percent (22.0 to 35.0 min, $p=.04$) and 24 percent (30.8 to 38.5 min, $p=0.11$) during acute and chronic HA exposure, respectively. The improvements in ETX were determined not to be associated with substrate mobilization and utilization, or to a reduction in PE. GRA

GRA

N90-12164# Army Research Inst. of Environmental Medicine, Natick, MA.

HEATSTROKE PATHOPHYSIOLOGY: THE ENERGY DEPLETION MODEL Report, May - Jun. 1989

ROGER W. HUBBARD 12 Jun. 1989 42 p (AD-A212156; USARIEM-M59-89) Avail: NTIS HC A03/MF A01 CSCL 06/10

This symposium focuses on exertional heatstroke, with emphasis on predisposing factors, clinical observations, diagnosis, treatment and recovery. The serious challenge to cardiovascular stability presented by exercise hyperthermia and some aspects of regulatory failure were reviewed in the introduction. The intent of this review, to describe how heat stress is translated into heat strain at the cellular level, is not to downplay the seriousness of the systemic condition. If we are successful, this may stimulate further interest on the impact of heat on the cell as a model for other factors which alter membrane integrity and permeability, lead to new experimental paradigms, and improve the diagnosis and treatment of other disorders such as toxic, hypovolemic or ischemic shock. This review may also stimulate interesting research regarding more subtle threats to homeostasis such as chronic exercise, hypohydration and thirst, ion imbalance, and sleep deprivation. We have discussed the relationship of this concept to carbohydrate metabolism, thirst, and the cellular aspects of heat

illness treatment. This article will attempt to integrate and extend some of those ideas. GRA

N90-12165# Army Research Inst. of Environmental Medicine, Natick, MA.

HUMAN BODY REGIONAL CONVECTIVE HEAT TRANSFER DETERMINATION USING SUBLIMATING NAPHTHALENE DISKS

STEPHEN KW. CHANG and RICHARD R. GONZALEZ Jul. 1989 22 p (Contract DA PROJ. 3E1-62787-A8-78) (AD-A212170; ARIEM-M66-89) Avail: NTIS HC A03/MF A01 CSCL 06/4

The regional convective heat transfer coefficients (hc) on the human body were determined using sublimating naphthalene disks. Circular naphthalene disks were affixed to various body segments of a stationary, life size manikin, under constant temperature and wind speed in an environmental chamber. The amount of naphthalene weight loss through sublimation was translated to hc using the Chilton-Colburn j-factor analogy between heat and mass transfer. The regional convective heat transfer coefficients can be determined by using strictly the heat-mass transfer analogy, excluding any supplementary technique of cylindrical body segment approximations or other shape extrapolations. The logarithmic mean density factor for naphthalene sublimating in air (PAM,n) was also determined. PAM,n for the naphthalene-air sublimation environment is only one third of the water vapor-air diffusion environment (PAM). PAM,n is an essential factor for extracting the correct hc value from the naphthalene mass transfer data. GRA

N90-12166# California Univ., Irvine. Center for the Neurobiology of Learning and Memory.

ADAPTIVE INFORMATION PROCESSING IN AUDITORY CORTEX Annual Report, 1 Jun. 1988 - 31 May 1989

NORMAN M. WEINBERGER 31 May 1989 51 p (Contract N00014-87-K-0433)

(AD-A211294) Avail: NTIS HC A04/MF A01 CSCL 06/4

The principles of biological intelligence are of central importance to the understanding of brain function and to the development of devices based on the extraordinary computing and information processing abilities of brains. Adaptive cognitive and behavioral performance must be based on principles of brain function that have been selected in evolution so that organisms can successfully cope with environmental demands. Although these principles are not yet known, they may be advantageously approached by analyzing how they modify information processing within the brain. Central to adaptive information processing as expressed in the mammalian brain, are the cerebral neocortex and associative learning. In both fields, new perspectives are emerging. In particular, information processing in sensory neocortex involves the operation of active learning processes which transform receptive fields. These and related findings provide a basis for understanding the functional role of sensory cortical physiological plasticity and for a bridge between physiological plasticity and adaptive information processing in the cerebral cortex. GRA

N90-12167# Army Aeromedical Research Lab., Fort Rucker, AL.

VISUAL ACUITY AND STEREOPSIS WITH NIGHT VISION GOGGLES Final Report

ROGER W. WILEY Jun. 1989 30 p (AD-A211552; USAARL-89-9) Avail: NTIS HC A03/MF A01 CSCL 17/5

Measurements of visual performance (stereopsis and visual resolution) were acquired to compare results achieved using unaided monocular and binocular viewing, monocular and binocular viewing with the AN/PVS-5A night vision goggles, and models A and B of the AN/PVS-7 binocular night vision goggles. All of the goggles were equipped with 2nd generation tubes. Using a modified Howard-Dolman apparatus to assess stereopsis, all of the goggle-assisted thresholds were very much larger than stereoscopic thresholds achieved with unaided binocular vision. Statistical analysis of the results indicated that stereopsis through

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night vision goggles, regardless of the model or viewing condition, is essentially eliminated and equivalent to the threshold obtained with unaided monocular viewing. In comparison, spatial resolution capability with all of the goggle systems is superior to performance with unaided vision. In agreement with previously published data, visual acuity with the goggles is approximately 20/50, but only for high contrast targets and simulated full moon ambient light levels. As light levels decrease to quarter moon conditions or target contrasts are reduced to more realistic values, visual spatial resolution with the goggles is much poorer. For infantry use, any differences in visual performance between monocular, biocular, and binocular designs probably are not operationally meaningful.

GRA

N90-12168# Central Inst. for the Deaf, Saint Louis, MO.
BINAURAL MASKING: AN ANALYSIS OF MODELS Final Technical Report, 15 Jul. 1986 - 14 Mar. 1989

ROBERT H. GILKEY 1 Aug. 1989 15 p
(Contract AF-AFOSR-0298-86; AF PROJ. 2313)
(AD-A211578; AFOSR-89-1164TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

The overall goal of this program of research is to specify the processes used by the auditory system to detect signals presented in noisy backgrounds. A wide variety of experimental approaches were used to examine these processes. The data suggest that subjects often detect the signal as a change in the spectral/temporal pattern of stimulus information. These results conflict with the classical models of simple auditory masking that suggest that subjects restrict their analysis to a narrow frequency band and a brief temporal window. Quantitative models of the process that compares information across spectral/temporal regions were developed, which combine excitatory and inhibitory components. While it has traditionally been assumed that quite different mechanisms govern monaural and binaural masking phenomena, very similar models were successfully applied to the two sets of data. Other significant results include a more complete description on internal noise processes, evidence that the external masker is not cancelled by the binaural processor, empirical and theoretical evaluations of the efficiency of psychophysical procedures, and hardware and software developments to aid psychoacoustic research. Overall, the work examined issues and models of contemporary interest and thus has implications for auditory theory in general and for the study of auditory pattern analysis and auditory masking in specific.

GRA

N90-12169# Retina Foundation, Boston, MA. Eye Research Inst.

EYE MOVEMENTS AND SPATIAL PATTERN VISION Final Report, 1 Mar. 1986 - 30 Apr. 1989

LAWRENCE E. AREND 15 Jul. 1989 12 p
(Contract AF-AFOSR-0128-86; AF PROJ. 2313)
(AD-A211650; AFOSR-89-1151TR) Avail: NTIS HC A03/MF A01 CSCL 06/4

Models of lightness and color perception must take account of human color constancy, a tendency for apparent surface color to be relatively independent of the color and intensity of the illuminating light source. Observers matched the lightness and brightnesses of regions in simple and complex achromatic spatial patterns. The data showed that the observers' knowledge of the surface reflectances (revealed by lightness matches) was unaffected by changing brightness of the same surfaces (revealed by brightness matches). In the analogous chromatic experiments, observers matched the hue and saturation of patches or the patches' apparent surface colors. The observers' knowledge of the surface colors was not as reliable as in the achromatic case. Patches' hues and saturations matched when their chromaticities were approximately the same. Shifts of hue attributable to simultaneous color contrast were in the correct direction but too small to produce hue constancy.

GRA

N90-12170# State Univ. of New York, Buffalo. Dept. of Psychology.

CELLULAR AND MOLECULAR MECHANISMS OF HIGH PRESSURE INTROPY IN CARDIAC MUSCLE Annual Report, 1 Aug. 1988 - 31 Jul. 1989

PERRY M. HOGAN and STEPHEN R. BESCH 1 Aug. 1989 20 p

(Contract N00014-88-K-0550; RR04108)
(AD-A211695) Avail: NTIS HC A03/MF A01 CSCL 06/10

Cardiac muscle subjected to increased hydrostatic pressure from 2 to 150 atmospheres respond with an increase in developed tension, a phenomenon we refer to as high pressure intropy (HPI). Experiments were performed on papillary muscles isolated from adolescent rabbit hearts to test the possibility that HPI is due to a preferential action of pressure to partially inhibit the activity of the sodium-potassium pump of the cell membrane leading to calcium accumulation through reduced sodium-calcium exchange. Ouabain, a cardiac glycoside known to inhibit pump activity, prevented the development of HPI when applied before pressure was increased. Both ouabain and pressure altered the time course of mechanical restitution and the development of the resting state contraction in a similar manner that could be mimicked by a computer model when the calcium extrusion ordinarily occurring during each cardiac cycle was substantially retarded. Finally, we reported on progress made to develop a microfluorimeter for measuring cytosolic calcium in single cardiac myocytes under hyperbaric conditions.

GRA

N90-12171# Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.

BASE LEVEL MANAGEMENT OF RADIO FREQUENCY RADIATION PROTECTION PROGRAM Final Report

STEVEN E. RADEMACHER and NOEL D. MONTGOMERY Apr. 1989 98 p

(AD-A211787; AFOEHL-89-023RC0111DRA) Avail: NTIS HC A05/MF A01 CSCL 06/7

AFOEHL developed this report to assist the base level aerospace medical team manage their radio frequency radiation protection program. This report supersedes USAFOEHL Report 80-42, A Practical R-F Guide for BEES.

GRA

N90-12172# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Flugmedizin.

STUDIES ON PREDICTING THE RESYNCHRONIZATION OF THE CIRCADIAN SYSTEM AFTER TRANSMEDIAN FLIGHTS

Ph.D. Thesis - Technische Hochschule, Aachen

MICHAEL RIPKENS Feb. 1989 122 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-1177)

(DFVLR-FB-89-10; ISSN-0171-1342; ETN-89-95307) Avail: NTIS HC A06/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Federal Republic of Germany, 40 deutsche marks

Resynchronization in the circadian rhythms of different body functions after timeshifts of 6 and 9 hours is studied. Three flight experiments involving eight subjects each were carried out to determine whether the speed of adaptation could be predicted from the individual rhythm parameters of preflight control days. Significant correlations were found only in a few single cases for some functions. Since, in addition, the consistency grade was too small, the hypothesis of a reliable predictiveness of the individual adaptation speed had to be refused. This statement should not be generalized, as the number of subjects was too small and the applied procedure did not permit more general conclusions.

ESA

N90-12173* National Aeronautics and Space Administration, Washington, DC.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 329)

Nov. 1989 66 p
(NASA-SP-7011(329); NAS 1.21:7011(329)) Avail: NTIS HC A04; NTIS standing order as PB89-912300, \$10.50 domestic, \$21.00 foreign CSCL 06/5

This bibliography lists 184 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during October 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N90-13013*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CARDIOVASCULAR, RENAL, ELECTROLYTE, AND HORMONAL CHANGES IN MAN DURING GRAVITATIONAL STRESS, WEIGHTLESSNESS, AND SIMULATED WEIGHTLESSNESS: LOWER BODY POSITIVE PRESSURE APPLIED BY THE ANTIGRAVITY SUIT Thesis - Oslo Univ.

STEIN E. KRAVIK Oct. 1989 142 p Sponsored in part by NAS-NRC, Washington, DC; Joint Medical Service, HQ Defense Command, Norway and the Norwegian Research Council for Science and the Humanities (NASA-TM-102232; A-89084; NAS 1.15:102232) Avail: NTIS HC A01/MF A01 CSCL 06/19

Because of their erect posture, humans are more vulnerable to gravitational changes than any other animal. During standing or walking man must constantly use his antigravity muscles and his two columns, his legs, to balance against the force of gravity. At the same time, blood is surging downward to the dependent portions of the body, draining blood away from the brain and heart, and requiring a series of complex cardiovascular adjustments to maintain the human in a bipedal position. It was not until 12 April 1961, when Yuri Gagarin became the first human being to orbit Earth, that we could confirm man's ability to maintain vital functions in space -- at least for 90 min. Nevertheless, man's adaptation to weightlessness entails the deconditioning of various organs in the body. Muscles atrophy, and calcium loss leads to loss of bone strength as the demands on the musculoskeletal system are almost nonexistent in weightlessness. Because of the lack of hydrostatic pressures in space, blood rushes to the upper portions of the body, initiating a complex series of cardioregulatory responses. Deconditioning during spaceflight, however, first becomes a potentially serious problem in humans returning to Earth, when the cardiovascular system, muscles and bones are suddenly exposed to the demanding counterforce of gravity -- weight. One of the main purposes of our studies was to test the feasibility of using Lower Body Positive Pressure, applied with an antigravity suit, as a new and alternative technique to bed rest and water immersion for studying cardioregulatory, renal, electrolyte, and hormonal changes in humans. The results suggest that Lower Body Positive Pressure can be used as an analog of microgravity-induced physiological responses in humans. Author

N90-13014# Army Research Inst. of Environmental Medicine, Natick, MA.

HEAT EXHAUSTION

LAWRENCE E. ARMSTRONG 30 Jun. 1989 4 p (AD-A212128; USARIEM-M61-89) Avail: NTIS HC A01/MF A01 CSCL 06/10

Heat exhaustion is the most common heat illness, among soldiers and athletes. This manuscript is written in an ask the expert format, per request of the journal editor, to describe heat exhaustion for the athletes and practitioner. This manuscript describes the signs/symptoms, physiological cause, treatment, and measures which can be taken to prevent heat exhaustion. GRA

N90-13015# Health Effects Research Lab., Research Triangle Park, NC. Neurotoxicology Div.

EFFECTS OF ATMOSPHERIC MIX AND TOXIC FUMES ON MILITARY PERFORMANCE

VERNON A. BENIGNUS 1989 85 p (PB89-223630; EPA/600/D-89/060) Avail: NTIS HC A05/MF A01 CSCL 06/16

The individual and combined neurobehavioral effects of carbon monoxide, hydrogen cyanide, carbon dioxide and hypoxic hypoxia were studied. The literature of the effects of combined exposures were covered. This is a relatively sparse literature. The empirical

and physiological information available was encoded as a series of dose-effects and pharmacokinetic equations. Assuming additive effects, a mathematical model was proposed for the combined exposure. Several pharmacokinetic interactions make the received dose of the combined pollutants nonadditive, however, and thus introduce nonadditivity into the combined model. The model was useful in pointing out the kind of information still needed to make predictions. The model thus serves a mainly heuristic purpose. GRA

N90-13016# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.

TIME-FREQUENCY FACTORS IN AUDITORY PERCEPTION

Annual Report, 15 Apr. 1988 - 14 Apr. 1989
GREGORY H. WAKEFIELD 30 Jun. 1989 13 p (Contract AF-AFOSR-0193-87; AF PROJ. 2313) (AD-A211491; AFOSR-89-1081TR) Avail: NTIS HC A02/MF A01 CSCL 06/4

This research investigates how the human auditory system processes temporal properties of a complex signal across two or more regions of the frequency spectrum. Much of the primary research from the original proposal on envelope phase disparity using AM carriers is complete. Several findings are outlined. A computer model has also been developed and analyzed to consider issues of cross-spectral temporal disparities. The model is based on localization by Colburn, among others. GRA

N90-13017# Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.

BASE LEVEL MANAGEMENT OF RADIO FREQUENCY RADIATION PROTECTION PROGRAM Final Report

STEVEN E. RADEMACHER and NOEL D. MONTGOMERY Apr. 1989 111 p (AD-A211759; USAFOEHL-89-023RC0111DRA) Avail: NTIS HC A06/MF A01 CSCL 25/2

Assistance is being developed for the base level aerospace medical team to manage their radio frequency radiation protection program. This report supersedes USAFOEHL Report 80-42, A practical R-F Guide for BEES. GRA

N90-13018# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Flugmedizin.

BIOCHEMICAL AND PHYSIOLOGICAL CHANGES IN GLIDER PILOTS DURING MULTIHOUR FLIGHTS Thesis - Bonn Univ.

KLAUS GERECHT Jun. 1989 118 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1183)

(DLR-FB-89-29; ISSN-0171-1342; ETN-89-95838) Avail: NTIS HC A06/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 40 Deutsche marks

Nine male glider pilots were studied during 12 multi-hour glider flights. Blood and urine samples were taken before, during and after each flight. The results revealed a high sympathetic, adrenomedullary and adrenocortical activity. Findings included a reduction in numbers of eosinophils, changes in blood lipid fractions due to induced lipolysis and an elevation of blood sugar concentrations during the flight, going back to normal shortly after landing. Excretion of adrenaline was highest during the preflight period showing a high level of anticipatory stress, followed by moderate reductions during the flight as opposed to increasing excretion rates of noradrenaline and 17-hydroxycorticosteroids. This pattern is related to increasing fatigue with length of flight. Subsequently loss of weight and elevated packed cell volumes were noted. Reduced serum potassium concentrations associated with more alkaline urine are sequels of hyperventilation, a common condition in pilots under flight stress. ESA

N90-13019# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Flugmedizin.

EFFECTS OF A TIME ZONE SHIFT OF NINE HOURS ON THE CIRCADIAN RHYTHMS IN COCKPIT AIRCREW MEMBERS ON LONGHAUL FLIGHTS Ph.D. Thesis - Tech. Hochschule Aachen

SILKE RUTH HASENCLEVER Jun. 1989 94 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1185)

(DLR-FB-89-31; ISSN-0171-1342; ETN-89-95840) Avail: NTIS HC A05/MF A01; DLR, VB-PL-DO, Postfach 40 60 58, 5000 Cologne, Fed. Republic of Germany, 32 Deutsche marks

Twelve aircrew members on a flight schedule crossing nine time zones are tested for heart rate, temperature, and excretion of certain hormone metabolites and electrolytes in the urine over a period of seven days. The data is analyzed regarding circadian rhythmicity. The results of this analysis are demonstrated and the possible effects of disturbing body rhythms of members of this profession are discussed. ESA

N90-13020# Army Research Inst. of Environmental Medicine, Natick, MA.

EXERTIONAL HEATSTROKE: AN INTERNATIONAL PERSPECTIVE. AN INTRODUCTION: THE ROLE OF EXERCISE IN THE ETIOLOGY OF EXERTIONAL HEATSTROKE Report, May - Jun. 1989

ROGER W. HUBBARD 12 Jun. 1989 17 p (AD-A212242; USARIEM-M60-8968) Avail: NTIS HC A03/MF A01 CSCL 06/10

Exertional heatstroke usually occurs among healthy, fit individuals who are motivated to perform strenuous exercise because of peer pressure, discipline, or athletic competition. In fact, exertional heatstroke deaths among high school athletes in the United States ranked only third to head and neck injuries and heart failures. The reluctance of race directors to cancel or postpone mass participation road races during periods of severe heat and humidity, emphasize a continuing need for widespread dissemination of information. The purposes of this symposium are to: (1) convey essential information to the members of ACSM who are involved in exercise prescription, patient care, or athletic training, and (2) to disseminate recent scientific theories and research concerning exertional heatstroke. GRA

N90-13021# Virginia Univ., Charlottesville. Dept. of Materials Science.

SHAPE INSTABILITIES OF PLATE-LIKE STRUCTURES. 1: EXPERIMENTAL OBSERVATIONS IN HEAVILY COLD WORKED IN SITU COMPOSITES

T. H. COURTNEY (Naval Research Lab., Washington, DC.), J. C. MALZAHN KAMPE, and Y. LENG 1989 12 p Submitted for publication

(Contract DAAL03-88-K-0091) (AD-A212251; ARO-25177.4-MS-1) Avail: NTIS HC A03/MF A01 CSCL 23/2

Because hearing protectors attenuate the noise and signal by equal amounts within a given frequency range, reducing both to a level where there is less likelihood of distortion, they often provide improved listening conditions. The crossover level from disadvantage to advantage usually occurs between 80 and 90 dB. However, hearing protectors may adversely affect speech recognition under a variety of conditions. For hearing-impaired listeners, whose average hearing levels at 2000, 3000, and 4000 Hz exceed 30 dB, certain speech sounds will fall below the level of audibility. Visual cues may decrease the disadvantage imposed by hearing protectors. However, the Occlusion Effect, which decreases vocal output when the talker wears protection, adversely affects the listener's speech recognition. The poorest performance occurs when both talkers and listeners wear protectors. Hearing protectors affect warning signal perception in a similar manner. Again the crossover level seems to be between 80 and 90 dB, and there is greater degradation for individuals with impaired hearing. Earmuffs appear to pose greater problems than plugs, and this is especially true of difficulties in signal localization. Earplugs produce mainly front-back localization errors, while earmuffs produce left-right localization errors as well. Earmuffs also drastically impede localization in the vertical plane. GRA

N90-13022# Arizona State Univ., Tempe. Coll. of Liberal Arts and Sciences.

PREDICTION OF THERMAL STRESS CASUALTIES Final Report, Mar. 1986 - Sep. 1988

GARY S. KRAHENBUHL, JOSEPH HARRIS, STEFAN H. CONSTABLE (School of Aerospace Medicine, Brooks AFB, TX.), DON W. MORGAN, and JEFFREY K. ALLEN May 1989 44 p (Contract F33615-83-D-0602; AF PROJ. 2729) (AD-A212356; USAFSAM-TR-88-23) Avail: NTIS HC A03/MF A01 CSCL 06/10

Young adult male subjects (n=15) were monitored under conditions featuring various combinations of three factors: work (rest or treadmill walking at 50 percent VO₂), clothing (USAF flight suit or USAF flight suit plus the MOPP-IV chemical defense ensemble (CDE)), and environment (in an air conditioned laboratory or outside in the desert summer). Biogenic amine and metabolite responses were determined from timed urine samples using the high performance liquid chromatography (HPLC) with electrochemical detection. The response profiles of subjects (n=9) able to persist in their exercise while wearing CDE outdoors in the heat were compared with those (n=6) unable to persist (those who voluntarily terminated exercise at 50 percent VO₂ max before they had worked for 30 min or reached a rectal temperature of 38.5 C (101.3 F)). The data supports the conclusion that subjects who persisted in their exercise did so because they pushed themselves harder. In doing so, they experienced a higher level of physiological stress as indicated by the alteration in the excretion rates of the biogenic amines and metabolites. GRA

N90-13023# Science Applications International Corp., McLean, VA.

CALCIUM DISPLACEMENT CAUSED BY ELECTROMAGNETIC FIELDS Final Report, 1 Nov. 1982 - 31 Aug. 1989

JAMES D. BOND and CAROL A. JORDAN 31 Aug. 1989 9 p (Contract N00014-83-C-0008; RR04108) (AD-A212690; SAIC-89/1587) Avail: NTIS HC A02/MF A01 CSCL 06/7

The research effort was to determine theoretically a physical basis for the interaction of low intensity externally applied electromagnetic fields with biological tissue. The primary aim of the investigation was to establish a molecular basis for the class of interactions commonly referred to as nonthermal effects of electromagnetic fields with biological systems. In particular, the biological structure of interest was the plasma membrane since it had been either directly or indirectly implicated in numerous experimental studies. It was demonstrated how a membrane undergoing a phase transition could qualitatively account for the release and/or uptake of divalent calcium ions. A characterization of changes in the structure of the membrane/electrolyte interface due to field induced changes in enzymatic activity was demonstrated. The role of critical phenomena was shown analytically to be able to account for the unique sensitivity of biomembranes to weak external field perturbations, and describe alterations in the passive transport of sodium ions in rabbit erythrocytes. GRA

N90-13024# Naval Medical Research Inst., Bethesda, MD.

RADIO FREQUENCY (13.56 MHZ) ENERGY ENHANCES REWARMING FROM MILD HYPOTHERMIA Interim Report

R. L. HESSLINK, R. G. OLSEN (Naval Aerospace Medical Research Lab., Pensacola, FL.), L. D. ALLEN, L. D. HOMER, S. B. LEWIS, and V. HARMON 9 May 1989 13 p (AD-A212703; NMRI-89-46) Avail: NTIS HC A03/MF A01 CSCL 06/5

The rate of warming after hypothermia depends on the method of rewarming. The effectiveness is compared of radio frequency (RF) energy against hot (41 C) water immersion (HW) and an insulated cocoon (IC) for rewarming hypothermic men. Six men fasted overnight and were rewarmed for one hour after attaining a 0.5 reduction in rectal temperature (Tre). Tre and esophageal temperature (Tes) were recorded every 5 minutes with non-metallic thermal probes. The baseline value for Tre and Tes just prior to rewarming was subtracted from each 5 minute Tre and Tes during

rewarming to delta Tre and delta Tes. The twelve delta Tes values were average for each individual and compared using ANOVA. The superiority of radio frequency energy for rewarming mildly hypothermic men is shown. GRA

N90-13025# Naval Medical Research Inst., Bethesda, MD.
**EFFECTS OF SERIAL WET-DRY-WET COLD EXPOSURE:
 THERMAL BALANCE, PHYSICAL ACTIVITY, AND COGNITIVE
 PERFORMANCE Final Report, Jan. - Mar. 1988**

T. J. DOUBT, R. P. WEINBERG, R. L. HESSLINK, and S. T. AHLERS Mar. 1989 52 p
 (AD-A212704; NMRI-89-35) Avail: NTIS HC A04/MF A01
 CSCL 06/10

Thermal balance, physical performance, and cognitive function were examined in 7 U.S. Navy divers who each performed two 7-hour cold exposures while wearing a TLS dry suit with M-400 Thinsulate insulation for thermal protection. The exposures consisted of 2.5 h immersed in 5 C water, followed by 2 h in 5 C air, and then reentering the water for another 2.5 h. This exposure paradigm was intended to simulate an operational mission involving a wet-dry-wet cold exposure. During each exposure, leg exercise at 50 W was performed for the last 30 min of the first immersion and the first 30 min of the second immersion. In the course of one cold exposure, the subject walked 90 min on a treadmill at 2 mph during the dry phase, while during the other exposure he remained seated at rest for the dry phase. Cognitive function, measured at rest during the midpoint of each dry phase, was assessed by a battery of 7 NMRI-PAB tests. GRA

N90-13026# National Academy of Sciences - National Research Council, Washington, DC. Committee on Hearing, Biocoustics and Biomechanics.

**SOUND LOCALIZATION BY HUMAN OBSERVERS
 SYMPOSIUM PROCEEDINGS Technical Report, 1 Oct. 1988 -
 30 Sep. 1989**

1 Jul. 1989 68 p Symposium held in Washington, DC, 14-16 Oct. 1988
 (Contract N00014-87-C-0342)

(AD-A212877) Avail: NTIS HC A04/MF A01 CSCL 06/4

The relation between binaural perception of actual sounds in space and of stimuli presented over headphones, base on head-related transfer functions, showed a high correlation. Listeners reported that the sound image presented over headphones remained internal to the head and not external in space, as with natural sound. Head movement, context, bias, experience, and integration of information across senses remain probable contributions to externalizing headphone-delivered sounds at their real-world positions. Sensory information provided by one sense modality may modulate that received by another modality via motor and/or efferent control. Interest was expressed in the possibility of constructing, and adapting to, super localization systems. The symposium focused on mammalian research but crucial insights were reported on other animal models. Thus there was demonstration that auditory space for the cat may be coded by spatial maps within the superior colliculus. Some human data were presented on the poorer accuracy of locating a source in the presence of multiple sources. Monaural localization, and the coding of sound movement were discussed. GRA

N90-13027# Naval Aerospace Medical Research Lab., Pensacola, FL.

**A SCHEINER-PRINCIPLE POCKET OPTOMETER FOR
 SELF-EVALUATION AND BIOFEEDBACK ACCOMMODATION
 TRAINING Interim Report, 1987 - 1988**

WILLIAM B. CUSHMAN 19 Apr. 1989 14 p
 (AD-A213171; NAMRL-1344) Avail: NTIS HC A03/MF A01
 CSCL 20/6

Most humans tend toward myopia when presented with a visual field without sufficient detail to stimulate focusing mechanisms. This means that a pilot flying in darkness, or in an empty field such as empty sky, will be likely to focus nearer the windscreen than at the optical infinity required to focus on visual targets of probable interest. Biofeedback training to counter this

problem is limited in practical application by expensive and cumbersome instrumentation. A Scheiner-principle optometer was developed for self-evaluation of accommodative state and biofeedback training. The specific advantages of the new invention over earlier optometers are: (1) simplicity of design; (2) hand held, portable implementation; (3) light weight; (4) small size; (5) low manufacturing cost; (6) the use of a monochromatic light source to eliminate the effects of chromatic aberrations in the subject's eye; and (6) effectiveness as a training aid. Four prototypes of the pocket optometer have built and were used to implement biofeedback training to correct night myopia in 12 Navy aviation candidates. All subjects were emmetropic in full light. Training was limited in duration due to the transient nature of subject availability but was reasonably successful in 10 out of the 12 cases. GRA

N90-13028# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

**THE EFFECT OF CONCURRENT STRENGTH AND
 ENDURANCE TRAINING ON ELECTROMECHANICAL DELAY,
 MAXIMUM VOLUNTARY CONTRACTION, AND RATE OF
 FORCE DEVELOPMENT**

D. G. BELL, I. JACOBS, D. G. SALE, and J. D. MACDOUGALL
 Aug. 1989 25 p
 (AD-A213316; DCIEM-88-RR-33) Avail: NTIS HC A03/MF A01
 CSCL 06/10

The effect of strength and endurance training and their combination on electromechanical delays (EMD), rate of force development (RFD) and maximum voluntary isometric contraction force (MVC) of the knee extensors in male and female subjects is compared. The seven male and six female subjects were separated into a strength trained group (SG), 3 males and 3 females, and an endurance group (EG), 4 males and 3 females. The SG performed strength training solely with one leg and combined strength and endurance training with the other leg. The EG performed endurance training solely in one leg and combined strength and endurance training in the other leg. Strength training consisted of one legged work on a leg press weight machine. Endurance training consisted of one legged cycling on a cycle ergometer. EMD values were derived from electromyographic activity (EMG) recorded from the vastus lateralis muscle during MVC. MVC forces was measured with a force transducer. Rate of force development (RFD) was determined from the MVC/time curves using computer software. The EMG, MVC/time curves and light signal data were simultaneously recorded on FM tape and later sampled at 2Khz and stored digitally. The results showed that EMD was significantly reduced only in the SG females. Post training data showed that the EMD values for the SG females had increased and were not different from initial levels. EMD times for the males were significantly shorter than the females. GRA

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BEHAVIORAL SCIENCES

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

A90-13308*# Booz-Allen and Hamilton, Inc., Reston, VA.

SPACE STATION FREEDOM CREW TRAINING
 KAROL J. BOBKO, EDWARD G. GIBSON, SUSAN A. MARONEY,
 and JAMES D. MUCCIO (Booz-Allen and Hamilton, Inc., Reston,
 VA) IAF, International Astronautical Congress, 40th, Malaga,
 Spain, Oct. 7-13, 1989. 7 p.
 (Contract NASW-4300)

(IAF PAPER 89-098) Copyright

The nature of the Space Station Freedom Program presents an array of new and enhanced challenges which need to be addressed en route to developing an effective and affordable infrastructure for crew training. Such an infrastructure is essential

for the safety and success of the program. The three major challenges that affect crew training are the long lifetime of the program (thirty years), the interdependence of successive increments, and the participation of the three International Partners (Canada, European Space Agency, and Japan) and a myriad of experimenters. This paper addresses these major challenges as they drive the development of a crew training capability and the actual conduct of crew training. Author

A90-13743

THE OCCURRENCE OF THE VECTION ILLUSION AMONG HELICOPTER PILOTS WHILE FLYING OVER WATER

TIMOTHY J. UNGS (USCG, Kodiak, AK; Wright State University, Dayton, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1099-1101. refs
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U.S. Coast Guard helicopter pilots were questioned on the occurrence of the vection illusion while flying over water under different light and sea conditions. A total of 267 (79.9 percent) pilots completed the study questionnaire. The illusion of vection was experienced by 248 (92.5 percent) of these pilots. The majority of the pilots, 209 (84.6 percent), reported that dark rather than light visual conditions increased the likelihood of experiencing vection. Vection was considered likely to occur over rough seas by more pilots, 114 (46.2 percent) than over smooth seas, 81 (37.8 percent). Several pilots commented that they had responded to the illusion with aircraft movement. Author

A90-13747

THE SPOUSAL FACTOR IN PILOT STRESS

MARVIN KARLINS (South Florida University, Tampa, FL), FREDDIE KOH, and LEN MCCULLY (Singapore Airlines, Airmail Transit Centre, Singapore) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1112-1115. refs

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This paper discusses the various occupational and nonoccupational stresses faced by commercial aviators, with particular emphasis on the role of the pilot's spouse in the stress management equation. Using findings from scientific studies, it is suggested that the spouse can be a major social support system for the aviator and a significant factor in the pilot's ability to deal effectively with psychosocial stress. It is recommended that airlines develop programs that honor (recognize) the spouses for their contribution to safe aircraft operation (by helping the aviator cope with stress more effectively) and make both husband and wife more aware of the special needs, concerns, and challenges that each partner faces in an 'airline marriage'. Author

N90-12174*# Essex Corp., Orlando, FL.

MICROCOMPUTER-BASED TESTS FOR REPEATED-MEASURES: METRIC PROPERTIES AND PREDICTIVE VALIDITIES

ROBERT S. KENNEDY, DENNIS R. BALTZLEY, WILLIAM P. DUNLAP, ROBERT L. WILKES, and LOIS-ANN KUNTZ 1 May 1989 34 p

(Contract NAS9-17326; NSF ISI-85-21282; DAMD17-85-C-5095) (NASA-CR-185517; NAS 1.26:185517; EOTR-89-02) Avail: NTIS HC A03/MF A01 CSCL 05/9

A menu of psychomotor and mental acuity tests were refined. Field applications of such a battery are, for example, a study of the effects of toxic agents or exotic environments on performance readiness, or the determination of fitness for duty. The key requirement of these tasks is that they be suitable for repeated-measures applications, and so questions of stability and reliability are a continuing, central focus of this work. After the initial (practice) session, seven replications of 14 micro-computer-based performance tests (32 measures) were completed by 37 subjects. Each test in the battery had previously been shown to stabilize in less than five 90-second administrations and to possess retest reliabilities greater than $r = 0.707$ for three minutes of testing. However, all the tests had never been administered together as a battery and they had never been

self-administered. In order to provide predictive validity for intelligence measurement, the Wechsler Adult Intelligence Scale-Revised and the Wonderlic Personnel Test were obtained on the same subjects. Author

N90-12175*# Essex Corp., Orlando, FL.

A MENU OF SELF-ADMINISTERED MICROCOMPUTER-BASED NEUROTOXICOLOGY TESTS

ROBERT S. KENNEDY, ROBERT L. WILKES, LOIS-ANN KUNTZ, and DENNIS R. BALTZLEY Nov. 1988 25 p

(Contract NAS9-17326)

(NASA-CR-185518; NAS 1.26:185518; EOTR-88-10) Avail: NTIS HC A03/MF A01 CSCL 05/9

This study examined the feasibility of repeated self-administration of a newly developed battery of mental acuity tests. Researchers developed this battery to be used to screen the fitness for duty of persons in at-risk occupations (astronauts, race car drivers), or those who may be exposed to environmental stress, toxic agents, or disease. The menu under study contained cognitive and motor tests implemented on a portable microcomputer including: a five-test core battery, lasting six minutes, which had demonstrable reliabilities and stability from several previous repeated-measures studies, and also 13 new tests, lasting 42 minutes, which had appeared in other batteries but had not yet been evaluated for repeated-measures implementation in this medium. Sixteen subjects self-administered the battery over 10 repeated sessions. The hardware performed well throughout the study and the tests appeared to be easily self-administered. Stabilities and reliabilities of the test from the core battery were comparable to those obtained previously under more controlled experimental conditions. Analyses of metric properties of the remaining 13 tests produced eight additional tests with satisfactory properties. Although the average retest reliability was high, cross-correlations between tests were low, indicating factorial richness. The menu can be used to form batteries of flexible total testing time which are likely to tap different mental processes and functions. Author

N90-12176# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.

THREE DIMENSIONAL OBJECT RECOGNITION EMPLOYING COMBINED VISUAL AND TACTILE SENSING Final Project Report, 1 Jul. 1985 - 31 Aug. 1988

REN C. LUO, HORNG-HAI LOH, and PATRICK ROBINSON Dec. 1988 56 p

(Contract NSF DMC-85-05166)

(PB89-219489; NSF/ENG-88037) Avail: NTIS HC A04/MF A01 CSCL 05/9

The objective of the project was the development of a combined use of 2-D visual and 2-D tactile information for 3-D object recognition purposes. A conventional video camera is used to obtain the top view of an object. Two tactile sensing arrays mounted on a robot gripper are also used to measure information about the lateral surfaces of an object. Three dimensional reference models are established as a hierarchical decision tree. Measuring the available features derived from the sensor information of an object, a decision tree is traversed to identify and label the sensed object. Developments include: (1) a system capable of performing the tasks in an integrated fashion; (2) the construction of an effective and efficient way of discriminating objects; and (3) new algorithms for dealing with tactile information developed and implemented in the form of an automatic decision tree generation generator. Author

N90-12177# Washington Univ., Seattle. Dept. of Psychology.

METACOGNITION AND RETRIEVAL FROM LONG-TERM MEMORY AT MOUNT EVEREST Final Report, 13 May 1988 - 23 Jun. 1989

THOMAS O. NELSON 27 Jun. 1989 19 p

(Contract AF-AFOSR-0226-88; AF PROJ. 2313)

(AD-A211629; AFOSR-89-1113TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

Behavioral data were collected from climbers at various

altitudes on Mount Everest. In contrast to earlier findings that altitude impairs the acquisition of information into memory, no changes were found in the accuracy or latency of retrieving information from memory, even at extreme altitudes above 21,000 ft (6,400 m). This lack of effect on retrieval occurred for both the recall and recognition of answers to general information questions (e.g., what is the capital of Finland). Self confidence about the accuracy of recent retrieval was also not affected by altitude. However, the feeling of knowing (i.e., self confidence about upcoming retrieval) declined at extreme altitudes and remained lower even after return to Kathmandu. This pattern of results is close to opposite of the pattern obtained when the independent variable is alcohol intoxication and the same test battery is employed. These and related results are described in an attempt to give a relatively comprehensive picture of the climbers' performance, and suggestions are offered for future research.

GRA

N90-13029# Yale Univ., New Haven, CT. School of Medicine. **FEAR-POTENTIATED STARTLE AS A MODEL SYSTEM FOR ANALYZING LEARNING AND MEMORY Annual Report, 1 Jun. 1988 - 30 Jun. 1989**

MICHAEL DAVIS 25 Jul. 1989 7 p
(Contract AF-AFOSR-0336-87; AF PROJ. 2312)
(AD-A212131; AFOSR-89-1221TR) Avail: NTIS HC A02/MF A01
CSCL 05/8

Previous research has shown that the acoustic startle response, a simple reflex mediated by four synapses in the brainstem and spinal cord, can be increased when elicited in the presence of a light previously paired with a footshock. This fear-potentiated startle effect can be selectively blocked by drugs that decrease anxiety in humans as well as by lesions of the central nucleus of the amygdala, an area of the brain known to be critical for fear. This year it was found that local infusion of N-methyl-D-aspartate (NMDA) selective antagonists such as AP5 or CPP completely block the acquisition of fear-potentiated startle. This effect could not be attributed to a decrease in shock sensitivity or vision and did not occur when these compounds were infused into the cerebellum. These data indicate that an NMDA-dependent mechanism in the amygdala is involved in fear conditioning and that fear-potentiated startle may provide an excellent behavioral model system to analyze cellular and biochemical mechanisms of learning and memory.

GRA

N90-13030# California Univ., San Diego. Dept. of Neurosciences.

ELECTROPHYSIOLOGICAL STUDIES OF VISUAL ATTENTION AND RESOURCE ALLOCATION Final Report, 1 Jun. 1986 - 31 May 1989

STEVEN A. HILLYARD, G. R. MANGUN, and S. J. LUCK 30 Aug. 1989 48 p
(Contract N00014-86-K-0291; RR04209)
(AD-A212287; SDEPL-002) Avail: NTIS HC A03/MF A01
CSCL 05/8

The objective of this project was to better understand mechanisms of visual selective attention in humans, both at the level of perceptual processing and at the level of the underlying brain mechanisms. The main approach was to record event related brain potentials (EPRs) from the intact scalp using multielectrode arrays. Selective attention to stimulus location was found to enhance short latency brain evoked activity, analysis of current source densities indicated that visual inputs were subject to attentional control at or before the level of the pre-striate occipital cortex. Stimuli patterns of early sensory modulation were found during spatially focussed attention to rapid sequences of unilateral stimuli, to single stimuli occurring at precued locations, and to bilateral stimulus arrays. Applications of these techniques for evaluating how human operators allocate their attention to visual displays are discussed.

GRA

N90-13031# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

A COMPARISON OF TWO SUBJECT-CONTROLLED ATTITUDE MEASURES DURING SOMATOGRATIC ILLUSION EXPOSURE M.S. Thesis - Saint Mary's Univ.

JOHN F. THOMPSON May 1989 82 p
(AD-A212528; AFIT/CI/CIA-88-236) Avail: NTIS HC A05/MF
A01 CSCL 06/10

The United States Air Force School of Aerospace Medicine (USAFSAM) has a requirement for a performance evaluation and comparison of two subject-controlled attitude indicators during exposure to the somatogravic or posturogravic illusion. This illusion is well known for giving aircraft pilots a false sensation of excessive pitch-up during take-off. With a lack of visual stimuli, the pilot misinterprets the resultant gravito-inertial force vector as approximating the vertical force vector of gravity. Accidents occur when pilots adjust to what they feel is level flight, when they are, in fact, pitched down toward the ground. The USAFSAM Vertifuge (spatial disorientation device) was used to generate this illusion in 16 subjects (8 experienced pilots and 8 nonpilots) by varying gravito-inertial and actual (cabin) pitch positions. Each subject rode the Vertifuge twice. During one session, the subject used a canopy-mounted downpointer to estimate position in space relative to the ground, and in other session the subject used a joystick-controlled inside-out aircraft attitude indicator. As expected, the results clearly indicate that the canopy-mounted downpointer is better at quantifying the somatogravic illusion in this Vertifuge study. Furthermore, it is apparent that there are no significant differences in performance between pilots and nonpilots using either device.

GRA

N90-13032# New York Univ., New York. Dept. of Psychology.

THREE STAGES AND TWO SYSTEMS OF VISUAL PROCESSING

GEORGE SPERLING 1989 35 p
(Contract AF-AFOSR-0140-88; AF PROJ. 2313)
(AD-A212670; AFOSR-89-1131TR) Avail: NTIS HC A03/MF A01
CSCL 20/6

Three stages of visual processing determine how internal noise appears to an external observer: light adaptation, contrast gain control, and a postsensory/decision stage. Dark noise occurs prior to adaptation, determines dark-adapted absolute thresholds, and mimics stationary external noise. Sensory noise occurs after dark adaptation, determines contrast thresholds for sine gratings and similar stimuli, and mimics external noise that increases with mean luminance. Postsensory noise incorporates perceptual, decision, and mnemonic process. It occurs after contrast-gain control and mimics external noise that increases with stimulus contrast (i.e., multiplicative noise). Dark noise and sensory noise are frequently specific and primarily affect weak signals. Only postsensory noise significantly affects to strong signals, and it has constant power over a wide spatial frequency range in which sensory noise varies enormously.

GRA

N90-13033# Southeastern Center for Electrical Engineering Education, Inc., Saint Cloud, FL.

EFFECTS OF TYPE OF RESPONDING ON MEMORY/VISUAL SEARCH: RESPONDING JUST YES OR JUST NO CAN LEAD TO INFLEXIBLE PERFORMANCE Final Report, May - Sep. 1986

ARTHUR D. FISK and PHILLIP L. ACKERMAN Aug. 1989 10 p
(Contract F30602-81-C-0193)
(AD-A212764; AFHRL-TR-88-75) Avail: NTIS HC A02/MF A01
CSCL 05/8

Interactions of stimulus consistency and type of responding were examined during perceptual learning. Subjects performed hybrid memory-visual search tasks over extended consistent and varied mapping process. Response conditions required subjects to respond to both the presence and absence of a target, only when a target is not present. After training, the subjects were transferred to a different response condition. The results indicate that: (1) performance on search tasks with stimuli that are variably

mapped shows no qualitative changes attributable to manipulation of response format; (2) improvement due to consistent mapping (CM) practice is attenuated in the no-only response condition; (3) yes-only CM training attenuates the subjects' ability to transfer to no-only responding; and (4) yes/no CM training leads to the greatest improvement and transfer when compared with other responding conditions. The practice and transfer data support and extend previous research investigating effects of response set in memory/visual search and help to delineate factors that facilitate or inhibit reduction of load effects in memory and visual search.

GRA

N90-13034# Air Force Human Resources Lab., Brooks AFB, TX. Manpower and Personnel Div.

INDIVIDUAL DIFFERENCES IN ASSOCIATIVE LEARNING AND FORGETTING Interim Report, Nov. 1985 - Nov. 1988

PATRICK C. KYLLONEN and WILLIAM C. TIRRE Aug. 1989
36 p
(AD-A212765; AFHRL-TP-89-46) Avail: NTIS HC A03/MF A01
CSC 05/8

Individual differences in retention were examined, with particular emphasis on its relationship with item-specific learning speed, general learning speed, and general cognitive factors. Young adults (N=710) were taught 13 name number pairs to varying successive success criteria using an item dropout procedure to ensure equal learning. Subjects were then taught re-pairings to varying criteria, in an A-B, A-Br design, so as to produce a range of forgetting conditions. Subjects then were asked to recall and relearn the original pairs. Item-specific learning speed predicted retention and reacquisition speed: The fastest learners, despite having the fewest number of study opportunities, remembered more and relearned faster. This relationship held over all forgetting conditions, and after statistically equating for within-list interference. General learning speed, as indicated by performance on an independent set of items administered in a variety of formats, also predicted retention and relearning. To examine the effects of other cognitive factors on learning and retention, various latent-variable path models were fit to the data. Results are contrasted with those of other investigators who, by employing different procedures for equating degree of learning, have concluded that there are no individual differences in retention. Implications for the discrepancy in conclusions are discussed.

GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A90-13261#
INNOVATIVE APPROACHES TO THE DESIGN OF BIOREGENERATIVE LIFE SUPPORT SYSTEMS FOR ADVANCED MISSIONS

S. H. SCHWARTZKOPF, T. M. OLCOTT, and E. F. LAURSEN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 10 p. refs
(IAF PAPER 89-026) Copyright

The design requirements and applications of innovative bioregenerative life support technologies and hybrid bioregenerative/physicochemical technologies to advanced manned missions are considered. The processing of atmosphere, water, and waste is discussed. Food production and the integration of biological systems on advanced manned missions are addressed.

C.D.

A90-13269#
MODULAR A&R SYSTEM TESTBED FOR DEVELOPMENT AND IMPLEMENTATION OF AUTOMATION AND ROBOTICS ELEMENTS WITHIN FUTURE ORBITAL SYSTEMS

E. SCHMIDT and K.-P. LUDWIG (MBB-ERNO Raumfahrttechnik GmbH, Bremen, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs
(IAF PAPER 89-036)

A study has been made of the automation and robotics (A&R) elements needed to operate the experiment facilities of the Columbus Free Flying Laboratory during the free flying mode and to support the astronaut in the Columbus Attached Laboratory. A potential A&R concept alternative for the payload operation within the Attached Laboratory is described, and the system definition of a modular A&R testbed as a tool for developing, optimizing, and verifying automation concepts in realistic simulations and tests is outlined.

V.L.

A90-13272#
A NEW METHOD FOR AUTONOMOUS RETRIEVAL OF A SATELLITE USING A VISUAL SENSOR AND A MANIPULATOR
SHINSUKE AZUMA, ICHIRO NAKATANI, and KEIKEN NINOMIYA (Institute of Space and Astronautical Science, Sagami-hara, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. refs
(IAF PAPER 89-041) Copyright

An autonomous satellite retrieval experiment using an onboard manipulator and a visual sensor has been studied. It is shown that attitude motion of a torque-free, asymmetric rigid body is approximately described as a superposition of three rotational motions of constant angular velocities. Thus, the motion of a particular principal axis of a target satellite nearly stops relative to the end effector of a manipulator, when a chaser satellite and the end of its manipulator make rotational motions of certain constant angular velocities. Besides, a new method is proposed for visual information processing which is necessary for capturing the target satellite. Computer simulation and an experiment have been carried out to prove the validity of the proposed scheme.

Author

A90-13277#
THE FLIGHT TELEROBOTIC SERVICER - NASA'S FIRST OPERATIONAL SPACE ROBOT

RONALD K. BROWNING, HARRY G. MCCAIN, and RUTH I. WHITMAN (McDonnell Douglas Space Systems Co., Huntington Beach, CA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p.
(IAF PAPER 89-050)

The Flight Telerobotic Servicer (FTS) is a NASA development of an operational space telerobot and supporting systems to be used in the assembly and maintenance of the international Space Station Freedom. The functional capabilities of the FTS and some of the unique technical challenges faced in developing the system are discussed. The architectural approach taken with FTS is described.

C.D.

A90-13278#
DEVELOPMENT OF THE 2ND GENERATION SPACE ROBOT IN NASDA

TSUTOMU IWATA, MITSUSHIGE ODA, and TAICHI NAKAMURA (National Space Development Agency of Japan, Tsukuba Space Center, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs
(IAF PAPER 89-051) Copyright

The research and development on space Automation and Robotics at the National Space Development Agency of Japan (NASDA) covers a range of projects, from the Remote Manipulator System of the Japanese Experimental Module of the International Space Station to the advanced space robotics, that are utilized in the future space activities. The research effort is now concentrated on the second generation space robotics which will be used for the Orbital Servicing Vehicle and other unmanned vehicles. The characteristics of the second generation space robotics is

teleoperation with semiautonomous control, or shared autonomy. The role sharing between human operator and the robot will be the key issue of this advanced space robotics. In this paper, NASDA's scenario for achieving semiautonomous/teleoperational space robotics is presented. Author

A90-13279*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ADVANCES IN SPACE ROBOTICS

GIULIO VARSÌ (JPL, Pasadena, CA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 12 p. refs (IAF PAPER 89-052)

The problem of the remote control of space operations is addressed by identifying the key technical challenge: the management of contact forces and the principal performance parameters. Three principal classes of devices for remote operation are identified: anthropomorphic exoskeletons, computer aided teleoperators, and supervised telerobots. Their fields of application are described, and areas in which progress has reached the level of system or subsystem laboratory demonstrations are indicated. Key test results, indicating performance at a level useful for design tradeoffs, are reported. Author

A90-13289#

REQUIREMENTS AND CONCEPTS FOR THE SPACE STATION REMOTE MANIPULATOR SYSTEM

J. H. DUECKMAN, D. M. GOSSAIN, S. S. SACHDEV, and J. A. MIDDLETON (Spar Aerospace, Ltd., Remote Manipulator Systems Div., Toronto, Canada) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. (IAF PAPER 89-069) Copyright

The Mobile Servicing System (MSS) that is Canada's contribution to the NASA Space Station Freedom will be used for station assembly, maintenance, and servicing; the MSS's Remote Manipulator System (RMS) is a large robotic system derived from the Space Shuttle's RMS, which will be operated by astronauts aboard the station. The Freedom RMS is a seven degree-of-freedom manipulator with a central elbow joint as well as a three-joint cluster and an end-effector at either end. This configuration allows the RMS to be relocated by using each end effector alternately as the base or as the tip of the arm. O.C.

A90-13300#

DESIGN GUIDELINES FOR ACCOMMODATION OF ROBOTIC AND MANIPULATIVE DEVICES ON SPACE STATION FREEDOM

JOHN BOUVIER, DANIEL POL, CURT NEWPORT, JOHN O'DONNELL, and JOSEPH PARRISH (Ocean Systems Engineering, Falls Church, VA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 11 p. refs (IAF PAPER 89-084)

The purpose of this paper is to address the issues related to the development of the design guidelines necessary for the accommodation of robotic and manipulative devices used for the assembly, maintenance and servicing of Space Station Freedom. Analogies and lessons learned will be drawn from the sub-sea and related industries and comparisons will be made to Space Station planned tasks and phased configurations. Criteria will be discussed in the consideration of human/machine compatibility, standardization, commonality, kinematics, operational constraints and task/resource matching. Present Space Station robotic technology will be compared to future space activity requirements. Author

A90-13301*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

HUMAN FACTORS AND PRODUCTIVITY ON SPACE STATION FREEDOM

C. S. LEACH, J. W. BROWN, and P. A. SANTY (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p. refs (IAF PAPER 89-087) Copyright

Three main facets of man systems are investigated with reference to the Space Station Freedom program: specific hardware systems that focus on the human element; requirements definition for man-systems integration; and crew interface and operations analysis. Three key criteria have been identified for selecting individuals to constitute the human system or crew for Space Station Freedom missions: aptitude for mission specific skills, motivation, and sensitivity to self and others. Integration of the human system into the complex engineering and science systems planned on Space Station Freedom will require the close collaboration of engineers, physicians, psychologists, and human factors experts. Ground-based research and experiments on the KC-135 aircraft are providing information about how human systems will function on a space station and how to design other systems to interact with the crew. A laboratory for further research will be provided onboard Space Station Freedom. C.E.

A90-13302#

SIMULATION BY PERSONAL WORKSTATION FOR MAN-MACHINE INTERFACE DESIGN

S. BERTHIER, R. MIGINIAC (AMDBA, Saint-Cloud, France), and W. FREI (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs (IAF PAPER 89-089) Copyright

This paper presents a simulation tool which has been developed for Man-Machine Interface design study, in the context of the European EVA Space Suit System development, under contract of ESA/ESTEC. The main new point is that this simulation is based on a personal workstation, and not on a heavy real-time computer, as in most simulation centers. It will be used in ESTEC to perform low cost simulations of the front part of a manned system, to improve and develop MMI with efficiency. Author

A90-13303#

DESIGN AND EVALUATION OF MAN-IN-THE-LOOP CONTROL SYSTEM OF JAPANESE EXPERIMENTAL MODULE REMOTE MANIPULATOR SYSTEM

K. YAMAWAKI, K. KURAOKA (National Space Development Agency of Japan, Tokyo), M. SHIGEHARA, K. GOMA, T. SUMI (Toshiba Corp., Space Programs Div., Kawasaki, Japan) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p. (IAF PAPER 89-090) Copyright

The Japanese Experimental Module Remote Manipulator System (JEMRMS) has two manipulator arms, the main arm (MA) and the small fine arm (SFA). The MA provides the capability of transferring, retrieving, and berthing user payload in the vicinity of the servicing bays. Attached to the MA, the SFA performs dexterous tasks, such as antenna assembly and replacement of test samples. Both arms are controlled by a single operator in the Pressurized Module (PM). The JEMRMS operation console is equipped with various man-machine interface equipments such as display and TV monitors, control panels, a keyboard, and a six-degree-of-freedom hand controller. The vision subsystem provides the RMS operator with an indirect image of the work monitored by TV cameras mounted on the MA/SFA arms, the exposed facility, and the PM. A stereoscopic image monitored by a stereoscopic TV camera mounted on the SFA's shoulder provides the human operator with three-dimensional visual information considered as the center of the man-in-the-loop control system. Several man-in-the-loop experiments were conducted to evaluate the algorithm of the control system and the design of the man-machine interface. A set of significant data have been obtained for the phase C development of the JEMRMS program. C.E.

A90-13305#

STUDIES ON HABITATION MODULE AND INTERCONNECTING ELEMENTS FOR A FUTURE EUROPEAN SPACE STATION

U. RIEDEL and J. EWALD (MBB-ERNO Raumfahrttechnik GmbH, Bremen, Federal Republic of Germany) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989

20 p.

(IAF PAPER 89-092)

This paper describes the design concepts of the Habitation Module (HAB) of a future European space station and the Interconnecting Element (ICE), which will allow the architectural built-up of several elements forming the configuration of an orbital station. Special attention is given to the key requirements for the HAB and ICE designs and to their overall configurations, with special attention given to the human factors and safety aspects of the system. Consideration is also given to the HAB and the ICE subsystems; the internal architecture of HAB; the development, test, and ground support of HAB; and the key technologies involved in the HAB/ICE. Design diagrams of the HAB and ICE are included. I.S.

A90-13306*# Lockheed Engineering and Sciences Co., Houston, TX.

USING COMPUTER GRAPHICS TO DESIGN SPACE STATION FREEDOM VIEWING

B. S. GOLDSBERRY, B. O. LIPPERT, S. D. MCKEE (Lockheed Engineering and Sciences Co., Houston, TX), J. L. LEWIS, JR., and F. E. MOUNT (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 5 p.
(IAF PAPER 89-093)

An important aspect of planning for Space Station Freedom at the United States National Aeronautics and Space Administration (NASA) is the placement of the viewing windows and cameras for optimum crewmember use. Researchers and analysts are evaluating the placement options using a three-dimensional graphics program called PLAID. This program, developed at the NASA Johnson Space Center (JSC), is being used to determine the extent to which the viewing requirements for assembly and operations are being met. A variety of window placement options in specific modules are assessed for accessibility. In addition, window and camera placements are analyzed to insure that viewing areas are not obstructed by the truss assemblies, externally-mounted payloads, or any other station element. Other factors being examined include anthropometric design considerations, workstation interfaces, structural issues, and mechanical elements. Author

A90-13613#

OXYGEN SEPARATION SYSTEM OF RESIDENTIAL SPACE AT THE LUNAR BASE

YASUFUMI UEDA, NAOAKI IZUTANI, and HIROYASU YAMAMOTO (Daikin Industries, Ltd., Mechanical Engineering Laboratory, Sakai, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p.
(IAF PAPER 89-574) Copyright

With the aim of developing the lunar resources, helium-3, the scheme to build a lunar base has been advanced. The development of the Closed Ecological Life Support System (CELSS) is important for this scheme of building a lunar base. The investigations of the oxygen separation methods, selection of the suitable oxygen separation methods, and the determination of the equipment specifications are presented in this paper. Author

A90-13614#

STUDY ON THE NITROGEN FIXATION SYSTEM REQUIRED FOR PLANT CULTURE IN A LUNAR BASE

TORU NUMAGUCHI, KATSUTOSHI KIKUCHI (Toyo Engineering Corp., Research Center, Mobarra, Japan), SYOKO YAMADAYA, YUJI SHINDO (National Chemical Laboratory for Industry, Tsukuba, Japan), and KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 7 p. refs
(IAF PAPER 89-575) Copyright

The paper proposes the optimal process for the nitrogen fixation system for eight crews in a lunar base. Evaluation was carried out by the MUF method from the overall viewpoint of safety, compactness, efficiency, realizability, operability, and main-

tainability. And through evaluation, the unit process which had better be improved by establishment of preventive measures for safety was also made clear. Author

A90-13615#

A STUDY ON CULTURING MODULES FOR CELSS IN LUNAR BASE

KAZUO SEZAKI, SHINJI NISHIZAKI, SHOJI YAMAZAKI, YASUO MIYATA, YOICHI SEKI (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p.
(IAF PAPER 89-576) Copyright

A feasibility study is reported on a plant culture subsystem for covering food supply and oxygen recycling through photosynthesis. The subsystem is a part of the Closed Ecological Life Support System (CELSS) on a lunar base. Plant culture modules have been conceived that measure 4.5 m in diameter by 15 m in length. Internally the modules are arranged in tiers of hydroponic beds, provided with a controlled environment including artificial illumination, and equipped with a robot for unattended culture of wheat, rice, potato, sweet potato, soybean, leaf lettuce, and spinach. The mean sustenance capability per module is 1.7 persons. Thus, five modules should suffice to sustain eight persons on a lunar base. C.D.

A90-13616#

APPLICATION OF TUBULAR PHOTO-BIOREACTOR SYSTEM TO CULTURE SPIRULINA FOR GAS EXCHANGE AND FOOD PRODUCTION IN CELSS

MITSUO OGUCHI, KEIJI NITTA, KOJI OTSUBO (National Aerospace Laboratory, Chofu, Japan), ATSUHIRO SHIMADA, KAZUO MIYAZAKI (Tonen Corp., Corporate Research and Development Laboratory, Saitama, Japan) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 9 p. refs
(IAF PAPER 89-577) Copyright

The experimental apparatus of a closed algal cultivation system has been developed, using *Spirulina* for continuous O₂ and food production as well as CO₂ removal. In early experiments, it was not possible to keep *Spirulina* culture in good conditions for a long time due to cell adhesion to the reactor wall and the hollow fibers. To solve this problem a cultivation reactor and gas separator of improved design were developed. The new reactor is made of a semitransparent flexible teflon tube of 6 mm bore. In order to achieve the high efficiency of light energy supply and to obtain the heat for culture from lamp irradiation, the teflon tube is coiled around a fluorescent lamp as the light source. Separation of generated O₂ gas is conducted with a hydrophobic microporous polytetrafluoroethylene tube module through which the cultivation solution flows, thus preventing algae adhesion. The newly designed tubular photobioreactor used in the batch culture experiment is found to be satisfactorily applicable to O₂ and food production. C.E.

A90-13618#

A FOOD/NUTRIENT SUPPLY PLAN FOR LUNAR BASE CELSS

Y. MIDORIKAWA, T. FUJII (JGC Corp., Tokyo, Japan), M. TERAI (Tokyo Institute of Science and Technology, Japan), K. OMASA (National Institute for Environmental Studies, Tsukuba, Japan), and K. NITTA (National Aerospace Laboratory, Tokyo, Japan) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 8 p. refs
(IAF PAPER 89-579) Copyright

A nutrient recommendation for lunar base has been presented, based on the amino acid requirement. A plan for nutrient supply and plant farming for the 8-16 crew lunar base is discussed. The bed area for plant cultivation is restricted to less than 40 sq m per person, thus supplying enough food for the crews from the nutrition point of view. To satisfy the essential nutrient elements required, mushroom cultivation for supply of vitamin B₂, transportation of lime from earth for calcium, and recovery of sodium from human urine for sodium chloride are considered. In such an isolated and closed environment as a lunar base, not

only nutrient sufficiency but also the pleasure of eating should be considered. It is necessary to generate as much food as possible from a limited number of plant species. C.E.

A90-13619#**PLANT CULTURAL SYSTEM INCORPORATED INTO CELSS**

M. KIYOTA, Y. KITAYA, I. AIGA, K. YABUKI (Osaka Prefecture, University, Sakai, Japan), M. FUJII (Yanmar Technical Center, Kyoto, Japan) et al. IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 6 p. refs (IAF PAPER 89-580) Copyright

To confirm the possibility of plant cultivation under microgravity in space, the growth of lettuce and turnips cultivated upside down was investigated. Rooting beds were arranged above and below an array of fluorescent lamps. Plants were grown normally in the lower bed and upside down in the upper beds. The results show no remarkable differences in growth rates and morphological aspects of the plants in the lower and upper beds. These facts mean that phototropism can overcome geotropism, and that a PPFD of 300 micro-E/sq m/s ensures plant growth regardless of gravity direction. Author

A90-13620#**THE EFFECTS OF AUTOMATION ON WORK IN SPACE**

LESLIE A. WICKMAN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IAF, International Astronautical Congress, 40th, Malaga, Spain, Oct. 7-13, 1989. 10 p. refs (IAF PAPER 89-583) Copyright

The nature of the relationship between automation and the astronaut's work in space is investigated. The approach to this study is based on extensive literary research on the topic and original data collection from groups cooperating with NASA in the implementation of automation in space. The following issues are considered: relationship between technology and work in space; productivity versus astronaut job satisfaction; and effects of automation on astronaut skills. Findings on these issues are summarized and discussed. C.E.

A90-13737**HEAD COOLING IS DESIRABLE BUT NOT ESSENTIAL FOR PREVENTING HEAT STRAIN IN PILOTS**

JOHN FRIM (Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Nov. 1989, p. 1056-1062. refs Copyright

Liquid-cooled garments (LCGs) are being considered for reducing heat strain in pilots. While head cooling has been shown to be thermally efficient and subjectively desirable, it is technically difficult to achieve. A laboratory study was carried out to see if head cooling in addition to torso cooling is a necessity. Cooling conditions were: control, no fluid circulation; condition VEST, only torso cooling; condition HEAD, both torso and head cooling. Subjective thermal comfort assessments confirmed the desirability of head cooling, but performance measurements and physiological measurements of thermal strain showed no statistically significant difference between conditions VEST and HEAD. It was concluded that head cooling is desirable but not essential. Author

A90-14998*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SPACE ROBOTICS IN THE '90S

CARL F. RUOFF (JPL, Pasadena, CA) Aerospace America (ISSN 0740-722X), vol. 27, Aug. 1989, p. 38-41, 46. Copyright

The use of telerobots and rovers in space missions is examined. The functioning of the telerobots and rovers and their proposed applications are described. Research developments needed to design robots for specific environments and functions are described. Examples of NASA robotics projects are presented. I.F.

A90-14999#**WEST GERMANY'S FIRST SPACE ROBOT**

GERD HIRZINGER (DLR, Cologne, Federal Republic of Germany) Aerospace America (ISSN 0740-722X), vol. 27, Aug. 1989, p. 42-46.

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The proposed telerobotic technology experiment, Rotex, is described. Rotex is a six-axis robot in a spacelab rack; it has force and torque sensors, range finders, and a stereo camera. Rotex capabilities include assembly and servicing tasks and grasping of floating objects. Also the robot has slow and fast modes of operation. The design and operation of the robot's gripper and laser range finders are examined; a diagram of the Rotex's gripper is presented. Teleoperation from the ground is discussed. I.F.

A90-15426* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

LIFE SCIENCES AND SPACE RESEARCH XXIII(3): NATURAL AND ARTIFICIAL ECOSYSTEMS; PROCEEDINGS OF THE TOPICAL MEETINGS OF THE 27TH COSPAR PLENARY MEETING, ESPOO, FINLAND, JULY 18-29, 1988

R. D. MACELROY, ED. (NASA, Ames Research Center, Moffett Field, CA), T. W. TIBBITTS, ED. (Wisconsin, University, Madison), B. G. THOMPSON, ED. (Alberta Research Council, Edmonton, Canada), and T. VOLK, ED. (New York University, NY) Meetings sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, 202 p. For individual items see A90-15427 to A90-15447.

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The present conference discusses topics in the fields of higher plant growth under controlled environmental conditions, waste oxidation, carbon cycling, and biofermentor design and operation. Attention is given to CO₂ and O₂ effects on the development and fructification of wheat in closed systems, transpiration during life cycle in controlled wheat growth, sources and processing of CELSS wastes, waste-recycling in bioregenerative life support, and the effect of iodine disinfection products on higher plants. Also discussed are carbon cycling by cellulose-fermenting nitrogen-fixing bacteria, a bioreactor design with sunlight supply and operations systems for use in the space environment, gas bubble coalescence in reduced gravity conditions, and model system studies of a phase-separated membrane bioreactor. O.C.

A90-15427* Utah State Univ., Logan.

CURRENT AND POTENTIAL PRODUCTIVITY OF WHEAT FOR A CONTROLLED ENVIRONMENT LIFE SUPPORT SYSTEM

B. G. BUGBEE and F. B. SALISBURY (Utah State University, Logan) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 5-15. Research supported by Utah State University. refs (Contract NCC2-139)

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Several determinants of crop growth are analyzed to determine theoretical and potentially achievable productivity. These include: incident photosynthetic photon flux (PPF); percent absorption of the incident PPF by photo synthetic tissue; photosynthetic efficiency; respiratory carbon use efficiency; and harvest index. The effects of optimal environmental and cultural factors on each of these determinants are also investigated. Results indicate that an increase in the percentage of absorbed photons is responsible for most of the improvement in wheat yields in an optimal controlled environment. An integrated PPF of 150 mol/sq m per d has produced 60 g/sq m per d of grain. There is almost a linear increase in wheat yields with increasing PPF. At intermediate and equal integrated daily PPF levels, photoperiod had little effect on yield per day or energy efficiency. Decreasing temperature from 23 to 17 deg increased yield per day by 20 percent but increased the life cycle from 62 to 89 days. C.E.

A90-15428**EFFECT OF CO₂ AND O₂ ON DEVELOPMENT AND FRUCTIFICATION OF WHEAT IN CLOSED SYSTEMS**

M. ANDRE, D. MASSIMINO, J. MASSIMINO (CEA, Institut de Recherche Fondamentale, Saint-Paul-lez-Durance, France), A. GERBAUD (Institut National de la Recherche Agronomique, Montpellier, France), F. COTTE et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 17-28. Research supported by CNES. refs
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The cultivation of wheat (*Triticum aestivum* L.) was performed in controlled environment chambers with the continuous monitoring of photosynthesis, dark respiration, transpiration and main nutrient uptakes. A protocol in twin chambers was developed to compare the specific effects of low O₂ and high CO₂. Each parameter is able to influence photosynthesis but different effects are obtained in the development, fructification and seed production, because of the different effects of each parameter on the ratio of reductive to oxidative cycle of carbon. The first main conclusion is that low level of O₂, at the same rate of biomass production, strongly acts on the rate of ear appearance and on seed production. Ear appearance was delayed and seed production reduced with a low O₂ treatment (about 4 percent). The O₂ effect was not mainly due to the repression of the oxidative cycle. The high CO₂ treatment (700 to 900 microl/l delayed ear appearance by 4 days, but did not reduce seed production. High CO₂ treatment also reduced transpiration by 20 percent. Two hypothesis were proposed to explain the similarities and the difference in the O₂ and CO₂ effects on the growth of wheat. Author

A90-15429

UTILIZATION OF SWEET POTATOES IN CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS)

WALTER A. HILL, PHILIP A. LORETAN, CONRAD K. BONSI, CARLTON E. MORRIS, JOHN Y. LU (Tuskegee University, AL) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 29-39, 41. refs
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A number of short-term hydroponic studies selected the sweet potatoes as a potentially important crop for CELSS. Full-term studies were needed to understand the physiology of storage root enlargement and to evaluate sweet potato production potential for CELSS. In a nutrient film technique (NFT), storage root yields as high as 1790 g were produced with an edible growth rate of up to 66 g/sq m per d and a harvest as high as 89 percent under greenhouse conditions. Preliminary experiments indicate that high yields can be achieved in controlled environmental chambers. Significant cultivar differences appeared in all systems studied. Nutritive composition of storage roots and foliage were similar to field grown plants. C.E.

A90-15430* Hebrew Univ., Jerusalem (Israel).

CARBON BALANCE AND PRODUCTIVITY OF LEMNA GIBBA, A CANDIDATE PLANT FOR CELSS

J. GALE (Jerusalem, Hebrew University, Israel), D. T. SMERNOFF (Stanford University, CA), B. A. MACLER, and R. D. MACELROY (NASA, Ames Research Center, Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 43-52. refs
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The photosynthesis and productivity of *Lemna gibba* is analyzed for CELSS based plant growth. Net photosynthesis of *Lemna gibba* is determined as a function of incident photosynthetic photon flux (PPF), with the light coming from above, below, or from both directions. Light from below is about 75 percent as effective as from above when the stand is sparse, but much less so with dense stands. High rates of photosynthesis are measured at 750 micromol / sq m per sec PPF and 1500 micromol / mol CO₂ at densities up to 660 g fresh weight (FW) / sq m with young cultures.

The analysis includes diagrams illustrating the net photosynthesis response to bilateral lighting of a sparse stand of low assimilate *Lemna gibba*; the effect of stand density on the net photosynthesis response to bilateral lighting of high assimilate *Lemna gibba*; the net photosynthesis response to ambient CO₂ of sparse stands of *Lemna gibba*; and the time course of net photosynthesis and respiration per unit chamber and per unit dry weight of *Lemna gibba*. C.E.

A90-15431

UTILIZATION OF WHITE POTATOES IN CELSS

THEODORE W. TIBBITTS, SUSAN M. BENNETT, ROBERT C. MORROW, and RAYMOND J. BULA (Wisconsin, University, Madison) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 53-59. Copyright

The potential of white potatoes (*Solanum tuberosum*) as a useful crop species in a functioning CELSS is investigated. The cultivars Denali were grown in a controlled environment room to maximize yield productivity in terms of grams per unit area per day. Environmental response to irradiance and CO₂ interactions, light duration changes, light/dark cycles, and diurnal temperature fluctuations is considered. Attempts have been made to obtain cultivars selected for long daylengths and for adaptation to high temperatures. The study of cultural procedures include substrates and media; continuous harvesting of tubers; and plant spacing and container configuration. The high productivity of nutritious tubers, high harvest index, and low irradiance requirement of the potato plant make it a particularly strong candidate for use in CELSS to provide food and oxygen, and to remove CO₂ for space inhabitants. C.E.

A90-15432* New York Univ., New York.

TRANSPIRATION DURING LIFE CYCLE IN CONTROLLED WHEAT GROWTH

TYLER VOLK (New York University, NY) and JOHN D. RUMMEL (NASA, Washington, DC) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 61-64. refs
(Contract NCA2-101)
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A previously-developed model of wheat growth, designed for convenient incorporation into system-level models of advanced space life support systems is described. The model is applied to data from an experiment that grew wheat under controlled conditions and measured fresh biomass and cumulated transpiration as a function of time. The adequacy of modeling the transpiration as proportional to the inedible biomass, and an age factor which varies during the life cycle, are examined. Results indicate that during the main phase of vegetative growth in the first half of the life cycle, the rate of transpiration per unit mass of inedible biomass is more than double the rate during the phase of grain development and maturation during latter half of the life cycle. Author

A90-15433

LONG-TERM EXPERIMENTS ON MAN'S STAY IN BIOLOGICAL LIFE-SUPPORT SYSTEM

I. I. GITEL'SON, I. A. TERSKOV, B. G. KOVROV, G. M. LISOVSKII, IU. N. OKLADNIKOV (AN SSSR, Institut Biofiziki, Krasnoyarsk, USSR) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 65-71. refs
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The described experimental system having maximal possible closure of material recycling in an ecosystem including people and plants, which was carried out in a hermetically sealed experimental complex 'BIOS-3', is 315 sq m in volume. The system

included two experimentators and three phytotrons with plants (total sowing area of 63 sq m). Plants were grown with round-the-clock lamp irradiation with 130 W/sq m PAR intensity. The plants' production was food for people. Water exchange of ecosystem, as well as gas exchange, was fully closed excluding liquids and gas samples taken for chemical analysis outside the system. The total closure of material turnover constituted 91 percent. Health state of the crew was estimated before, during and after the experiment. A 5-month period did not affect their health. The experiments demonstrate that the closed ecosystem of 'man-plants' is a prototype of a life-support system for long-term space expeditions. Author

A90-15434* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

WASTE RECYCLING ISSUES IN BIOGENERATIVE LIFE SUPPORT

R. D. MACELROY (NASA, Ames Research Center, Moffett Field, CA) and D. WANG (NASA, Ames Research Center; TGS Technology, Inc., Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 75-84. refs

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Research and technology development issues centering on the recycling of materials within a bioregenerative life support system are reviewed. The importance of recovering waste materials for subsequent use is emphasized. Such material reclamation will substantially decrease the energy penalty paid for bioregenerative life support systems, and can potentially decrease the size of the system and its power demands by a significant amount. Reclamation of fixed nitrogen and the sugars in cellulosic materials is discussed. Author

A90-15435* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SOURCES AND PROCESSING OF CELSS WASTES

T. WYDEVEN (NASA, Ames Research Center, Moffett Field, CA), J. TREMOR, C. KOO (NASA, Ames Research Center; TGS Technology, Inc., Moffett Field, CA), and R. JACQUEZ (New Mexico State University, Las Cruces) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 85-97. refs

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The production rate and solid content of waste streams found in a life support system for a space habitat (in which plants are grown for food) are discussed. Two recycling scenarios, derived from qualitative considerations as opposed to quantitative mass and energy balances, tradeoff studies, etc., are presented; they reflect differing emphases on and responses to the waste stream formation rates and their composition, as well as indicate the required products from waste treatment that are needed in a life support system. The data presented demonstrate the magnitude of the challenge to developing a life support system for a space habitat requiring a high degree of closure. Author

A90-15436* Niigata Univ. (Japan).

SUBCRITICAL AND SUPERCRITICAL WATER OXIDATION OF CELSS MODEL WASTES

Y. TAKAHASHI (Niigata University, Japan), T. WYDEVEN (NASA, Ames Research Center, Moffett Field, CA), and C. KOO (NASA, Ames Research Center; TGS Technology, Inc., Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 99-110. refs

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A mixture of ammonium hydroxide with acetic acid and a slurry of human feces, urine, and wipes were used as CELSS model wastes to be wet-oxidized at temperatures from 250 to 500 C, i.e.

below and above the critical point of water (374 C and 218 kg/sq cm or 21.4 MPa). The effects of oxidation temperature (250-500 C) and residence time (0-120 mn) on carbon and nitrogen and on metal corrosion from the reactor material were studied. Almost all of the organic matter in the model wastes was oxidized in the temperature range from 400 to 500 C, above the critical conditions for water. In contrast, only a small portion of the organic matter was oxidized at subcritical conditions. A substantial amount of nitrogen remained in solution in the form of ammonia at temperatures ranging from 350 to 450 C suggesting that, around 400 C, organic carbon is completely oxidized and most of the nitrogen is retained in solution. The Hastelloy C-276 alloy reactor corroded during subcritical and supercritical water oxidation. C.E.

A90-15437

THE C23A - FIRST STEP TO A MONITORING SYSTEM OF CELSS IN FLIGHT

CH. LASSEUR (Matra Espace, Velizy-Villacoublay, France), D. MASSIMINO, J. L. RENOUE, and CH. RICHAUD (CEA, Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance, France) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 111-116. refs

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For the past 15 years, the C23A automatic control system has been used to monitor and quantify gases, water, and chemical compounds for several processes of CELSS. A new version is introduced, adapted to space requirements and equipped with the latest computing system for remote control, independent functioning, multiplication of alarms and controls, multiplexing of analyzers, and reliable quality measurements. The architecture of the computing system comprises three independent functions: acquisition, monitoring, and supervision. The use of multiplex analyzers such as the IRGA mass spectrometer and chemical analyzer, increases measurement accuracy and could facilitate the spatialization. The new C23A structure anticipates a complete separation between automation in space and control/command on ground. C.E.

A90-15439* National Aeronautics and Space Administration, Washington, DC.

THE ROLE OF COMPUTERIZED MODELING AND SIMULATION IN THE DEVELOPMENT OF LIFE SUPPORT SYSTEM TECHNOLOGIES

MICHAEL MODELL (Modell Development Corp., Framingham, MA), PEGGY EVANICH (NASA, Washington, DC), CHAU-CHYUN CHEN, SELIM ANAVI, and JEFF MAI (Aspen Technology, Inc., Cambridge, MA) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 121-131. refs

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Computerized modeling and simulation (CMAS) is a tool that can greatly reduce both the time and cost of technology development. CMAS refers to computer methods for correlating, storing, and retrieving property data for chemical species and for solving the phenomenological equations of physical/chemical processes. Furthermore, process conditions based on properties of materials, mass, and energy balances; equipment sizing based on rate processes; and the governing equations for unit operations can be determined using CMAS. CMAS systems can be used to evaluate an LSS process with minimal requirements for laboratory experimentation. A CMAS model is presented for a vapor compression distillation system (VCD) for reclaiming water from urine. C.E.

A90-15444

DESIGN FOR A BIOREACTOR WITH SUNLIGHT SUPPLY AND OPERATIONS SYSTEMS FOR USE IN THE SPACE ENVIRONMENT

KEI MORI (Keio University, Yokohama, Japan), HARUHIKO OHYA, KANJI MATSUMOTO (Yokohama National University, Japan), HIROYUKI FURUUNE, KYOKO ISOZAKI (La Foret Engineering and Information Service Co., Tokyo, Japan) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 161-168. refs
Copyright

A photosynthetic bioreactor and a solar light collection system to support fast cultivation of algae at high densities in the weightlessness of space is presented. Designed for long operation in space without maintenance, the system will be able to filter most of the harmful ultraviolet and infrared radiation from sunlight and transfer the concentrated visible light through optical fiber cables to illuminate cultivation tanks. Five major components operating within a closed system of tank, tubes and monitoring devices are discussed: tank illumination subsystem; light supply subsystem; CO₂ supply and O₂ collection subsystem; culture supply and separation subsystem; and nutrient supply and recycling subsystem. Results of an experiment using *Chlorella ellipsoidea* to investigate the characteristics of O₂-CO₂ gas exchange, the concentration and separation of *Chlorella*, and the dialysis of ionic salts in the growth medium are presented. C.E.

A90-15445

CLOSED AND CONTINUOUS ALGAE CULTIVATION SYSTEM FOR FOOD PRODUCTION AND GAS EXCHANGE IN CELSS

MITSUO OGUCHI, KOJI OTSUBO, KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan), ATSUHIRO SHIMADA, SHIGEO FUJII (Toa Nenryo Kogyo, Corporate Research and Development Laboratory, Saitama, Japan) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 169-177.
Copyright

A new cultivation system has been developed to produce algae continuously in a closed condition. Due to high food value, easy digestion, rapid growth, easy harvest, and high utilization efficiency of CO₂, *Spirulina maxima*, *Spirulina oscillatoria*, and *Spirulina subsalsa* are used in a liquid culture medium for food production and gas exchange in CELSS. These experiments were performed under the following conditions: light intensity at 3,000 to 10,000 lux; temperature at 30 C; pH at 8.6 to 10.5; internal pressure at 0.01 to 0.10 kgf/sq cm; O₂D at 10 to 30 percent; and a pumping speed of 820 to 2,000 ml/min. A computer system is set to control four operational modes of algae cultivation: ordinary mode, harvest mode, high pressure mode, and low pressure mode. All data are automatically recorded in the computer and transcribed into a graph. This new equipment is a primary ground-experiment model for cultivation of algae under space weightlessness conditions. C.E.

A90-15447* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PHASE SEPARATED MEMBRANE BIOREACTOR - RESULTS FROM MODEL SYSTEM STUDIES

G. R. PETERSEN, P. K. SESHAN (JPL, Pasadena, CA), and E. H. DUNLOP (Colorado State University, Fort Collins) (COSPAR, Plenary Meeting, 27th, Topical Meetings on Life Sciences and Space Research XXIII(3): Natural and Artificial Ecosystems, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 8, 1989, p. 185-193.
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The operation and evaluation of a bioreactor designed for high intensity oxygen transfer in a microgravity environment is described. The reactor itself consists of a zero headspace liquid phase separated from the air supply by a long length of silicone rubber tubing through which the oxygen diffuses in and the carbon dioxide diffuses out. Mass transfer studies show that the oxygen is film diffusion controlled both externally and internally to the tubing and not by diffusion across the tube walls. Methods of upgrading

the design to eliminate these resistances are proposed. Cell growth was obtained in the fermenter using *Saccharomyces cerevisiae* showing that this concept is capable of sustaining cell growth in the terrestrial simulation. Author

A90-15800

TELEOPERATORS

WILLIAM R. UTTAL (Arizona State University, Tempe) *Scientific American* (ISSN 0036-8733), vol. 261, Dec. 1989, p. 124-129.
Copyright

In the absence of fully autonomous robots, machines operated by a person at a distance can carry out tasks in remote or hostile environments. The fundamental challenge is to design powerful, flexible links between the human operator and the distant machine. The task is shaped as much by human perceptual, cognitive, and motor abilities as it is by engineering considerations. The prototype teleoperators described here show that most of the physical technology needed for these highly complex and useful teleoperators is already available. C.E.

A90-16352

ROBOTICS AND TELEOPERATION

IAN PARKER *Space* (ISSN 0267-954X), vol. 5, Nov.-Dec. 1989, p. 10-12.
Copyright

The use of telepresence and teleoperation for EVA is examined. The application of robotic technology to microgravity experiments, risk reduction for astronauts, and docking procedures is discussed. Current advances in robotics and the advantages they provide for space exploration and research are considered. I.F.

A90-16522

ACTIVE VIBRATION CONTROL FOR FLEXIBLE SPACE ENVIRONMENT USE MANIPULATORS

T. KOMATSU, M. UENOHARA, S. IIKURA (Toshiba Corp., Mechanical Engineering Laboratory, Kawasaki, Japan), H. MIURA, and I. SHIMOYAMA (Tokyo University, Japan) IN: *Dynamics of controlled mechanical systems*; Proceedings of the IUTAM/IFAC Symposium, Zurich, Switzerland, May 30-June 3, 1988. Berlin and New York, Springer-Verlag, 1989, p. 181-192. refs
Copyright

A new dynamic control system for flexible space manipulators has been developed from the practical viewpoint. The key concept is that the local position and torque PD feedback loop at each joint should be used for position and structural-vibration control. The manipulator dynamics is derived, and then feedback control is developed using an appropriate potential function. An experimental setup using an air-suspended SCARA flexible manipulator is described. The effectiveness of this method has been verified by experimental results, adapting it to automatic payload handling. Author

A90-16531* New York Univ., New York.

THE CASE FOR CELLULOSE PRODUCTION ON MARS

TYLER VOLK (New York University, NY) and JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC) IN: *The case for Mars III: Strategies for exploration* - Technical. San Diego, CA, Univelt, Inc., 1989, p. 87-94. refs
(Contract NCA2-101)
(AAS PAPER 87-232) Copyright

From examining the consequences of not requiring that all wastes from life support be recycled back to the food plants, it is concluded that cellulose production on Mars could be an important input for many nonmetabolic material requirements on Mars. The fluxes of carbon in cellulose production would probably exceed those in food production, and therefore settlements on Mars could utilize cellulose farms in building a Mars infrastructure. Author

A90-16533

A DIAGNOSTIC AND ENVIRONMENTAL MONITORING SYSTEM (DEMS) CONCEPT TO SUPPORT MANNED MARS IN-FLIGHT AND SURFACE OPERATIONS

CORINNE M. BUONI, MARK S. KOTUR, LARRY S. MILLER, and

BENJAMIN BARTILSON (Battelle Memorial Institute, Columbus, OH) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 107-127. refs (AAS PAPER 87-234) Copyright

A microbiological assay concept for both in-flight and Martian surface application is discussed. The Diagnostic and Environmental Monitoring System (DEMS), which combines state-of-the-art colorimetric and immunoassay technology is proposed. The advantages include the DEMS ability to conduct a large number of biological assay for a variety of samples (liquids, solids, and atmosphere), eliminate time-consuming culturing techniques, provide a high degree of selectivity and sensitivity, respond rapidly, meet the requirement for small size, and use commercially available reagents and assay techniques. The advantages and disadvantages of current and improved microbiological diagnostic and monitoring systems for a manned Mars mission are reviewed. The scientific basis of DEMS and the overall design and operational requirements are identified and discussed, including an engineering development strategy to create an initial version of DEMS available for Space Station applications. C.E.

A90-16534

A ZERO-G CELSS/RECREATION FACILITY FOR AN EARTH/MARS CREW SHUTTLE

ALICE EICHOLD (California, University, Berkeley) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 129-138. refs (AAS PAPER 87-235) Copyright

This paper presents a zero-gravity architectural design for a module on an earth/Mars crew shuttle. Although in the early stages of development and of uncertain immediate cost-effectiveness, Controlled Ecological Life Support (CELSS) promises the most synergetic long-term means for providing food, air and water as well as accommodating 'homesickness'. In this project, plant growth units have been combined with recreation facilities to ensure that humans have daily opportunities to view their gardens. Furthermore, human exercise contributes toward powering the mechanical systems for growing the plants. The solution was arrived at by the traditional architectural design process with an empirical emphasis. The solution consists of smaller volumes for exercise facilities and plant growth units contained within a large geometrical sphere. Moisture and heat-generating activities thus share facilities and favorable gas exchanges are exploited. Author

A90-16539

INDIVIDUAL DIFFERENCES, MISSION PARAMETERS, AND SPACEFLIGHT ENVIRONMENT HABITABILITY

ALBERT A. HARRISON, NANCY J. STRUTHERS, and BERNARD J. PUTZ (California, University, Davis) IN: The case for Mars III: Strategies for exploration - Technical. San Diego, CA, Univelt, Inc., 1989, p. 191-199. refs (AAS PAPER 87-240) Copyright

Preliminary results of empirical tests of a Three Factor Model of environmental habitability are discussed. The impact of individual differences, environmental attributes and mission parameters on the rated acceptability of space habitat attributes is analyzed. The individual differences include gender, age, occupational preferences, and preferred levels of activity. Environmental attributes include interior space availability, food and other nutritional quality, availability of good hygiene facilities, and protection against radiation, bone decalcification, cardiac deconditioning, and other medical or health risks. Mission parameters such as mission destination and crew size are manipulated experimentally. Both individual differences and mission parameters affected rated acceptability. It is concluded that spaceflight environment is considered equally acceptable for either a Mars or a moon base. C.E.

A90-16541

CONSIDERATIONS FOR THE LIVING AREAS WITHIN SPACE SETTLEMENTS

JOEL HAGEN IN: The case for Mars III: Strategies for exploration

- Technical. San Diego, CA, Univelt, Inc., 1989, p. 217-223. refs (AAS PAPER 87-242) Copyright

Physiology, physics and engineering set initial limits on space habitats. Beyond these factors, anthropological, sociological and aesthetic considerations become significant. Ideas on aesthetic use of space drawn from other cultures provide alternatives that could complement architectural and engineering concepts on efficient use of space. Planned off-world communities can be viewed as the current incarnation of the architectural utopia concept. An examination of two utopian cities built in the 50's, Brasilia and Chandigarh, may provide valuable lessons to the designers of orbital, lunar and Mars colonies. Both cities were intended to efficiently meet human needs, and are among the most interesting experiments in large-scale planned human habitats available to us. Their successes and failures are of particular relevance to planners of space habitats. Author

N90-12178*# Good Samaritan Hospital and Medical Center, Portland, OR. Dept. of Neuro-otology.

AGE-RELATED CHANGES IN HUMAN POSTURE CONTROL: MOTOR COORDINATION TESTS

R. J. PETERKA and F. O. BLACK 1989 13 p

(Contract NAG9-117)

(NASA-CR-185855; NAS 1.26:185855) Avail: NTIS HC A03/MF A01 CSCL 05/8

Postural responses to support surface displacements were measured in 214 normal human subjects ranging in age from 7 to 81 years. Motor tests measured leg muscle Electromyography (EMG) latencies, body sway, and the amplitude and timing of changes in center of pressure displacements in response to sudden forward and backward horizontal translations of the support surface upon which the subjects stood. There were small increases in both EMG latencies and the time to reach the peak amplitude of center of pressure responses with increasing age. The amplitude of center of pressure responses showed little change with age if the amplitude measures were normalized by a factor related to subject height. In general, postural responses to sudden translations showed minimal changes with age, and all age related trends which were identified were small relative to the variability within the population. Author

N90-12179# Pennsylvania State Univ., University Park. Dept. of Engineering Science and Mechanics.

WRIST ORIENTATION EFFECT ON GRIP STRENGTH AND ENDURANCE Final Report

JEAN LANDA PYTEL and THOMAS J. MACKIN 28 Nov. 1988 25 p

(Contract PHS-OH-02178)

(PB89-200935) Avail: NTIS HC A03/MF A01 CSCL 05/8

The study provides basic data about some factors that may affect the ability of an individual to apply a gripping force. The study determines the effect of wrist orientation on grip strength and grip endurance. Twenty men and 20 women were used as subjects. They were asked to apply a maximum static force to a grip dynamometer and maintain a maximum contraction until their gripping force falls to 70 percent of the peak. The duration of the grip force application was used as a measure of fatigue time or endurance. Peak forces and linear impulses (to determine how the gripping force changed) of the gripping forces at various wrist orientations were measured and related to the maximum values generated by each subject. Wrist orientations varied by 15-degree increments in wrist angle in four directions: plantar flexion, dorsiflexion, ulnar deviation and radial deviation. Relative changes in peak force, fatigue time and linear impulse were evaluated for all the subjects at all wrist positions and also compared between sex groups. This type of basic data is of use to those people who are concerned with musculoskeletal disorders. They will be able to suggest changes in the manner in which a tool is held in order to decrease the susceptibility of an individual to musculoskeletal disorders. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

N90-12180# California Univ., Irvine. Dept. of Cognitive Sciences.

DISCRIMINATING RIGID FROM NONRIGID MOTION Studies in the Cognitive Sciences

MYRON L. BRAUNSTEIN, DONALD D. HOFFMAN, and FRANK E. POLLICK 31 Jul. 1989 38 p
(Contract N00014-88-K-0354; N00014-87-G-0135; NSF BNS-88-19565; NSF IRI-87-00924; RR04209)
(AD-A211794; UCI-51) Avail: NTIS HC A03/MF A01 CSCL 05/8

Theoretical investigations of structure from motion have demonstrated that an ideal observer can discriminate rigid from nonrigid motion from two views of as few as four points. Three experiments are reported that demonstrate similar abilities in human observers: In one experiment 4 of 6 subjects made this discrimination from two views of four points; the remaining subjects required five points. Accuracy in discriminating rigid from nonrigid motion depended on the amount of nonrigidity in the nonrigid structure. The measure on nonrigidity was based on the variance of the interpoint distances over views. The ability to detect a rigid group dropped sharply as noise points (points not part of the rigid group) were added to the display. It is concluded that human observers do extremely well in discriminating between nonrigid and fully rigid motion, but do quite poorly at segregating points in a display on the basis of rigidity. GRA

N90-12181# Naval Personnel Research and Development Center, San Diego, CA.

THE EFFECT OF INCENTIVES ON THE RELIABILITY AND VALIDITY OF COGNITIVE SPEED TESTS Technical Report, FY 1987 - FY 1988

DENNIS P. SACCUZZO, GERALD E. LARSON, and JAMES BROWN (San Diego State Univ., CA.) Jul. 1989 50 p
(AD-A211346; NPRDC-TR-89-14) Avail: NTIS HC A03/MF A01 CSCL 05/8

In the present study, financial incentives were used to motivate test takers, so that the effect of motivation on elementary cognitive tests could be determined. One hundred and nine male and female volunteer college students were tested on a battery of microcomputerized cognitive tests. One hundred of these subjects returned for a second session in which they were randomly assigned to an incentive or no incentive condition and then retested. The effort expended on the tests were measured via heart rate, skin conductance, and a self-report questionnaire pertaining to the perceived level of difficulty of the tests and amount of effort expended on them. Criterion measures, including the Advanced Otis-Lennon Test of Mental Abilities, Standard and Advanced Raven Progressive Matrices, and scores on the Scholastic Aptitude Test were also taken. The findings revealed that incentives led to better performance only on the most complex task in the study. In no case, however, did incentives affect the overall IQ-performance correlation for the tests used in the battery. These results support the view that correlations between cognitive speed and intelligence reflect common mental capacities, rather than some affective variable such as motivation. GRA

N90-13035*# Johns Hopkins Univ., Baltimore, MD. Injury Prevention Center.

FATIGUE, PILOT DEVIATIONS AND TIME OF DAY Report, 15 Jul. 1988 - 30 Jun. 1989

SUSAN P. BAKER 23 Jun. 1989 36 p
(Contract NCC2-555)
(NASA-CR-185369; NAS 1.26:185369) Avail: NTIS HC A03/MF A01 CSCL 05/8

The relationships between pilot fatigue, pilot deviations, reported incidents, and time of day are examined. A sample of 200 Aviation Safety Reporting System (ASRS) reports were analyzed from 1985 and 200 reports from 1987, plus 100 reports from late 1987 and early 1988 that were selected because of possible association with fatigue. The FAA pilot deviation data and incident data were analyzed in relation to denominator data that summarized the hourly operations (landings and takeoffs of scheduled flights) at major U.S. airports. Using as numerators FAA data on pilot deviations

and incidents reported to the FAA, the rates by time of day were calculated. Pilot age was also analyzed in relation to the time of day, phase of flight, and type of incident. B.G.

N90-13036*# Auburn Univ., AL. Dept. of Aerospace Engineering.

PROPOSAL FOR A ZERO-GRAVITY TOILET FACILITY FOR THE SPACE STATION Final Report

EDGAR L. FLERI, JR., PAUL A. GALLIANO, MARK E. HARRISON, WILLIAM B. JOHNSON, and GREGORY J. MEYER Jun. 1989 56 p Sponsored by USRA
(Contract NASW-4435)
(NASA-CR-183151; NAS 1.26:183151) Avail: NTIS HC A04/MF A01 CSCL 06/11

This proposed toilet facility has a straightforward design. It has few moving parts and is easily maintained. Air and water flow provide sanitary movement of the waste. The toilet's chambers are coated with Teflon which, along with the water flow, makes it self-cleaning. An added disinfectant called Betadiene kills any bacteria that may form on the chamber walls. The chair is contoured to take into account the neutral body position and the necessary strain position for defecation. Restraints at the ankles, knees, and midsection hold the body in the chair. The waste is stored in discs of Gortex material which are inside a replaceable storage chamber. This chamber can be removed, capped and stored until eventual return to earth. Author

N90-13037# Advanced Decision Systems, Mountain View, CA.

TELEROBOTIC CONTROL FOR TEAMS OF SEMI-AUTONOMOUS AGENTS, PHASE 1 Final Report, 19 Jul. 1988 - 27 Feb. 1989

MARCEL SCHOPPERS and DANIEL SHAPIRO 20 Apr. 1989 37 p
(Contract DAAE07-88-C-R076)
(AD-A211648; ADS-TR-3213-01) Avail: NTIS HC A03/MF A01 CSCL 2/2

A Robotic Command Center is to be developed to allow a commander and two drivers (three people) to control four remote vehicles. The drivers will be attempting to control two vehicles each, a difficult task. Giving vehicles a measure of autonomy is one way to simplify that task. On the other hand, deployed vehicles must not be hampered by software with limited competence or reliability. The only solution available soon is a vehicle control interface that allows for the entire range of possibilities between autonomous behavior and continuous teleoperation. Ideas are fused from telerobotics and from the Reaction Planning subfield of Artificial Intelligence, to develop a technology that permits vehicles to react autonomously to expected circumstances, while also permitting the human operator to instruct vehicles about what to do and how to do it. This study will program some examples of behaviors for the vehicles to perform semi-autonomously, and those behaviors by running them in the Team Works I environment. An interface was designed and built that allows the vehicle driver to communicate with the intelligent software controlling any and all of the vehicles. A single person is capable of controlling four simulated vehicles at the same time. The competence of the vehicle is to be expanded to give the operator new ways of instructing the vehicles, and to push those capabilities toward deployment in the real world. GRA

N90-13038# Ecole Nationale Supérieure des Telecommunications, Paris (France).

STATE OF THE ART OF HUMAN/MACHINE DIALOG TOOL PROTOTYPES [ETAT DE L'ART SUR LES OUTILS DE PROTOTYPAGE DE DIALOGUE HOMME-MACHINE]

FRANCOIS CORNEC Jun. 1989 66 p In FRENCH
(TELECOM-PARIS-89-H001; ISSN-0751-1361; ETN-89-95505)
Avail: NTIS HC A04/MF A01

Computer man/machine interfaces available on the market are investigated and criticized. The need to develop interfaces with good graphic quality is stressed. The need for portable work stations directed the researcher to use a bitmap screen, and use of a Macintosh was not excluded. The ideal tool is identified as

one capable of operating on a wide variety of interface levels. The theory and function of different interface systems are outlined. ESA

N90-13039 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Speech and Hearing Group.
PRE- AND POSTFLIGHT POSTURAL CONTROL OF THE D1 SPACELAB MISSION ASTRONAUTS EXAMINED WITH A TILTING ROOM

W. BLES and J. L. VANRAAIJ Dec. 1988 26 p
(IZF-1988-25; TD89-0532; ETN-89-94462) Copyright Avail:
TNO Inst. for Perception, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The postural stability of the astronauts, examined with stabilometry in a tilting room, is examined. Postural control is effectuated again, on the preflight level, on the day after their return from space. Two of the astronauts are examined a few hours after their spaceflight and their postural control is affected. In one of them a preference for the visual information is found, resulting in a large body sway and disturbed spatial orientation. The other astronaut preferred otolith information and maintained postural control with effort. Theoretical background, experimental set up and consequences are discussed. No correlation is found between the behavior in the tilting room and spacesickness susceptibility. ESA

N90-13040# Laboratoire de Psychologie Experimentale, Grenoble (France).

PSYCHOLOGICAL MECHANISMS INVOLVED IN THE DISORIENTATION OF PILOTS DUE TO FLIGHT CONDITIONS Final Report [MECANISMES PSYCHOLOGIQUES IMPLIQUES PAR LE PILOTAGE DES SYSTEMES DE POINTAGE]

CHRISTIAN MARENDAZ and THEOPHILE OHLMANN 1988 20 p In FRENCH
(Contract DRET-86-047-00-470-75-01)
(ETN-89-95014) Avail: NTIS HC A03/MF A01

A flight simulation apparatus designed to test the disorientation effects of flight conditions is described. A pilot seat on a tri-axial mounting with a variety of visual simulation accessories is described. Tests carried out to determine what type of movements cause flight motion sickness are described. Different visual illusions are used to test pilots ability to deal with situations in which there is no horizon line reference. The use of such a simulation bench to select individuals best suited for fighter pilot service or space flight is stressed. ESA

N90-13041 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Human Performance Group.
SPATIAL TESTS FOR AVIATORS

L. C. BOER Aug. 1988 24 p
(Contract A85/K/077)
(IZF-1988-15; TD88-4123; ETN-89-95090) Copyright Avail:
TNO Inst. for Perception, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The spatial ability measured by tests and required in the cockpit of a fighter plane is discussed and new tests are proposed. They are based on tasks occurring in the cockpit, and include aspects such as the conflict between cognition and sensation, and the use of wide visual fields and moving objects. The spatial efficiency in the actual flying performance can be approximated by the use of checklists or rating scales for spatial performances in the air. Sense of direction, or navigation ability in real life are suggested as a secondary criterion. ESA

N90-13042 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Audiology Group.

APPLICATION OF ACTIVE NOISE REDUCTION FOR HEARING PROTECTION AND SPEECH INTELLIGIBILITY IMPROVEMENT

H. J. M. STEENEKEN and J. G. VANVELDEN Dec. 1988 24 p
(Contract A87/K/048)
(IZF-1988-21; TD89-0321; ETN-89-96005) Copyright Avail:
TNO Inst. for Perception, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

Two active noise reduction systems for improving the sound attenuation of earmuffs are evaluated. The sound attenuation is objectively and subjectively measured. The speech intelligibility of the intercom facility is measured in combination with noise. The system increases the sound attenuation at frequencies below 500Hz up with 10 to 20 dB. The intelligibility in noise with a level of 110 dB increases with 0.2 speech transmission index. A field evaluation experiment revealed that the active noise reduction systems do not work at noise levels above 120 dB. Below this level, most subjects preferred the active noise reduction systems to their earmuffs. ESA

N90-13043# Army Natick Research and Development Command, MA.

AIR FORCE FLIGHT FEEDING. VOLUME 1: EVALUATION OF CURRENT SYSTEM AND ALTERNATIVE CONCEPTS Final Report, Oct. 1982 - Jan. 1985

ROBERT OBRIEN, BARBARA BELL, and CHRISTOPHER REES Jul. 1989 157 p
(Contract DAAK60-83-C-0055)
(AD-A212789; NATICK/TR-89/039-VOL-1) Avail: NTIS HC A08/MF A01 CSCL 06/8

This report covers the initial phase of the project, during which the current Air Force flight feeding system was evaluated via an extensive data collection and analysis effort. Project objectives included development of a new flight feeding system concept to meet the needs of current flight missions as well as those of the coming decade, improved flight meal customer acceptance, and increased operating efficiency of flight kitchens. Crew opinions were obtained through 2,811 mail survey and 146 on-site surveys. Feedback was received on availability and acceptability of menu items, adequacy of galley equipment on board the aircraft, and flight feeding issues in general. Project team members visited several Air Force bases to observe flight kitchens in operation, to collect technical data on selected aircraft, and to meet with key personnel (crew members, food service personnel, aircraft maintenance representatives) to determine current flight feeding deficiencies and to identify possible solutions. Structured telephone surveys of 40 Air Force flight kitchens were conducted to determine equipment inventories, work space, storage space, and personnel resources. GRA

55

SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A90-16035

HOW DID THE FIRST CELLS APPEAR? [KAK POIAVILIS' PERVYE KLETKI?]

DAVID DEAMER (California, University, Davis), AL'FA I. MIKHAILOV (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR), and SERGEI A. SELEZNEV (Tselinogradskii Meditsinskii Institut, Tselinograd, Kazakh SSR) Priroda (ISSN 0032-874X), Oct. 1989, p. 3-9. In Russian. refs
Copyright

The stage of chemical evolution preceding biological evolution is examined. An unorthodox scheme of biogenesis is proposed with the following sequence of events preceding the appearance of the first organisms: (1) the appearance of primordial membrane-separated cells made up of relatively simple molecules, (2) the appearance of cells containing oligopeptides, and (3) the appearance of genetic material. In contrast to Oparin's model based on the probability of the spontaneous appearance of protein aggregates, the present conception is based on the possibility of the abiogenic synthesis of relatively simple lipidlike molecules forming closed layered systems. B.J.

55 SPACE BIOLOGY

A90-16160* Chicago Univ., IL.

PRE-BIOTIC ORGANIC MATTER FROM COMETS AND ASTEROIDS

EDWARD ANDERS (Chicago, University, IL) *Nature* (ISSN 0028-0836), vol. 342, Nov. 16, 1989, p. 255-257. Research supported by NASA. refs

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Only meteoritic fragments small enough to be gently decelerated by the atmosphere (10 to the -12th g to 10 to the -6th g) can deliver organic matter intact. The amount of such 'soft-landed' organic carbon can be estimated from data for the infall rate of meteoritic matter. At present rates, only about 0.0006 g/sq cm intact organic carbon would accumulate in 100 million years, but at the higher rates of about four billion yr ago, about 20 g/sq cm may have accumulated in the few hundred million years between the last cataclysmic impact and the beginning of life. It may have included some biologically important compounds that did not form by abiotic synthesis on earth. C.D.

A90-16360

3.5 BILLION YEARS AGO: LIFE ON MARS? HINTS, INDICATIONS, SPECULATIONS [VOR 3,5 MILLIARDEN JAHREN: LEBEN AUF DEM MARS? HINWEISE, INDIZIEN, SPEKULATIONEN]

JOHANNES FIEBAG (Karlstadt, Landratsamt, Federal Republic of Germany) *Astronautik* (ISSN 0004-6221), vol. 26, July-Sept. 1989, p. 81-83. In German. refs

Copyright

The geological aspects of Mars which bear on the possibility of life having existed there 3.5 Gyr ago are discussed. Cryptoendolithic organisms in Antarctica and algal mats in ice-covered seas are examined as examples of organisms that could survive under Martian conditions. The Elephant Moraine meteorite is considered as a possible evidence of extraterrestrial life. Evidence for the existence of extensive moisture on Mars in the distant past is discussed. C.D.

N90-12804*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE NASA SETI SKY SURVEY: RECENT DEVELOPMENTS

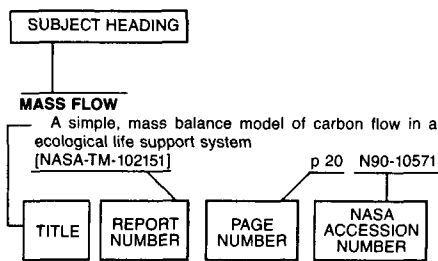
M. J. KLEIN, S. GULKIS, E. T. OLSEN, and N. A. RENZETTI *In its* The Telecommunications and Data Acquisition Report p 218-226 15 Aug. 1989 Previously announced in IAA as A89-17852

Avail: NTIS HC A11/MF A02 CSCL 06/3

NASA's Search for Extraterrestrial Intelligence (SETI) project utilizes two complementary search strategies: a sky survey and a targeted search. The SETI team at the Jet Propulsion Laboratory (JPL) in Pasadena, California, has primary responsibility to develop and carry out the sky survey part. Described here is progress that has been made developing the major elements of the survey including a 2-million channel wideband spectrum analyzer system that is being designed and constructed by JPL for the Deep Space Network (DSN). The system will be a multiuser instrument; it will serve as a prototype for the SETI sky survey processor. This prototype system will be used to test the signal detection and observational strategies on DSN antennas in the near future.

Author

Typical Subject Index Listing



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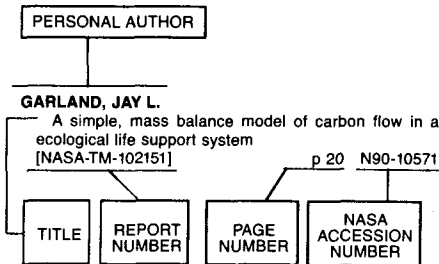
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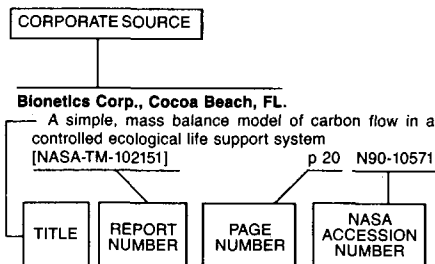
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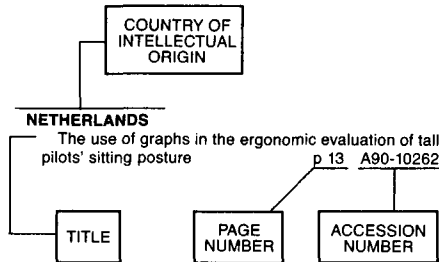
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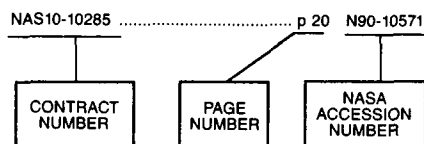
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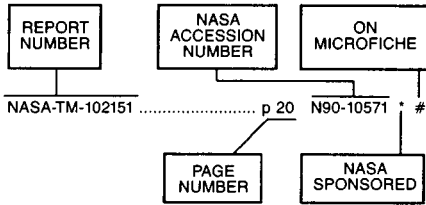


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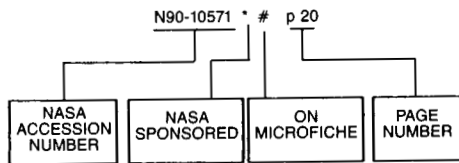
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