

NASA SP-7011 (362)

May 1992

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P-118

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(NASA-SP-7011(362)) AEROSPACE MEDICINE AND
BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH
INDEXES (SUPPLEMENT 362) (NASA) 118 p

N92-27068

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NASA SP-7011 (362)

May 1992

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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

1992

INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 357 reports, articles and other documents originally announced in April 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-15962 — N92-18005
IAA (A-10000 Series)	A92-20827 — A92-24398

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

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the respective announcement journals.

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

A cumulative index for 1992 will be published in early 1993.

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

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER → N92-11637*# ← CORPORATE SOURCE
Vanderbilt Univ., Nashville, TN. Dept. of Electrical Engineering.

TITLE → ROBOT GRAPHIC SIMULATION TESTBED Final Report

AUTHORS → GEORGE E. COOK, JANOS SZTIPANOVITS, CSABA BIEGL, GABOR KARSAL, and JAMES F. SPRINGFIELD Aug. 1991 ← PUBLICATION DATE
119 p Original contains color illustrations

CONTRACT NUMBER → (Contract NAG8-690) ← AVAILABILITY SOURCE

REPORT NUMBERS → (NASA-CR-188998; NAS 1.26:188998) Avail: NTIS HC/MF A06; ← PRICE CODE
12 functional color pages CSCL 06/11 ← COSATI CODE

The objective of this research was twofold. First, the basic capabilities of ROBOSIM (graphical simulation system) were improved and extended by taking advantage of advanced graphic workstation technology and artificial intelligence programming techniques. Second, the scope of the graphic simulation testbed was extended to include general problems of Space Station automation. Hardware support for 3-D graphics and high processing performance make high resolution solid modeling, collision detection, and simulation of structural dynamics computationally feasible. The Space Station is a complex system with many interacting subsystems. Design and testing of automation concepts demand modeling of the affected processes, their interactions, and that of the proposed control systems. The automation testbed was designed to facilitate studies in Space Station automation concepts.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER → A92-10353

TITLE → EFFECTS OF HYPOXIA AND COLD ACCLIMATION ON THERMOREGULATION IN THE RAT

AUTHORS → H. GAUTIER, M. BONORA, S. B. M'BAREK, and J. D. SINCLAIR ← AUTHORS' AFFILIATION
(Paris VI, Universite, France; Auckland, University, New Zealand)

JOURNAL TITLE → Journal of Applied Physiology (ISSN 0161-7567), vol. 71, Oct. 1991, p. 1355-1363. Research supported by Institut National de la Sante et de la Recherche Medicale. refs ← PUBLICATION DATE

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Results are reported from an experimental study tracing the effects of hypoxia on thermoregulation and on the different sources of thermogenesis in rats before and after periods of 1-4 wk of cold acclimation. Measurements of the metabolic rate (VO₂) and body temperature (T_b) were made at 5-min intervals, and shivering activity was recorded continuously in groups of rats subjected to three protocols. Recordings were made in normoxia and in hypoxia on different days in the same animals. The results show that: (1) in noncold-acclimated (NCA) rats, cold exposure induced increases in VO₂ and shivering that were proportional to the decrease in T_a; (2) in cold-acclimated (CA) rats in normoxia, for a given ambient temperature, VO₂ and T_b were higher than in NCA rats, whereas shivering was generally lower; and (3) in both NCA and CA rats, hypoxia induced a transient decrease in shivering and a sustained decrease in nonshivering thermogenesis associated with a marked decrease in T_b that was about the same in NCA and CA rats. It is concluded that hypoxia acts on T_b control to produce a general inhibition of thermogenesis.

P.D.

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 362)

May 1992

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LIFE SCIENCES (GENERAL)

A92-20827 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

LIFE SCIENCES AND SPACE RESEARCH XXIV(1) - GRAVITATIONAL BIOLOGY; PROCEEDINGS OF SYMPOSIA 10 AND 13 OF THE TOPICAL MEETING OF THE INTERDISCIPLINARY SCIENTIFIC COMMISSION F (MEETINGS F1 AND F2) OF THE COSPAR 28TH PLENARY MEETING, THE HAGUE, NETHERLANDS, JUNE 25-JULY 6, 1990

R. S. YOUNG, ED. (NASA, Kennedy Space Center, Cocoa Beach, FL), A. COGOLI, ED. (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), H. PLANEL, ED. (Toulouse III, Universite, France), G. A. UBBELS, ED. (Netherlands Institute for Developmental Biology, Utrecht), A. SIEVERS, ED. (Bonn, Universitaet, Federal Republic of Germany), H. OSER, ED. (ESA, Paris, France), G. HORNECK, ED. (DLR, Cologne, Federal Republic of Germany), and H. WAGNER, ED. (Saarland, Universitaet, Saarbruecken, Federal Republic of Germany) Meeting sponsored by COSPAR, ESA, NASA, et al. *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, 411 p. For individual items see A92-20828 to A92-20878.

Copyright

Topics presented include an introduction to theories and models of biological response to gravity, gravity effects on biological systems, the function of calcium in plant graviperception, developmental biology on unmanned spacecraft, and the effect of microgravity on the development of plant protoplasts flown on Biocosmos 9. Also presented are the mechanism by which an asymmetric distribution of plant growth hormone is attained, the perception of gravity by plants, an animal research facility for Space Station Freedom, the long-term effects of microgravity and possible countermeasures, and an experimental system for determining the influence of microgravity on B lymphocyte activation and cell fusion. R.E.P.

A92-20828

GRAVITY DETECTION THROUGH BIFURCATION

D. K. KONDEPUDI and P. B. STORM (Wake Forest University, Winston-Salem, NC) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 7-14. refs

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Bifurcation is a phenomenon in which a physical system is forced to make a choice between one of the several possible states to which it can evolve. In this process the system can become extremely sensitive to very small influences - smaller than the size of the fluctuations - that favor one of the states. A general theory of this sensitivity and a simple model for gravity detection

is presented. The difference between systems in thermodynamic equilibrium and those that are far from equilibrium is also discussed. Author

A92-20829

POSSIBLE ACTIONS OF GRAVITY ON THE CELLULAR MACHINERY

D. A. M. MESLAND (ESTEC, Noordwijk, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 15-25. refs

Copyright

Since the first flight of the ESA Biorack on the German Spacelab Mission D1 in 1985 evidence has been obtained that biological cells and small unicellular organisms function differently under conditions of microgravity. However, there is still lack of scientific proof that these effects are caused by a direct influence on the cells in the weightlessness condition. The question how normal gravity may play a role in cellular activity is being addressed and the results show that gravity may provide important signals during certain state transitions in the cell. These would be gravity-sensitive windows in the biological process. Also, by amplification mechanisms inside the cell, the cell may assume a state that is typical for normal gravity conditions and would change in microgravity. Experimental tools are discussed that would provide the conditions to obtain evidence for direct action of gravity and for the possible existence of gravity-sensitive windows. Author

A92-20830

BIOLOGICAL ROLE OF GRAVITY - HYPOTHESES AND RESULTS OF EXPERIMENTS ON 'COSMOS' BIOSATELLITES

ALEKSEI M. ALPATOV, VSEVOLOD V. ANTIPOV, and MURAD G. TAIRBEKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 27-32. refs

Copyright

To determine the biological significance of gravity, microgravity effects have been studied at the cellular, organism and population levels. Attention is given to whether cell adaptation to weightlessness is possible, whether any gravity-dependent processes exist in a cell, and whether the integral characteristics of living beings change in weightlessness. These questions are addressed from a theoretical viewpoint, and using results obtained in experiments aboard Cosmos biosatellites. R.E.P.

A92-20831

THEORY AND EXPERIMENTAL RESULTS ON GRAVITATIONAL EFFECTS ON MONOCELLULAR ALGAE

JOHN O. KESSLER (Arizona, University, Tucson) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of

51 LIFE SCIENCES (GENERAL)

the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 33-42. Research supported by University of Arizona Foundation. refs
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It is noted that the orientation of a body that has an anisotropic distribution of mass and which is suspended in water is biased by gravitational torque, so that the center of gravity lies below the center of buoyancy. Populations of single cells, moving in the presence of gravity, are coupled through fluid/mechanical interactions that cause temporal and spatial patterns of fluid convection and cell concentration. These patterns change the cell's environmental interactions, by assisting downward migrations of cell populations, by mixing the embedding fluid and its contents, and by providing a collective mechanism for controlling light intensity at the individual cell level. In summary, gravity modulates the interaction of algal cells with their environment and with each other. R.E.P.

A92-20832* National Inst. of Standards and Technology, Boulder, CO.

PHYSICAL EFFECTS AT THE CELLULAR LEVEL UNDER ALTERED GRAVITY CONDITIONS

PAUL TODD (NIST, Boulder, CO) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 43-49. refs
(Contract NASA ORDER H-89756-B)

Several modifications of differentiated functions of animal cells cultivated *in vitro* have been reported when cultures have been exposed to increased or decreased inertial acceleration fields by centrifugation, clinorotation, and orbital space flight. Variables modified by clinorotation conditions include inertial acceleration, convection, hydrostatic pressure, sedimentation, and shear stress, which also affect transport processes in the extracellular chemical environment. Autocrine, paracrine and endocrine substances, to which cells are responsive via specific receptors, are usually transported *in vitro* (and possibly in certain embryos) by convection and *in vivo* by a circulatory system or ciliary action. Increased inertial acceleration increases convective flow, while microgravity nearly abolishes it. In the latter case the extracellular transport of macromolecules is governed by diffusion. By making certain assumptions it is possible to calculate the Peclet number, the ratio of convective transport to diffusive transport. Some, but not all, responses of cells *in vitro* to modified inertial environments could be manifestations of modified extracellular convective flow.

Author

A92-20833

GRAVITY EFFECTS ON BIOLOGICAL SYSTEMS

A. SCHATZ, R. REITSTETTER, W. BRIEGLEB, and A. LINKE-HOMMES (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 51-53. refs
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Theoretical investigations of the membrane-solution interface predict different effects of gravity on vertically and horizontally oriented planar membranes. Single channel events of gramicidin incorporated into phosphatidylserine planar bilayer membranes were measured in 0.1 M KCl solution, pH 7, at room temperature. The potential difference across the membrane was set to ± 70 mV. The mean channel current was observed to be about 20 percent higher in horizontally oriented membranes compared to vertical membranes. This is in good agreement with the theoretical considerations and demonstrates that gravity does affect

membrane processes by interaction with the membrane-solution interface which is a ubiquitous structure in biological systems.

Author

A92-20834* Eidgenoessische Technische Hochschule, Zurich (Switzerland).

REDUCED LYMPHOCYTE ACTIVATION IN SPACE - ROLE OF CELL-SUBSTRATUM INTERACTIONS

F. K. GMUENDER, M. KIESS, J. LEE, A. COGOLI (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), and G. SONNENFELD (Louisville, University, KY) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 55-61. Research supported by Eidgenoessische Technische Hochschule Zuerich and ESA. Previously announced in STAR as N91-19621. refs
(Contract NAG9-181)
Copyright

The effect of substratum adhesiveness on lymphocyte responsiveness was investigated by reducing and blocking cell adhesion with poly-HEMA in a simple on ground system. Cells grown on medium thick and thick poly-HEMA films were rounded in shape and displayed no signs of spreading. By contrast, on tissue culture plastic and very thin poly-HEMA films, they showed clear signs of spreading. The mitogenic response of lymphocytes grown on thick poly-HEMA films was reduced by up to 68 percent of the control (tissue culture plastic). Interferon gamma production was virtually nil when the cells were grown on the least adhesive substratum. These results show that activated lymphocytes need to anchor and spread prior to achieving an optimal proliferation response. It is concluded that decreased lymphocyte adhesion could contribute to the depressed *in vitro* lymphocyte responsiveness found in the microgravity conditions of space flight.

Author

A92-20835

SYNAPTIC PLASTICITY AND GRAVITY - ULTRASTRUCTURAL, BIOCHEMICAL AND PHYSICO-CHEMICAL FUNDAMENTALS

H. RAHMANN, K. SLENZKA, K. H. KOERTJE, and R. HILBIG (Stuttgart, Universitaet, Federal Republic of Germany) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 63-72. refs
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Based on quantitative disturbances of the swimming behavior of aquatic vertebrates following long-term hyper g exposure the problem studied is whether or not changes in the gravitational vector might influence the central nervous system at the cellular level. By means of biochemical, histological, and histochemical analyses the effect of 2-4 x g for nine days on the gross morphology of the fish brain, and on different neuronal enzymes is investigated. Ultrastructural peculiarities of synaptic contact formation in gravity-related integration centers were observed. Results are discussed on the basis of a direct effect of hypergravity not only on the gravity-sensitive neuronal integration centers but possibly also on the physico-chemical properties of the lipid bilayer of neuronal membranes in general. R.E.P.

A92-20836 State Univ. of New York, Stony Brook.

CHROMOSOMES AND PLANT CELL DIVISION IN SPACE - ENVIRONMENTAL CONDITIONS AND EXPERIMENTAL DETAILS

H. G. LEVINE and A. D. KRIKORIAN (New York, State University, Stony Brook) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission

F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 73-82. refs
(Contract NAS1-11395; NAGW-1529)

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Details of the plant cultivation system developed for the CHROMEX experiment flown aboard the Shuttle Discovery (March, 1989) in NASA's Plant Growth Unit (PGU) are presented. The physical regime as measured during Spaceflight, both within the orbiter cabin environment and within the PGU itself, is discussed. These data function as a guide to what may be representative of the environmental regime in which Space-based plant cultivation systems will be operating, at least for the near-term. Attention is also given to practical considerations involved in conducting a plant experiment in Space. Of particular importance are the differences expected to occur in moisture distribution patterns within substrates used to cultivate plants in space vs on earth. Author

A92-20837

THE FUNCTION OF CALCIUM IN PLANT GRAVIPERCEPTION
N. A. BELIAVSKAIA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 83-91. refs

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Recent test results have demonstrated that the calcium second-messenger system plays an essential role in induction of graviresponsiveness. Data that stimuli of various nature produce a rise of hyaloplasm Ca level revealed by means of a pyroantimonate technique, and complete inhibition of the gravitropism in roots of pea seedlings, provide indirect but consistent evidence of this role of Ca ions. Space flight experimental data are reviewed and an attempt is made to compare these results with ground-based observations. R.E.P.

A92-20838

ULTRASTRUCTURAL ANALYSIS OF ORGANIZATION OF ROOTS OBTAINED FROM CELL CULTURES AT CLINOSTATING AND UNDER MICROGRAVITY

A. G. PODLUTSKII (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 93-98. refs

Copyright

Comparative analysis data on rhizogenesis in the *Arabidopsis thaliana* tissue culture growing in a solid nutrient medium under stationary conditions, clinostatic conditions and microgravity are presented. Tissue samples were set in Petrie dishes and placed in a horizontal slow clinostat (2 rev/min). The formed root cap manifested no essential differences, compared to the stationary control in the number of layers and cell sizes in its layers. R.E.P.

A92-20839

THE ROLE OF CELLULASES IN THE MECHANISM OF CHANGES OF CELL WALLS OF FUNARIA HYGROMETRICA MOSS PROTONEMA AT CLINOSTATING

E. M. NEDUKHA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances*

in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 99-102. refs

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Using biochemical and electroncytochemical techniques, differences between the cytochemical reaction intensity and activity of the cellulolytic enzymes in *Funaria hygrometrica* moss cells grown for 30 days in a horizontal clinostat (2 rev/min) and in a control are presented. It is shown that on clinostating, the precipitate size and amount increases with the cellulase activity enhancement in the periplasmic space and protonema cell walls, when compared to the control. Data obtained on the possible mechanism of cellulase activation and synthesis inhibition and cellulose crystallization in plant cell walls in the case of clinostating are discussed. R.E.P.

A92-20840

PECULIARITIES OF THE SUBMICROSCOPIC ORGANIZATION OF CHLORELLA CELLS CULTIVATED ON A SOLID MEDIUM IN MICROGRAVITY

K. M. SITNIK, A. F. POPOVA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR), G. S. NECHITAILO (NPO Energiia, Moscow, USSR), and A. L. MASHINSKII (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 103-107. refs

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A study was conducted of the submicroscopic organization of *Chlorella vulgaris* cells grown over 30 days on a solid agarized medium aboard the Mir orbital station. Comparative cytological analysis shows general regularities of rearrangements of the submicroscopic organization in *Chlorella* cells cultivated on both semiliquid and solid agarized nutrient media. R.E.P.

A92-20841

CONFOCAL MICROSCOPY IN MICROGRAVITY RESEARCH

A. P. H. GOEDE, J. P. IMHOF, P. VAN KRALINGEN, W. A. MELS, P. SCHREINEMAKERS, A. ZEGERS (SRON, Utrecht, Netherlands), G. J. BRAKENHOFF, C. L. WOLDRINGH (Amsterdam, University, Netherlands), and J. W. G. AALDERS (SRON, Groningen, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 109-112. refs

(Contract ESTEC-7336/87/NL/PB(SC))

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The application and the feasibility of confocal scanning laser microscopy in microgravity research are studied. Its superior spatial resolution and 3D imaging capabilities and its use of light as a probe, render this instrument ideally suited for the study of living biological material on a (sub-)cellular level. In this paper a number of pertinent biological microgravity experiments is listed, concentrating on the direct observation of developing cells and cellular structures under microgravity condition. A conceptual instrument design is also presented, aimed at sounding rocket application followed by Biorack/Biolab application at a later stage. Author

A92-20842

SWIMMING BEHAVIOR OF PARAMECIUM - FIRST RESULTS WITH THE LOW-SPEED CENTRIFUGE MICROSCOPE (NIZEMI)

R. HEMMERSBACH-KRAUSE, W. BRIEGLEB (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), and D.-P. HAEDER (Erlangen-Nuernberg, Universitaet, Erlangen, Federal Republic of Germany) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission

F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 113-116. refs
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The low-speed centrifuge microscope NIZEMI is used to investigate the effects of slightly increased gravity in the fields of biology and material sciences. The swimming behavior of the *Paramecium* is studied in the NIZEMI, aided by a computer-controlled image analysis system. In the 1-g to 5-g acceleration range, cells retained their swimming capability, did not sediment, and even increased the precision of their negative gravitaxis, but reduced their mean swimming velocity. R.E.P.

A92-20843

DEVELOPMENTAL BIOLOGY ON UNMANNED SPACE CRAFT

GEERTJE A. UBBELS (Netherlands Institute for Developmental Biology, Utrecht) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 117-122. refs
Copyright

Sounding rocket flights have provided important basic new information about the influence of the lack of gravity on particular developmental processes, even with the short period (6-7 min) of real microgravity. ESA and the USSR have begun collaboration in the Biocosmos-9 mission with the aim of providing additional unmanned flight opportunities with a duration of 10-14 days. Considerable progress in methodology has been shown. Microgravity experiments have begun and cell and molecular biological approaches are increasingly applied. R.E.P.

A92-20844

THE EFFECT OF MICROGRAVITY ON THE DEVELOPMENT OF PLANT PROTOPLASTS FLOWN ON BIOKOSMOS 9

T.-H. IVERSEN, C. BAGGERUD (Trondheim, University, Norway), O. RASMUSSEN (Aarhus, University, Denmark), F. GMUENDER (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), E. L. KORDIUM (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR), V. V. LOZOVAIA (AN SSSR, Biologicheskii Institut, Kazan, USSR), and M. TAIRBEKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 123-131. Research supported by NAF. refs
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Preparatory experiments for the IML-1 Space Shuttle mission have been performed using both slow and fast rotating clinostats and in orbit to study the effect of real and simulated weightlessness on protoplast regeneration. In general, the regeneration processes studied were retarded in the flight samples with respect to the ground controls. Results are discussed and compared to those obtained on Biocosmos 9. R.E.P.

A92-20845

STRUCTURAL AND FUNCTIONAL ORGANISATION OF REGENERATED PLANT PROTOPLASTS EXPOSED TO MICROGRAVITY ON BIOKOSMOS 9

D. A. KLIMCHUK, E. L. KORDIUM, L. A. DANEVICH, E. B. TARNAVSKAIA (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR), M. G. TAIRBEKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), T.-H. IVERSEN, C. BAGGERUD (Trondheim, University, Norway), and O. RASMUSSEN (Aarhus, University, Denmark) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission

F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 133-140. refs
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Preparatory tests for the IML-1 mission utilizing plant protoplasts were flown on a 14 day flight aboard Biocosmos 9 during September 1989. Ultrastructural and fluorescence analysis of cell aggregates from hypocotyl cells of rapeseed and suspension cultures of carrot protoplasts, cultured under microgravity conditions, was performed. The processes of cell proliferation and differentiation under microgravity did not differ significantly from those under normal gravity conditions. Various aspects of utilizing isolated protoplasts for clarifying the mechanisms of biological effects of micro-g are discussed. R.E.P.

A92-20846

LYMPHOCYTES ON SOUNDING ROCKETS

M. COGOLI, B. BECHLER, A. COGOLI (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), N. ARENA, S. BARNI, P. PIPPIA, G. SECHI, N. VALORA (Sassari, Università, Italy), and R. MONTI (Napoli, Università, Naples, Italy) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 141-144. Research supported by Eidgenoessische Technische Hochschule Zuerich and ASI. Previously announced in STAR as N91-19620. refs

(Contract SNSF-3,338-0,86)

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In two experiments performed on sounding rockets the early steps of the binding of Concanavalin A (Con A) to human lymphocytes under microgravity conditions were studied. No significant difference in the binding of Con A to lymphocytes and subsequent patching and capping between the flight samples and 1 g ground control were observed. In a further experiment the effect of gravity on the cytoskeletal structure of lymphocytes was investigated. Preliminary results indicate that the structure of vimentin may be influenced by altered gravity conditions. Author

A92-20847

IDENTIFICATION OF SPECIFIC GRAVITY SENSITIVE SIGNAL TRANSDUCTION PATHWAYS IN HUMAN A431 CARCINOMA CELLS

P. J. RIJKEN, A. J. VERKLEIJ, J. BOONSTRA (Utrecht, State University, Netherlands), R. P. DE GROOT, W. KRUIJER, and S. W. DE LAAT (Netherlands Institute for Developmental Biology, Utrecht) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 145-152. Research supported by NWO. refs
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The influence of gravity on epidermal growth factor-(EGF) induced EGF-receptor clustering and early gene expression as well as on actin polymerization and actin organization were investigated. Preliminary results indicate that EGF-induced EGF-receptor clustering stayed unchanged irrespective of the gravity conditions. R.E.P.

A92-20848

POSSIBLE MECHANISM OF MICROGRAVITY IMPACT ON CARAUSIUS MOROSUS ONTOGENESIS

I. A. USHAKOV and A. M. ALPATOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of

the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 153-155. refs
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Experiments aboard 'Spacelab-D1' and 'Cosmos-1887' revealed an adverse effect of space flight on *Carausius morosus* embryos. The main influencing factor for stick insect eggs turned out to be microgravity, while the contribution of HZE particles of cosmic radiation was relatively low. Flight experiments indicated an increased vulnerability of stick insect eggs to microgravity at intermediate stages of development, that could support the 'convection' hypothesis. Author

A92-20849

MICROGRAVITY EFFECTS ON DROSOPHILA MELANOGASTER DEVELOPMENT AND AGING -

COMPARATIVE ANALYSIS OF THE RESULTS OF THE FLY

EXPERIMENT IN THE BIKOSMOS 9 BIOSATELLITE FLIGHT
R. MARCO, J. GONZALEZ-JURADO, M. CALLEJA, R. GARESSE, M. MAROTO (Madrid, Universidad Autonoma; Instituto de Investigaciones Biomedicas, Spain), E. RAMIREZ, M. C. HOLGADO, E. DE JUAN, and J. MIQUEL (Alicante, Universidad, Spain) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 157-166. Research supported by Plan Nacional del Espacio and ESA. refs
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A92-20850* Wisconsin Univ., Madison.

MICROGRAVITY EFFECTS OF SEA URCHIN FERTILIZATION AND DEVELOPMENT

S. STEFFEN, C. SIMERLY, H. SCHATTEN, G. SCHATTEN (Wisconsin, University, Madison), and R. FISER (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 167-173. refs
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Gravity has been a pervasive influence on all living systems and there is convincing evidence to suggest that it alters fertilization and embryogenesis in several developmental systems. Notwithstanding the global importance of gravity on development, it has only been recently possible to begin to design experiments which might directly investigate the specific effects of this vector. The goal of this research program is to explore and understand the effects of gravity on fertilization and early development using sea urchins as a model system. Sea urchin development has several advantages for this project including the feasibility of maintaining and manipulating these cells during spaceflight, the high percentage of normal fertilization and early development, and the abundant knowledge about molecular, biochemical, and cellular events during embryogenesis which permits detailed insights into the mechanism by which gravity might interfere with development. Furthermore, skeletal calcium is deposited into the embryonic spicules within a day of fertilization permitting studies of the effects of gravity on bone calcium deposition. Author

A92-20851* Indiana Univ., Bloomington.

UNDERSTANDING THE ORGANIZATION OF THE AMPHIBIAN EGG CYTOPLASM - GRAVITATIONAL FORCE AS A PROBE

ANTON W. NEFF, GEORGE M. MALACINSKI, HIROKI YOKOTA (Indiana University, Bloomington), and MASAMI WAKAHARA (Hokkaido University, Sapporo, Japan) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR

28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 175-180. refs
(Contract NAGW-1548)
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A combination of hypergravity (centrifugation) and hypogravity (clinostat) studies have been carried out on amphibian (frog, *Xenopus*) eggs. The results reveal that the twinning caused by centrifugation exhibits substantial spawning to spawning variation. That variation can be attributed to the apparent viscosity of the egg's internal cytoplasm. Simulated hypogravity results in a relocation of the egg's third (horizontal) cleavage furrow, toward the equator. Substantial egg-to-egg variation is also observed in this 'cleavage effect'. For interpreting spaceflight data and for using G-forces as probes for understanding the egg's architecture the egg variation documented herein should be considered. Author

A92-20852

FERTILIZATION AND DEVELOPMENT OF EGGS OF THE SOUTH AFRICAN CLAWED TOAD, XENOPUS LAEVIS, ON SOUNDING ROCKETS IN SPACE

GEERTJE A. UBBELS, SONJA KERKVLIT, JENNY NARRAWAY (Netherlands Institute for Developmental Biology, Utrecht), and WILLEM BERENDSEN (Utrecht, State University, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 181-194. Research supported by SRON. refs
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Egg rotation and centrifugation experiments strongly suggest a role for gravity in the determination of the spatial structure of amphibian embryos. Decisive experiments can only be made in space. Eggs of *Xenopus laevis*, the South African clawed toad, were the first vertebrate eggs which were successfully fertilized on sounding rockets in space. Unfixed, newly fertilized eggs survived reentry, and a reasonable number showed a seemingly normal gastrulation but died between gastrulation and neurulation. Only a few reached the larval stage, but these developed abnormally. It is intended to test whether this abnormal morphogenesis is due to reentry perturbations, or due to a real microgravity effect, through perturbation of the reinitiation of meiosis and other processes, or started by later sperm penetration. Author

A92-20853

PERCEPTION OF GRAVITY BY PLANTS

THOMAS BJORKMAN (Washington, University, Seattle) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 195-201. refs
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Physical principles can be used to predict some features about the gravity perception system in plants. The nature of the system has made it rather elusive, so this approach represents an additional source of information to help find it. For a gravitational stimulus to be detected, two masses must move relative to each other in a manner which causes a significant amount of work to be done on a receptor. Relative to cellular dimensions, the masses must be large, be dense and move noticeable distances. The main sources of noise are thermal motion and flexing of the plant tissue. Some new models for the function of amyloplasts as statoliths are presented. Author

51 LIFE SCIENCES (GENERAL)

A92-20854 Michigan State Univ., East Lansing.
THE MECHANISM BY WHICH AN ASYMMETRIC DISTRIBUTION OF PLANT GROWTH HORMONE IS ATTAINED
ROBERT S. BANDURSKI, AGA SCHULZE, PHILIP JENSEN, MARK DESROSIERS (Michigan State University, East Lansing), BERNARD EPEL (Tel Aviv University, Israel), and STANLEY KOWALCZYK (Torun, University, Poland) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 203-210. refs (Contract NAGW-97; NAG10-0067; NAG2-362; NSF DCB-88-05148)
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A92-20855
THE ROLE OF CALCIUM IN THE REGULATION OF HORMONE TRANSPORT IN GRAVISTIMULATED ROOTS
MICHAEL L. EVANS (Ohio State University, Columbus), LINDA M. YOUNG (Ohio Northern University, Ada), and KARL H. HASENSTEIN (Southwestern Louisiana, University, Lafayette, LA) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 211-218. refs
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The role of calcium in gravitropism was investigated by studying the effect of calcium on the movement of auxin in intact and in decapped roots of 3-day-old seedlings of maize, where the transport of auxin was followed in untreated roots and in roots treated by Ca, EGTA, or an auxin-transport inhibitor. Data are presented indicating that Ca promotes basipetal auxin movement in roots and that Ca is necessary for the establishment of gravity-induced asymmetric auxin movement across the root cap. I.S.

A92-20856
MODIFICATION OF PLANT GROWTH AND DEVELOPMENT BY ACCELERATION AND VIBRATION - CONCERNS AND OPPORTUNITIES FOR PLANT EXPERIMENTATION IN ORBITING SPACECRAFT
CARY A. MITCHELL (Purdue University, West Lafayette, IN) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 219-225. refs
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A92-20859
TELESCIENCE TESTBED FOR BIOMEDICAL EXPERIMENTS IN SPACE MORPHOLOGICAL AND PHYSIOLOGICAL EXPERIMENTS OF RAT MUSCULOSKELETAL SYSTEM
SATORU WATANABE, MASAFUMI TANAKA (Nagoya University, Japan), YOSHIRO WADA (Nara Medical College, Japan), DAI YANAGIHARA, NAOKA TSUJIMOTO, HIDEKI SUZUKI, NORIYO KAWAI, SHUNJI NAGAOKA (Chukyo University, Toyota, Japan), MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), TAKATOSHI SHOJI (NASDA; Kawasaki Heavy Industries, Ltd., Sagami-hara, Japan) et al. (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 243-247.

Research supported by MOESC. refs
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A92-20861* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANIMAL RESEARCH FACILITY FOR SPACE STATION FREEDOM
SJOERD L. BONTING (NASA, Ames Research Center; SETI Institute, Moffett Field, CA) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 253-257. refs
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An integrated animal research facility is planned by NASA for Space Station Freedom which will permit long-term, man-tended experiments on the effects of space conditions on vertebrates. The key element in this facility is a standard type animal habitat which supports and maintains the animals under full bioisolation during transport and during the experiment. A holding unit accommodates the habitats with animals to be maintained at zero gravity; and a centrifuge, those to be maintained at artificial gravity for control purposes or for gravity threshold studies. A glovebox permits handling of the animals for experimental purposes and for transfer to a clean habitat. These facilities are described, and the aspects of environmental control, monitoring, and bioisolation are discussed. Author

A92-20863
SPACE EXPERIMENT ON BEHAVIORS OF TREEFROG
AKEMI IZUMI-KUROTANI, MASAMICHI YAMASHITA (Institute of Space and Astronautical Science, Sagami-hara, Japan), and YUKISHIGE KAWASAKI (Mitsubishi Kasei Institute of Life Sciences, Machida, Japan) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 263-266.
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The paper describes the experimental system and the methods developed for observing the behavior of Japanese tree frogs (*Hyla japonica*), the species selected for space experiments aboard the MIR space station, under conditions of microgravity and under the effects of external stimuli. The system, which follows the same safety regulations as those applied for payloads on manned space vehicles, contains large number of instruments for passive observation and for observations of behavioral responses to various stimuli, such as visual or mechanical, and during feeding or courtship. I.S.

A92-20875* Arizona Univ., Tucson.
AN EXPERIMENTAL SYSTEM FOR DETERMINING THE INFLUENCE OF MICROGRAVITY ON B LYMPHOCYTE ACTIVATION AND CELL FUSION
D. W. SAMMONS, R. C. HUMPHREYS, S. P. EMMONS (Arizona, University, Tucson), U. ZIMMERMANN, P. GESSNER (Wuerzburg, Universitaet, Federal Republic of Germany), N. R. KLINMAN (Scripps Clinic, La Jolla, CA), and G. A. NEIL (Iowa, University, Iowa City) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 363-372. refs (Contract NAG8-716; BMFT-01-QV-88655)
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The influence of microgravity on lymphocyte activation is central to the understanding of immunological function in space. Moreover,

the adaptation of ground-based technologies to microgravity conditions presents opportunities for biotechnological applications including high efficiency production of antibody forming hybridomas. Because the emerging technology of microgravity hybridoma generation is dependent upon activation and cultivation of B lymphocytes during flight, mitogen-driven B lymphocyte stimulation and culture were adapted that allow for the in vitro generation of large numbers of antibody forming cells suitable for cell fusion over a period of 1-2 weeks. It is believed that this activation and cultivation system can be flown on near-term space flights to test fundamental hypotheses about mammalian cell activation, cell fusion, metabolism, secretion, growth, and bioseparation. Author

A92-20878* Alabama Univ., Birmingham.

PROTEIN CRYSTAL GROWTH ABOARD THE U.S. SPACE SHUTTLE FLIGHTS STS-31 AND STS-32

LAWRENCE J. DELUCAS, CRAIG D. SMITH (Alabama, University, Birmingham), DANIEL C. CARTER, PAM TWIGG, XIAO-MIN HE, ROBERT S. SNYDER (NASA, Marshall Space Flight Center, Huntsville, AL), PATRICIA C. WEBER, J. V. SCHLOSS (Du Pont de Nemours and Co., Central Research and Development Dept., Wilmington, DE), H. M. EINSPAHR, L. L. CLANCY (Upjohn Co., Kalamazoo, MI) et al. (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 393-400. refs

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Results obtained from the Shuttle flight STS-32 flown in January 1990, and preliminary results from the most recent Shuttle flight, STS-31, flown in April 1990, are presented. Crystals grown in microgravity environment include Canavalin, isocitrate lyase, human serum albumin, and Anti-HPr Fab. It is concluded that about 20 percent of proteins flown exhibit better morphologies or better quality data than their earth-grown counterparts. About 40 percent do not yield crystals at all and the remaining 40 percent yield crystals that are either too small for X-ray analysis or produce data of poorer quality than the best earth-grown crystals. O.G.

A92-20879

LIFE SCIENCES AND SPACE RESEARCH XXIV(2) - RADIATION BIOLOGY; PROCEEDINGS OF THE TOPICAL MEETING OF THE INTERDISCIPLINARY SCIENTIFIC COMMISSION F (MEETINGS F3, F4, F5, F6 AND F1) OF THE COSPAR 28TH PLENARY MEETING, THE HAGUE, NETHERLANDS, JUNE 25-JULY 6, 1990

G. KRAFT, ED. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany), A. B. COX, ED. (USAF, School of Aerospace Medicine, Brooks AFB, TX), J. R. MAISIN, ED. (Louvain, Universite Catholique, Belgium), E. J. AINSWORTH, ED. (Lawrence Berkeley Laboratory, Berkeley, CA), G. REITZ, ED., and G. HORNECK, ED. (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) Meeting sponsored by COSPAR, USAF, and IAA. Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, 475 p. For individual items see A92-20880 to A92-20932.

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The present topical meeting on life sciences and space research discusses heavy-ion effects in genetically relevant cellular structures, combined effects (radiation, microgravity, trauma, and other factors), physical and chemical protection against ionizing radiation, radiation risk assessment for manned spaceflights, and radiation protection aspects related to manned missions to Mars. Attention is given to delta-electron emission in fast heavy ion atom collisions, structures of heavy ion tracks in AgCl detectors, microdosimetric measurements of heavy ion tracks, and DNA structures and radiation injury. Topics addressed include human reproductive issues in space, a comparative study of spermatogonial survival after X-ray exposure, the treatment of radiation injuries, and alterations in glucose and protein metabolism in animals subjected to simulated microgravity. Also discussed

are radiation issues for a piloted Mars mission, the role of endogenous thiols in protection, radioprotection of DNA by biochemical mechanisms, and radioprotection by metals. C.A.B.

A92-20883

BIOCHEMICAL MECHANISMS AND CLUSTERS OF DAMAGE FOR HIGH-LET RADIATION

ALOKE CHATTERJEE and WILLIAM R. HOLLEY (Lawrence Berkeley Laboratory, Berkeley, CA) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 33-43. refs

(Contract DE-AC03-76SF-00098)

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Mechanisms of indirect and direct radiation are used to develop a generalized theory to account for strand break yields by high-LET particles. The major assumptions of this theory are: (1) damage at deoxyribose sites results primarily in strand break formation and (2) damage to bases leads to a variety of base alterations. Results of the present theory compare well with cellular data without enzymatic repair. As an extension of this theory, it is shown that damage clusters are formed near each double strand break for high-LET radiation only. For 10 MeV/n (LET = 450 keV/micron) neon ions, the results show that on average there are about 3 additional breaks and about 3 damaged bases formed near each double strand break. For 100 MeV/n helium ions (LET = 3 keV/micron), less than 1 percent of the strand breaks have additional damage within 10 base pairs. Author

A92-20884

DIRECT RADIATION ACTION OF HEAVY IONS ON DNA AS STUDIED BY ESR-SPECTROSCOPY

A. SCHAEFER, J. HUETTERMANN (Saarland, Universitaet, Homburg am Saar, Federal Republic of Germany), and G. KRAFT (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 45-49. Research supported by Gesellschaft fuer Schwerionenforschung mbH. refs

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The effects of heavy ions on the mechanisms of free radical formation in DNA-constituents as compared to low-LET irradiation are investigated by means of Electron Spin Resonance spectroscopy. Dose-yield curves were measured at low (T is less than 100 K) and ambient temperatures in order to obtain the G-value, that is number of radicals formed per 100 eV absorbed energy. These G-values show a characteristic LET-dependence and are one to two orders of magnitude lower than for low-LET irradiation. Measurements on 2-prime deoxycytidine at 300 K using combined heavy ion and X-ray irradiation methods suggested that this effect can be partially explained by a destruction of radicals during the irradiation. Author

A92-20885* Colorado State Univ., Fort Collins.

DEOXYRIBONUCLEOPROTEIN STRUCTURE AND RADIATION INJURY - CELLULAR RADIOSENSITIVITY IS DETERMINED BY LET-INFINITY-DEPENDENT DNA DAMAGE IN HYDRATED DEOXYRIBONUCLEOPROTEINS AND THE EXTENT OF ITS REPAIR

J. T. LETT and E. L. PETERS (Colorado State University, Fort Collins) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research

(ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 51-58. refs
(Contract NAG9-10)

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Until recently, OH radicals formed in bulk nuclear water were believed to be the major causes of DNA damage that results in cell death, especially for sparsely ionizing radiations. That hypothesis has now been challenged, if not refuted. Lethal genomic DNA damage is determined mainly by energy deposition in deoxyribonucleoproteins, and their hydration shells, and charge (energy) transfer processes within those structures. Author

A92-20886

HEAVY ION INDUCED DOUBLE STRAND BREAKS IN BACTERIA AND BACTERIOPHAGES

U. MICKE, M. SCHAEFER, A. ANTON, G. HORNECK, and H. BUECKER (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 59-63. refs

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DNA damage induced by heavy ions in bacteria cells and bacteriophages such as *Bacillus subtilis*, *E. coli*, and Bacteriophage T1 were investigated by analyzing the double strand breaks in the chromosomal DNA. To analyze double strand breaks in long molecules of DNA - up to some Mbp in length - the technique of pulse field agarose gel electrophoresis has been used. This allows the detection of one double strand break per genome. Cell lysis and DNA isolation were performed in small agarose blocks directly. This procedure secured minimum DNA destruction by shearing forces. After running a gel, the DNA was stained with ethidium bromide. The light intensity of ethidium bromide fluorescence for both the outgoing (running) DNA and the remaining intact DNA were measured by scanning. The mean number of double strand breaks was calculated by determining the quotient of these intensities. Strand break induction after heavy ion and X-ray irradiation was compared. Author

A92-20887

MICRODOSIMETRIC CONSIDERATIONS OF EFFECTS OF HEAVY IONS ON *E. COLI* K-12 MUTANTS

T. TAKAHASHI, F. YATAGAI, and K. IZUMO (Riken Corp., Saitama, Japan) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 65-68. Research supported by Institute of Research and Innovation. refs

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The inactivation cross sections of *E. coli* K-12 recombination-deficient mutants, JC1553 (recA) and AB2470 (recB), for several MeV/u alpha-particles and N ions have been successfully analyzed by Katz's target theory in which radiosensitivity parameter E(0) is assumed to be LET independent and equal to D37 for gamma-rays. For *E. coli* K-12 wild type, AB1157 rec(+), uvr(+), however, it is impossible to interpret the inactivation cross-section data by an LET independent E(0)-value. In the latter case, as in the case of *B. subtilis* spore, it is necessary to assume that the radiosensitivity of the target for the core of a heavy ion is higher than that for delta-electrons. Author

A92-20888

HEAVY ION INDUCED MUTATIONS IN GENETIC EFFECTIVE CELLS OF A HIGHER PLANT

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28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 69-72. Research supported by Gesellschaft fuer Schwerionenforschung mbH. refs
(Contract BMFT-01-QV-85650)

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Arabidopsis thaliana offers different possibilities for investigating heavy ion induced early and late damage. Mutations in genetic effective cells can yield early damage, in the form of reduced vitality of the descending cell-lines and/or late damage, such as mutation induction visible in the following generations. Investigation is possible on different levels of ploidy (4n, 2n, n). Different genetic effective cells with equal genomes are available. Additionally, several different biological endpoints for each level of genome ploidy can be observed. Recent results of work in this field are presented. Author

A92-20889

INDUCTION OF DNA BREAKS IN SV40 BY HEAVY IONS

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(Contract CEC-B16-0197-D)

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Simian virus (SV40) DNA was used to study the induction of DNA strandbreaks by heavy ions varying in LET. DNA was exposed to X-rays and to accelerated particles either in dilute solution or in the presence of different radical scavengers. Relative proportions of the intact supercoiled DNA, nicked form arising from single strand breaks (SSB) and linear molecules produced by double strandbreaks (DSB) were quantified on the basis of their electrophoretic mobility in agarose gels. Cross sections for the induction of SSBs and DSBs were calculated from the slope of dose effect curves. Mercaptoethanol was found to protect more efficiently against DNA strand breakage than Tris. When the biological efficiency, i.e., the number of strand breaks per unit dose and molecule weight, was evaluated as a function of LET, curves for SSB induction always showed a continuous decrease. For DSB induction, an increase in the yield of DSBs with a maximum around 500 keV/micron was observed in the presence of radical scavenger. Author

A92-20890

HEAVY ION-INDUCED CHROMOSOMAL DAMAGE AND REPAIR

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(Contract NIH-RR-05918; DE-AC03-76SF-00098)

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The available 'premature chromosome condensation' (PCC) technique data are reviewed, via the presentation of new Fe experiments, to summarize the current understanding of the action of high-velocity charged particles on mammalian chromosomes. The primary advantage of the PCC technique over standard mitotic chromosome analysis is that it makes it possible to detect chromosomal damage before substantial modification by cellular enzymatic processes. C.A.B.

A92-20891

DNA STRUCTURES AND RADIATION INJURY

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Federal Republic of Germany), M. ROSEMAN, K. REGEL, and H. ABEL (Zentralinstitut fuer Krebsforschung, Berlin, Federal Republic of Germany) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 91-101. refs

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Experimental results from radiobiological investigations of the sedimentation behavior of damaged and restored DNA subunits attached to the nuclear membrane are summarized. The studies were carried out with Chinese hamster cells V79-4 irradiated with different kinds of radiation (gamma rays, neutron and carbon ions) using the nucleoid sedimentation technique. Single-strand breaks relax the supercoiled DNA in the subunits resulting in a decreased sedimentation velocity. Rejoining leads to a correct restoration of the structure as can be studied by means of postincubation irradiation. Double-strand breaks release DNA fragments, again leading to an increased sedimentation velocity. If the average number of the induced double-strand breaks per subunit increases to a number higher than one, the measured results suggest that the structures should not be restored completely. C.A.B.

A92-20892

MUTAGENIC EFFECTS OF HEAVY IONS IN BACTERIA

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The peculiarities and mechanisms of the mutagenic action of gamma-rays and heavy ions on bacterial cells have been investigated. Direct mutations in the lac-operon of E. coli in wild type cells and repair deficient strains have been detected. The induction of revertants in Salmonella tester strains was measured. It was found that the mutation rate was a linear-quadratic function of dose in the case of both gamma-rays and heavy ions with LET up to 200 keV/micron. The relative biological effectiveness increased with LET up to 20 keV/micron. Low mutation rates were observed in repair deficient mutants with a block of SOS-induction. It was shown that the intensity of the SOS-induction in E. coli increased with increasing LET up to 40-60 keV/micron.

Author

A92-20893

MUTATION INDUCTION IN MAMMALIAN CELLS BY VERY HEAVY IONS

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V79 Chinese hamster cells were exposed to heavy ions (O to U) and assayed for mutants at the HGPRT-locus by incubation in selective medium containing 6-thioguanine. The LET ranged from 300 to 18,000 keV/micron. Mutants could be recovered from all particle radiation but the effectivity per deposited energy decreased with atomic numbers greater than 8. The results are discussed with regard to fundamental processes of cell reactions to very heavy ions and with respect to possible implications for hazard estimations.

Author

A92-20894

INDUCTION OF CHROMOSOME ABERRATIONS IN MAMMALIAN CELLS AFTER HEAVY ION EXPOSURE

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(Contract CEC-B16-0197-D)

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The induction of chromosome aberrations by heavy charged particles was studied in V79 Chinese hamster cells over a wide range of energies (3-100 MeV/u) and LET (20-16,000 keV/micron). For comparison, X-ray experiments were performed. The present data indicate quantitative and qualitative differences in the response of cells to particle and X-ray irradiation. For the same level of cell survival the amount of damaged cells which can be observed is smaller in heavy ion (11.4 MeV/u Ar) irradiated samples. The highest yield of damaged cells is found 8 to 12 hours after particle irradiation and 4 hours after X-irradiation. Differences in the amount of damaged cells are attributed to cell cycle perturbations which interfere with the expression of damage. After heavy ion exposure the amount of cells reaching mitosis (mitotic index) decreases drastically and not all damaged cells reach mitosis within 48 hours after exposure. A portion of cells die in interphase. Cell cycle delays induced by X-ray irradiation are less pronounced and all cells reach the first post-irradiation mitosis within 24 hours after irradiation.

Author

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ALTERATIONS IN GLUCOSE AND PROTEIN METABOLISM IN ANIMALS SUBJECTED TO SIMULATED MICROGRAVITY

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Reduction of physical activity due to disease or environmental restraints, such as total bed rest or exposure to spaceflight, leads to atrophy of skeletal muscle and is frequently accompanied by alterations in food intake and the concentration of metabolic regulatory hormones such as insulin. Hindlimb suspension of laboratory rats, as a model for microgravity, also shows marked atrophy of gravity-dependent muscles along with a reduced gain in body weight. Suspended rats exhibit enhanced sensitivity to insulin-induced glucose uptake when compared with normal control rats and resistance to insulin action when compared with control rats matched similarly for reduced body weight gain. These changes are accompanied by decreased insulin binding and tyrosine kinase activity in soleus but not plantaris muscle, unchanged glucose uptake by perfused hindlimb and decreased sensitivity but not responsiveness to insulin-induced suppression of net proteolysis in hindlimb skeletal muscle. These findings suggest that loss of insulin sensitivity during muscle atrophy is associated with decreased insulin binding and tyrosine kinase activity in atrophied soleus muscle along with decreased sensitivity to the effects of insulin on suppressing net protein breakdown but not on enhancing glucose uptake by perfused hindlimb.

Author

A92-20899* Tuskegee Inst., AL.

COMPARATIVE STUDY OF SPERMATOGONIAL SURVIVAL AFTER X-RAY EXPOSURE, HIGH LET (HZE) IRRADIATION OR SPACEFLIGHT

W. J. SAPP, C. S. WILLIAMS, J. W. WILLIAMS (Tuskegee

51 LIFE SCIENCES (GENERAL)

University, AL), D. E. PHILPOTT, K. KATO (NASA, Ames Research Center, Moffett Field, CA), J. M. MIQUEL (Alicante, Universidad, Spain), and L. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 179-189. refs
(Contract NCC2-12; NCC2-455; NIH-G12-RR-03059-01A1)
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Spermatogonial cell loss has been observed in rats flown on Space Lab 3, Cosmos 1887, Cosmos 2044 and in mice following irradiation with X-ray or with HZE particle beams. Spermatogonial loss is determined by cell counting in maturation stage-6 seminiferous tubules. With the exception of iron, laboratory irradiation experiments (with mice) revealed a similar pattern of spermatogonial loss proportional to the radiation dose at levels less than 0.1 Gy. Helium and argon irradiation resulted in a 5-percent loss of spermatogonia after only 0.01 Gy exposure. Significant spermatogonial loss (45 percent) occurred at this radiation level with iron particle beams. The loss of spermatogonia during each spaceflight was less than 10 percent when compared to control (nonflight) animals. Author

A92-20902

RADIOPROTECTION OF DNA BY BIOCHEMICAL MECHANISMS

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Attention is given to the presentation of genetic information and function by protecting the DNA from the deleterious effects of radiation by reducing the degree of damage, as well as to the utilization of biochemical entities whose function is to repair damage which has already been formed in DNA, thus enhancing the protection of living cells. Emphasis is placed on the compound nicotinamide (NA). Experiments showed that contrary to claims made of it being an inhibitor of repair, it exhibited at very low concentrations a definite property of enhancement of repair. The effect of NA is demonstrated not only on DNA repair and cell survival, but also on the manifestation of these properties in biological dosimetry: micronuclei formation as a result of radiation damage in lymphocytes decreases in the presence of NA even if it is added after exposure to gamma radiation. C.A.B.

A92-20904

RADIOPROTECTION BY METALS - SELENIUM

J. F. WEISS, V. SRINIVASAN, K. S. KUMAR, and M. R. LANDAUER (DNA, Armed Forces Radiobiology Research Institute, Bethesda, MD) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 223-231. Research supported by DNA. refs
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The radioprotective potential of selenium (Se) is examined. Both the inorganic salt, sodium selenite, and the organic Se compound, selenomethionine, enhance the survival of irradiated mice (Co-60, 0.2 Gy/min) when injected IP either before (-24 hr and -1 hr) or shortly after (+15 min) radiation exposure. When administered at equitoxic doses (one-fourth LD₁₀); selenomethionine = 4.0 mg/kg Se, sodium selenite = 0.8 mg/kg Se), both drugs enhanced the 30-day survival of mice irradiated at 9 Gy. Survival after 10-Gy

exposure was significantly increased only after selenomethionine treatment. An advantage of selenomethionine is lower lethal and behavioral toxicity (locomotor activity depression) compared to sodium selenite, when they are administered at equivalent doses of Se. Author

A92-20907

RADIATION PROTECTION AGAINST EARLY AND LATE EFFECTS OF IONIZING IRRADIATION BY THE PROSTAGLANDIN INHIBITOR INDOMETHACIN

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Protective effects of indomethacin, a prototype prostaglandin-inhibiting agent, against early and late sequelae of radiation injury (after X-rays or gamma-rays) in mice, were investigated. The following tissues or organs were examined: hematopoietic tissue, esophagus, jejunum, colon, lung, hair follicles, and tissues involved in the development of radiation-induced leg contractures. In addition, the effect of indomethacin was tested against radiation-induced carcinogenesis. In all experiments, the radiation was delivered as a single dose. Indomethacin led to significant protection of hematopoietic tissue, by a factor of 1.3. There was also some protection against radiation-induced pneumonitis and against radiation-induced carcinogenesis (protection factor of 1.2). The other tissues tested showed no change in their radioresponse after being treated with indomethacin. Thus, indomethacin can act as a radioprotective agent against both early and late sequelae of radiation, but its effect is dependent on the tissue tested. This protection is smaller than that observed with WR-2721. However, indomethacin combined with WR-2721 produced a radioprotective effect greater than the radioprotection achieved by individual treatments. Author

A92-20908

BEHAVIORAL TOXICITY OF SELECTED RADIOPROTECTORS

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Effective radioprotection with minimal behavioral disruption is essential for the selection of protective agents to be used in manned spaceflight. This overview summarizes the studies on the behavioral toxicity of selected radioprotectors classified as phosphorothioates, bioactive lipids, platelet activating factor (PAF), and immunomodulators (glucan, synthetic trehalose dicorynomycolate, and interleukin-1). Behavioral toxicity was examined in laboratory mice using a locomotor activity test. For all compounds tested, there was a dose-dependent decrease in locomotor behavior that paralleled the dose-dependent increase in radioprotection. While combinations of radioprotective compounds increased radioprotection, they also decreased locomotor activity. The central nervous system stimulant, caffeine, was able to mitigate the locomotor decrement produced by phosphorothioates or PAF. Author

A92-20918

EXPERIMENT 'SEEDS' ON BIKOSMOS 9 - DOSIMETRIC PART

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U. SCHOTT (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), and C. HEILMAN (CNRS, Centre de Recherches Nucleaires de Strasbourg, France) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 355-358. Research supported by BMFT. refs Copyright

The aim of the experiment 'Seeds' on the Soviet satellite Biokosmos 9 was the observation of mutagenic effects caused at special loci of seeds of *Arabidopsis Thaliana*, which were assigned to particles of cosmic radiation. Two types of exposure units were flown: a low-shielding unit Type I, mounted at the surface of the satellite (1.4 g/sq cm shielding) and, for comparison, an identical item inside (16 g/sq cm shielding), using nuclear emulsion as a track detector. A type II unit, flown inside (18 g/sq cm shielding) was mounted with AgCl track detectors. A first set of dosimetric data from the physical evaluation of the experiment will be presented. The subdivision into charge and LET groups shows a rather high contribution of the intermediate LET-group (350-1000 MeV/cm) due to medium heavy particles ($Z = 6-10$) and to ends of light (p, alpha) particles. Author

A92-20921

PRELIMINARY TOTAL DOSE MEASUREMENTS ON LDEF

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Data are presented on the measurements of absorbed dose of cosmic rays with the lithium fluoride thermoluminescence dosimeters (TLDs) that are part of the Free Flyer Biostack Experiment which is part of the NASA Long Duration Exposure Facility (LDEF). The twenty stacks of the Biostack are back on earth after spending nearly 6 yrs in the earth orbit. The paper discusses the major objectives of the Free Flyer Biostacks attached to the surface of the LDEF, the Biostack experimental units, and the flight parameters of the LDEF. Absorbed dose measurements are presented for three TLDs behind different shieldings in front of the dosimeters. Since most of the exposure time was spent during a period of minimal solar activity, the results can be regarded as representative for a solar minimum situation. I.S.

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LATE CATARACTOGENESIS IN PRIMATES AND LAGOMORPHS AFTER EXPOSURE TO PARTICULATE RADIATIONS

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Results are presented from a study in which regular examinations of cataractogenic development were conducted since 1987 in monkeys that were exposed in 1969, at the age of about 2 years, to low doses of 'mixed-energy' protons (10 and 110 MeV). The results of comparisons with age-matched controls showed that the cataractogenic patterns observed in the exposed monkeys are consistent with those observed in other groups of monkeys that were exposed at similar ages in 1964 and 1965 to

protons of different energies (Lett et al., 1986, 1988, 1989, and 1991). Comparisons were also made among recent results from different groups of primates and from New Zealand white rabbits that were exposed when young to Fe-56 and were monitored continuously thereafter. I.S.

A92-20924

RBE FOR NON-STOCHASTIC EFFECTS

G. W. BARENDSEN (Amsterdam, University, Netherlands) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 385-392. refs Copyright

The paper reviews data on the relationship between the nonstochastic effects of ionizing radiation (i.e., the impairment of tissue integrity and function), and the values of the relative biological effectiveness (RBE). It is shown that RBE values can be derived for effects of actual exposures to mixtures of high-LET and low-LET radiations by considering the doses received and the tissue at risk. Application of maximum RBE values (RBE/m), which can be derived by extrapolating on the basis of a radiobiological model, will yield estimates of maximum values of the equivalent doses. However, these values can only be applied for planning medical interventions if the contribution from high-LET radiation is small. I.S.

A92-20925

MULTIPLE CELL HITS BY PARTICLE TRACKS IN SOLID TISSUES

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Relative biological effectiveness (RBE) and quality factor (Q) at extreme values of linear energy transfer (LET) have been determined on the basis of experiments with single-cell systems and specific tissue responses. In typical single cell systems, each heavy particle (Ar or Fe) passes through a single cell or no cell. In tissue end-point experiments each heavy particle passes through several cells, and the LET can exceed 200 keV/microns in every cell. In most laboratory animal tissue systems, however, only a small portion of the hit cells are capable of expressing the end-point of interest to the investigator, such as cell killing, mutation or carcinogenesis. The following question must therefore be addressed: Do RBE's and Q factors derived from single-cell experiments properly account for the increased probability of multiple-cell damage by HZE tracks? A model is offered in which measured radiation effects and known tissue properties are combined to estimate the value of a multiplier of damage effectiveness on the basis of number of cells at risk, p_3n , per track containing a hit cell, where n is the number of cells per track, based on tissue and organ geometry, and p_3 is the probability that a cell in the track is capable of expressing the experimental end-point. Author

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DO HEAVY IONS CAUSE MICROLESIONS IN CELL MEMBRANES?

JAN P. KONIAREK and BASIL V. WORGUL (Columbia University, New York) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 417-420. refs (Contract NAG9-256; NIH-EY-02648) Copyright

51 LIFE SCIENCES (GENERAL)

The microlesion question is investigated by monitoring the electrical potential difference across the endothelium of rat corneas in vitro before, during, and after irradiation. When the corneas were exposed to 1 Gy of Fe-56 ions (450 and 600 MeV/a.m.u.), no effect was detected on this parameter. These results suggest that direct physical damage to cell membranes, as predicted by the microlesion theory, does not take place. Author

A92-20953

THE INITIATION OF BIOLOGICAL PROCESSES ON EARTH - SUMMARY OF EMPIRICAL EVIDENCE

MANFRED SCHIDLOWSKI (Max-Planck-Institut fuer Chemie, Mainz, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 143-156. refs

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An overview of geological indicators is given regarding the earliest existence of life with particular reference to the biogeochemical evidence of the oldest microbial systems. The quasi-continuous record of microbialites and other microfossils is described in terms of their prokaryotic affinity and history of at least 3.5 Gyr. Autotrophic and photosynthetic carbon fixation dating from the same period is also discussed in the light of the corresponding isotopic signatures found in the sedimentary carbon record. The carbon-isotope record is consistent with the bias towards C-12 related to photosynthesis and is considered evidence of the ribulose-1,5-biphosphate carboxylase reaction of the Calvin cycle. The data indicate conservatism in the evolution of autotrophic carbon fixation and lead to the conclusion that life on earth certainly originated in the Early Archean period. C.C.S.

A92-20958

SOME ASPECTS OF THE EARLY EVOLUTION OF PHOTOSYNTHESIS

Z. MASINOVSKY (Czechoslovak Academy of Sciences, Laboratory of Evolutionary Biology, Prague, Czechoslovakia), G. I. LOZOVAIA, and A. A. SIVASH (AN USSR, Institut Botaniki, Kiev, Ukrainian SSR) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 199-205. refs

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The early evolution of a photocatalytic system of the porphyrin type, able to efficiently collect and utilize solar energy for primary electron transfer is discussed. Experimental results concerning some spectral and photochemical properties of the porphyrins, biosynthetic precursors of chlorophyll and their complexes with polymeric templates are reviewed. Protoporphyrin IX associated with pigmented proteinoid is demonstrated to be a favorable candidate for a role of a photosensitizer of the first photosynthetic reaction centers. The origin and early evolution of the photosynthetic electron transfer chain and of the phosphorylating mechanism are discussed with emphasis on the energetic mechanisms of archaebacteria. Author

A92-20959* Universidad Nacional Autonoma de Mexico, Coyoacan.

THE ORIGIN AND EARLY EVOLUTION OF NUCLEIC ACID POLYMERASES

A. LAZCANO, R. CAPPELLO, V. VALVERDE (Universidad Nacional Autonoma de Mexico, Coyoacan, Mexico), V. LLACA (California, University, Davis), and J. ORO (Houston, University, TX) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and

F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 207-216. Research supported by CONASIDA. refs (Contract NGR-44-005-002)

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The hypothesis that vestiges of the ancestral RNA-dependent RNA polymerase involved in the replication of RNA genomes of Archean cells are present in the eubacterial RNA-polymerase beta-prime subunit and its homologues is discussed. It is shown that, in the DNA-dependent RNA polymerases from three cellular lineages, a very conserved sequence of eight amino acids, also found in a small RNA-binding site previously described for the E. coli polynucleotide phosphorylase and the S1 ribosomal protein, is present. The optimal conditions for the replicase activity of the avian-myeloblastosis-virus reverse transcriptase are presented. The evolutionary significance of the in vitro modifications of substrate and template specificities of RNA polymerases and reverse transcriptases is discussed. Author

A92-20960

SURVIVAL IN EXTREME DRYNESS AND DNA-SINGLE-STRAND BREAKS

K. DOSE, A. BIEGER-DOSE, M. LABUSCH, and M. GILL (Mainz, Universitaet, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 221-229. refs

(Contract BMFT-01-QV-174; BMFT-01-QV-8942)

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A wide variety of organisms (the so-called anhydrobiotes) are able to survive long periods of time in a state of utmost dehydration and can thus survive in extremely dry environments including artificially imposed or space vacuum. Known strategies of survival include the accumulation of certain polyols, especially disaccharides, which help prevent damage to membranes and proteins. It is reported that DNA in vacuum-dried spores is damaged to a very substantial degree by processes leading to DNA strand breaks. Most of these lesions are obviously repaired during germination, but extensive damage to DNA and enzymes after long exposure times (months to years) finally diminish the chances of survival. Author

A92-20962

ANHYDROBIOSIS - A STRATEGY FOR SURVIVAL

LOIS M. CROWE and JOHN H. CROWE (California, University, Davis) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 239-247. refs

Copyright

Many organisms from a wide variety of taxa have the ability to survive extreme dehydration, a phenomenon called anhydrobiosis. Concomitantly with resistance to the adverse effects of drying, these organisms are also resistant to the effects of freezing to very low temperatures, elevated temperature for brief periods, and the effects of ionizing radiation. One result of their resistance to environmental extremes is a greatly prolonged life span. The anhydrobiotes that have been investigated share a common metabolic adaptation, the production of certain disaccharides as a large proportion of their dry weight. Using these disaccharides, the sources of damage attendant upon drying and the mechanisms by which anhydrobiotes and model systems of isolated membranes and proteins avoid damage are investigated. This report summarizes aspects of this work. Author

A92-20963**THE EFFECTS OF VACUUM-UV RADIATION (50-190 NM) ON MICROORGANISMS AND DNA**

TAKASHI ITO (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 249-253. refs

Copyright

Using a synchrotron as a radiation source, highly monochromatic UV light in the range 50-190 nm was used in vacuum to obtain action spectra for inactivation and mutation of two strains of *B. subtilis* spores. The two strains were different with respect to their repair ability: one was a FUV-sensitive (excision deficient) strain, and the other was an X-ray-sensitive (DNA-polymerase-I deficient) strain. Action spectra for DNA strand breaks were also measured in the same range, using isolated plasmid DNA. I.S.

A92-20965**EXTREME DRYNESS AND DNA-PROTEIN CROSS-LINKS**

A. BIEGER-DOSE, K. DOSE, R. MEFFERT, M. MEHLER, and S. RISI (Mainz, Universitaet, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 265-270. refs

(Contract BMFT-01-QV-174; BMFT-01-QV-8942)

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Exposure of fungal conidia (*Aspergillus ochraceus*) or spores of *Bacillus subtilis* to extreme dryness or vacuum induces DNA lesions, including strand breaks and the formation of DNA-protein crosslinks. In wet cells only a small amount of protein is bound to DNA, but exposure to conditions of lowered water activity results in an increasing number of crosslinks between DNA and proteins. In fungal conidia these crosslinks are detected after selective iodination (J-125) of the DNA-bound proteins followed by gel electrophoresis and subsequent autoradiography. Another approach is the labeling of DNA with P-32 by means of nick translation and the detection of differences in the electrophoretic mobility of DNA before and after digestion with proteinase K of proteins bound to DNA. Author

A92-21018**DRYING AS ONE OF THE EXTREME FACTORS FOR THE MICROFLORA OF THE ATMOSPHERE**

S. V. LYSENKO and N. S. DEMINA (AN SSSR, Institut Mikrobiologii, Moscow, USSR) *British Interplanetary Society, Journal* (ISSN 0007-094X), vol. 45, Jan. 1992, p. 39-41. refs

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The effects of drying and drying-rewetting cycles on conidia of the atmospheric strain *Penicillium chrysogenum* from 48 to 77 km heights have been investigated under vacuum conditions of 0.01 torr at -30 C. It is found that the survival and restoration of the initial physiological properties are possible through some very efficient cellular mechanisms. Such adaptive possibilities explain the widespread diffusion of microbial cells throughout the earth biosphere. O.G.

A92-21480**EFFECT OF TAIL SUSPENSION ON CARDIOVASCULAR CONTROL IN RATS**

HIDEFUMI WAKI, MASAMICHI SUDOH (Jikei University School of Medicine, Tokyo, Japan), and CHIHIRO NISHIMURA (Fukuoka University, Japan) *Japanese Journal of Aerospace and Environmental Medicine* (ISSN 0387-0723), vol. 28, June 1991, p. 39-50. refs

The effect of tail suspension on the cardiovascular control in rats was investigated by examining cardiovascular parameters in

animals after a 10-day 20-deg or 45-deg head-down suspension (S) tests. Compared to the control group (0-deg S), 45-deg S resulted in increased falls of arterial-blood-pressure responses to the head-up tilt and LBNP. However, the carotid sinus baroreflex control of blood pressure was not attenuated by 45-deg S. The results suggest that the hemodynamic response patterns elicited in rats by a 10-day-long exposure to 45 S are similar to those associated with cardiovascular deconditioning induced by exposures to hypogravity. I.S.

A92-21770* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A STUDY OF LENS OPACIFICATION FOR A MARS MISSION

J. L. SHINN, J. W. WILSON (NASA, Langley Research Center, Hampton, VA), A. B. COX (USAF, School of Aerospace Medicine, Radiation Science Div., Brooks AFB, TX), and J. T. LETT (Colorado State University, Fort Collins, CO) *SAE, International Conference on Environmental Systems*, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs

(SAE PAPER 911354) Copyright

A method based on risk-related cross sections is used to estimate risks of 'stationary' cataracts caused by radiation exposures during extended missions in deep space. Estimates of the even more important risk of late degenerative cataractogenesis are made on the basis of the limited data available. Data on lenticular opacification in the New Zealand white rabbit, an animal model from which such results can be extrapolated to humans, are analyzed by the Langley cosmic ray shielding code (HZETRN) to generate estimates of stationary cataract formation resulting from a Mars mission. The effects of the composition of shielding material and the relationship between risk and LET are given, and the effects of target fragmentation on the risk coefficients are evaluated explicitly. P.D.

A92-21771* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LET ANALYSES OF BIOLOGICAL DAMAGE DURING SOLAR PARTICLE EVENTS

FRANCIS A. CUCINOTTA, JOHN W. WILSON, LAWRENCE W. TOWNSEND, JUDY L. SHINN (NASA, Langley Research Center, Hampton, VA), and ROBERT KATZ (Nebraska, University, Lincoln) *SAE, International Conference on Environmental Systems*, 21st, San Francisco, CA, July 15-18, 1991. 10 p. Research supported by DOE. refs

(SAE PAPER 911355) Copyright

The effects of nuclear reactions on integral low-linear-energy-transfer (LET) protons spectra are studied, behind typical levels of spacecraft and body shielding, for the historically largest flares using the high-energy transport code BRYNTRN in conjunction with several biological damage models. The cellular track model of Katz provides an accurate description of cellular damage from heavy ion exposure. The track model is applied with BRYNTRN to provide a LET decomposition of survival and transformation rates for solar proton events. In addition, a fluence-based risk coefficient formalism is used to estimate Harderian gland-tumor induction in rodents and cataractogenesis in rabbits from solar flares, and a LET analysis is used to assess the relative contribution from target fragments on these biological endpoints. Author

A92-21795* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CONCEPTS OF BIOISOLATION FOR LIFE SCIENCES RESEARCH ON SPACE STATION FREEDOM

GLENN A. FUNK (NASA, Ames Research Center; GE Government Services, Moffett Field, CA) and CATHERINE C. JOHNSON (NASA, Ames Research Center, Moffett Field, CA) *SAE, International Conference on Environmental Systems*, 21st, San Francisco, CA, July 15-18, 1991. 12 p. refs

(SAE PAPER 911475) Copyright

The risk concepts related to biological research in space are defined with attention given to the design and operation of experimental hardware for NASA's Biological Flight Research

Laboratory (BFRL). The definitions are set forth to describe safety measures for the use of nonhuman specimens in microgravity environments and the direct application of the risk-control concepts. Bioisolation is the process by which biological systems can coexist productively by means of physical, chemical, or biological methods; bioisolation requirements are given for mammals, plants, and microspecimens. The BFRL provides two levels of containment based on the complete sealing of all joints and interfaces in the Modular Habitat and an airflow system designed to provide net negative pressure of at least 0.13 kPa. The requirements are designed to assure a safe working environment for conducting nonhuman life-sciences research in the Space Station Freedom.

C.C.S.

A92-21851* Krug Life Sciences, Inc., Houston, TX. MICROBIAL GROWTH AND PHYSIOLOGY IN SPACE - A REVIEW

LOUIS A. CIOLETTI, S. K. MISHRA (Krug Life Sciences, Inc., Houston, TX), and DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 13 p. refs

(SAE PAPER 911512) Copyright

An overview of microbial behavior in closed environments is given with attention to data related to simulated microgravity and actual space flight. Microbes are described in terms of antibiotic sensitivity, subcellular structure, and physiology, and the combined effects are considered of weightlessness and cosmic radiation on human immunity to such microorganisms. Space flight results report such effects as increased phage induction, accelerated microbial growth rates, and the increased risk of disease communication and microbial exchange aboard confining spacecraft. Ultrastructural changes are also noted in the nuclei, cell membranes, and cytoplasmic streaming, and it appears that antibiotic sensitivity is reduced under both actual and simulated conditions of spaceflight.

C.C.S.

A92-21876* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. FLIGHT EQUIPMENT SUPPORTING METABOLIC EXPERIMENTS ON SLS-1

CAROLYN S. LEACH (NASA, Johnson Space Center, Houston, TX) and L. D. INNERS (Krug Life Sciences, Inc., Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs

(SAE PAPER 911561) Copyright

Five experiments in different aspects of human metabolism will be performed on Spacelab Life Sciences-1. Nine items of equipment from the Life Sciences Laboratory Equipment inventory will be used: the rack-mounted centrifuge, the hematocrit centrifuge, the low-gravity centrifuge, a body-mass measurement device, a urine monitoring system, the Spacelab refrigerator/freezer, the Orbiter refrigerator, an in-flight blood collection system, and a pocket voice recorder. In addition, each experiment will require some specialized equipment such as incubators and culture blocks for an immunology experiment, and tracers for a fluid and electrolyte experiment and a hematology experiment. The equipment for these experiments has been developed over many years, in some cases since the Skylab program in the early 1970s, and has been certified for use on the Space Shuttle.

Author

A92-21881* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. PERFORMANCE OF THE RESEARCH ANIMAL HOLDING FACILITY (RAHF) AND GENERAL PURPOSE WORK STATION (GPWS) AND OTHER HARDWARE IN THE MICROGRAVITY ENVIRONMENT

ROBERT P. HOGAN and BONNIE P. DALTON (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 15 p.

(SAE PAPER 911567) Copyright

This paper discusses the performance of the Research Animal

Holding Facility (RAHF) and General Purpose Work Station (GPWS) plus other associated hardware during the recent flight of Spacelab Life Sciences 1 (SLS-1). The RAHF was developed to provide proper housing (food, water, temperature control, lighting and waste management) for up to 24 rodents during flights on the Spacelab. The GPWS was designed to contain particulates and toxic chemicals generated during plant and animal handling and dissection/fixation activities during space flights. A history of the hardware development involves as well as the redesign activities prior to the actual flight are discussed.

Author

A92-21897* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

TECHNOLOGY DEVELOPMENT ACTIVITIES FOR HOUSING RESEARCH ANIMALS ON SPACE STATION FREEDOM

JEFFREY W. JENNER, VLADIMIR M. GARIN, and FRANK D. NGUYEN (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs

(SAE PAPER 911596) Copyright

The development and design of animal facilities are described in terms of the technological needs for NASA's Biological Flight Research Laboratory. Animal habitats are presented with illustrations which encompass waste-collection techniques for microgravity conditions that reduce the need for crew participation. The technology is intended to be highly compatible with animal morphology, and airflow is employed as the primary mechanism of waste control. The airflow can be utilized in the form of localized high-speed directed flow that simultaneously provides a clean animal habitat and low airflow rates. The design of an animal-habitat testbed is presented which capitalizes on contamination-control mechanisms and suitable materials for microgravity conditions. The developments in materials and technologies represent significant contributions for the design of the centrifuge facilities for the Space Station Freedom.

C.C.S.

A92-21898* California Polytechnic State Univ., San Luis Obispo. TRADE STUDY COMPARING SPECIMEN CHAMBER SERVICING METHODS FOR THE SPACE STATION CENTRIFUGE FACILITY

MICHAEL L. CALVISI (California Polytechnic State University, San Luis Obispo) and SIDNEY C. SUN (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 14 p. refs

(SAE PAPER 911597) Copyright

The Specimen Chamber Service Unit, a component of the Space Station Centrifuge Facility, must provide a clean enclosure on a continuing basis for the facility's plant, rodent and primate specimens. The specimen chambers can become soiled and can require periodic servicing to maintain a clean environment for the specimens. Two methods of servicing the specimen chambers are discussed: washing the chambers with an on-board washer, or disposing of the soiled chambers and replacing them with clean ones. Many of these issues are addressed by developing several servicing options, using either cleaning or replacement as the method of providing clean specimen chambers, and then evaluating each option according to a set of established quantitative and qualitative criteria. Disposing and replacing the Specimen Chambers is preferable to washing them.

Author

A92-22106 SYNTHESIS OF PUTRESCINE UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS

CARLOS WONG, J. C. SANTIAGO, LORENA RODRIGUEZ-PAEZ, MIGUEL IBANEZ, ISABEL BAEZA (Escuela Nacional de Ciencias Biologicas, Mexico City, Mexico), and J. ORO (Houston, University, TX) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 145-156. Research supported by Instituto Politecnico Nacional de Mexico. refs

Copyright

The synthesis of putrescine was accomplished by decarboxylation of L-ornithine when this amino acid was heated in aqueous solution in the absence of oxygen. Chromatographic,

radioisotopic, and enzymatic techniques were used to demonstrate that one mole of nonradioactive putrescine and one mole of (C-14)O₂ was formed during the heating of L-(1-C-14)-ornithine. This work indicates that the synthesis of putrescine can occur starting with ornithine in conditions that are presumed could have existed on the primitive earth. The possible significance of these results in the prebiotic molecular evolution is briefly discussed.

Author

A92-22108

ORIGIN OF GENETICALLY ENCODED PROTEIN SYNTHESIS - A MODEL BASED ON SELECTION FOR RNA PEPTIDATION

J. T.-F. WONG (Hong Kong University of Science and Technology, Hong Kong) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 165-176. Research supported by Medical Research Council of Canada. refs
Copyright

The difficulty in explaining the origin of genetic coding centers on the need to identify selective advantages that could account for the synthesis of peptidyl-tRNA, the essential intermediate in genetically programmed translation. It is resolved by a recognition of the functional advantages derivable from the post-transcriptional addition of peptide cofactors to RNA apo-catalysts. This enables the formulation of a theory for the origin of the genetic encoding of protein synthesis by RNA.

Author

A92-22262

DYNAMIC POLARIZATION VECTOR OF SPATIALLY TUNED NEURONS

DORA E. ANGELAKI (Minnesota, University, Minneapolis) IEEE Transactions on Biomedical Engineering (ISSN 0018-9294), vol. 38, Nov. 1991, p. 1053-1060. refs
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A method for estimating the spatial and temporal properties of neurons, like the otolith neurons, that are spatially tuned to different stimulus directions is presented. The method is based on the response ellipse that can be constructed from the measured response gain and phase values during stimulation along three orthogonal axes. The semimajor axis of the ellipse can specify the neuron's direction of maximum sensitivity (polarization vector), whereas the semiminor axis provides its sensitivity in the perpendicular direction. The predictions of the method for nonzero length of the semiminor axis are qualitatively the same as the experimentally observed dependence of response phase on stimulus orientation.

I.E.

A92-22342

MULTIPLE EVOLUTIONARY ORIGINS OF PROCHLOROPHYTES, THE CHLOROPHYLL B-CONTAINING PROKARYOTES

B. PALENIK and R. HASELKORN (Chicago, University, IL) Nature (ISSN 0028-0836), vol. 355, Jan. 16, 1992, p. 265-267. refs
Copyright

Molecular sequence data based on a fragment of the rpoC1 gene encoding a subunit of DNA-dependent RNA polymerase are presented which indicate that the known prochlorophyte lineages do not include the direct ancestor of chloroplasts. It is shown that the prochlorophytes are a highly diverged polyphyletic group, and that the use of chlorophyll b as a light-harvesting pigment has developed independently several times in evolution.

C.D.

A92-22343

MULTIPLE EVOLUTIONARY ORIGINS OF PROCHLOROPHYTES WITHIN THE CYANOBACTERIAL RADIATION

ENA URBACH, SALLIE W. CHISHOLM (MIT, Cambridge, MA), and DEBORAH L. ROBERTSON (Chicago, University, IL) Nature (ISSN 0028-0836), vol. 355, Jan. 16, 1992, p. 267-270. Research supported by NSF, EPA, and U.S. Navy. refs
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A92-23435

A STUDY OF A MUTATION EFFECT ARISING FROM SPACE FLIGHT FACTORS [IZSLEDVANE NA MUTAGENNOTO DEISTVIE NA FAKTORI NA KOSMICHESKIIA POLET]

D. K. BENOVA (Meditsinska Akademiia, Nauchen Institut po Nuklearna Meditsina, Radiobiologiya i Radiatsionna Khigiena, Sofia, Bulgariia) Aerokosmicheski Izsledvaniia v B'lgaria (ISSN 0861-1432), vol. 7, 1991, p. 82-84. In Bulgarian. refs
Copyright

Results obtained from rat experiments performed on the Cosmos 1129 and 1514 biosatellites are summarized. A mutation effect resulting from space flight factors was observed in somatic and sex cells. Zero gravity was not found to be of primary importance. More quantitative data are necessary to further explain its effects.

P.D.

A92-24274

CHINA'S BIOMEDICAL EXPERIMENT ON RECOVERABLE SATELLITES

LIPING SHEN and PUXIU WANG Aerospace China (ISSN 1002-7742), Dec. 1991, p. 12-15. In Chinese.

A Chinese biomedical experimental system tested on a recoverable satellite in October 1990 is described. The system consisted of a cabin with temperature control, atmosphere pressure control subsystem, air purification and humidity maintenance subsystem, animal service subsystem, and measurement, control, and power management subsystem. Biomedical experiments conducted on white mice, fruit flies, silkworm eggs, and wheat seeds conducted during the flight are discussed.

C.D.

N92-16542# Michigan State Univ., East Lansing. Plant Research Lab.

INTERDISCIPLINARY RESEARCH AND TRAINING PROGRAM IN THE PLANT SCIENCES

C. P. WOLK 1991 42 p
(Contract DE-FG02-91ER-20021)
(DE92-002818; DOE/ER-20021/1) Avail: NTIS HC/MF A03

This document is the compiled progress reports from the Interdisciplinary Research and Training Program in the Plant Sciences funded through the MSU-DOE Plant Research Laboratory. Fourteen reports are included, covering topics such as the molecular basis of plant/microbe symbiosis, cell wall proteins and assembly, gene expression, stress responses, growth regulator biosynthesis, interaction between nuclear and organelle genomes, sensory transduction and tropisms, intracellular sorting and membrane trafficking, regulation of lipid metabolism, the molecular basis of disease resistance and plant pathogenesis, developmental biology of Cyanobacteria and hormonal involvement in environmental control of plant growth.

DOE

N92-16543# California Univ., Riverside. Dept. of Biochemistry. CATALYTIC MECHANISM OF HYDROGENASE FROM AEROBIC N₂-FIXING MICROORGANISMS

D. J. ARP 1991 9 p
(Contract DE-FG03-84ER-13257)
(DE92-003395; DOE/ER-13257/T2) Avail: NTIS HC/MF A02

The results of this DOE-sponsored project have contributed to our understanding of the catalytic mechanism of *A. vinelandii* hydrogenase. A group of inhibitors have been characterized. These provide information about the different types of redox clusters involved in catalysis and the roles of each. One group has already used acetylene in a study of three desulfurobrian hydrogenases and shown that only the NiFe hydrogenases are inhibited. We have characterized a number of spectral properties of *A. vinelandii* hydrogenase. The EPR signals associated with this hydrogenase in the reduced state are reminiscent of other NiFe dimeric hydrogenases such as *A. eutrophus*, but distinctly different from others such as *D. gigas* and *Chromatium vinosum*. Thus, while the NiFe dimeric hydrogenases are now recognized as a large group of similar enzymes, there are differences in the spectral and catalytic properties which are not explained by their similar redox inventories, identical subunit structures, immunological cross reactivity and conserved sequences. The inhibitors we have

characterized are also proving of value in the spectral characterizations. Surprisingly, we only see a significant EP signal attributable to Ni after the enzyme has been inactivated with O₂ and then reduced (though not reactivated). No spectral perturbations (EPR or UV-V is) of active enzyme can be attributed to binding of H₂, even though H₂ clearly binds to this form of the enzyme. Acetylene, which does not substantially perturb the EPR signal of active hydrogenase, does result in a new absorption envelope in the UV-V is spectrum. Overall, the results of this project have revealed the complex interactions of the redox clusters in catalysis through studies of inhibitor mechanisms and spectral properties. DOE

N92-16544* # Pennsylvania State Univ., University Park. Dept. of Molecular and Cell Biology.

EFFECTS OF SPACEFLIGHT ON RAT PITUITARY CELL FUNCTION: PREFLIGHT AND FLIGHT EXPERIMENT FOR PITUITARY GLAND STUDY ON COSMOS, 1989 Final Report, Jun. 1989 - Apr. 1990

WESLEY C. HYMER Apr. 1990 29 p

(Contract NAG2-598)

(NASA-CR-189799; NAS 1.26:189799) Avail: NTIS HC/MF A03 CSCL 06C

The secretory capacity of growth hormone (GH) and prolactin (PRL) cells prepared from rats flown in space on the 12.5 day mission of Cosmos 1887 and the 14 day mission of Cosmos 2044 was evaluated in several post-flight tests on Earth. The results showed statistically significant and repeatable decrements in hormone release, especially when biological assays (rather than immunological assays) were used in the tests. Significant and repeatable intracellular changes in GH cells from the flight animals were also found; most important were increases in the GH-specific cytoplasmic staining intensities and cytoplasmic areas occupied by hormone. Tail suspension of rats for 14 days, an established model for mimicking musculo-skeletal changes seen in spaceflown rats, results in some changes in GH and PRL cell function that were similar to those from spaceflown animals. Our results add to a growing body of data that described deconditioning of physiological systems in spaceflight and provide insights into the time frame that might be required for readaptation of the GH/PRL cell system upon return to Earth. Author

N92-16545* # Ohio State Univ., Columbus. Dept. of Plant Biology.

THE ROLE OF CALCIUM AND CALMODULIN IN THE RESPONSE OF ROOTS TO GRAVITY Final Report, Mar. 1989 - Feb. 1991

MICHAEL L. EVANS Jan. 1992 7 p

(Contract NAGW-297; RF PROJ. 763005/714376)

(NASA-CR-189800; NAS 1.26:189800) Avail: NTIS HC/MF A02 CSCL 06C

There is general agreement that, in roots, the primary detection of the gravitropic signal occurs in the columella cells of the cap and that this results in the generation of a signal that moves into the elongation zone causing the asymmetric growth that leads to downward curvature. Recent work has generated considerable evidence that indicates that auxin is the ultimate mediator of differential growth during root (and shoot) gravitropism. Our studies of the time course of curvature, auxin redistribution and/or adaptation, and electrical potential changes in maize roots have led to the following generalizations: (1) downward curvature begins 18 to 32 min following gravistimulation; (2) asymmetric auxin redistribution across the root cap begins at about the same time as curvature or perhaps slight earlier; (3) there is a lag of approx. 15 min in the response of roots to applied auxin; and (4) gravi-induced changes in intracellular potentials of cortical cells within the elongation zone occur within 30 s following stimulation. Author

N92-16546# Argonne National Lab., IL.

EFFECTS OF SOLAR ULTRAVIOLET PHOTONS ON MAMMALIAN CELL DNA

M. J. PEAK and J. G. PEAK 1991 8 p Presented at the

Biologic Effects of Light Symposium, Atlanta, GA, 13-15 Oct. 1991

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

(DE92-003447; ANL/CP-73713; CONF-9110280-1) Avail: NTIS HC/MF A02

This document presents information on the possible mechanisms of carcinogenesis caused by UVA (ultraviolet radiation in the 320 to 400 nm region). Most studies showing the carcinogenic effects of ultraviolet light have concentrated on UVB (280 to 320 nm). UVA had been considered harmless even though it penetrates biological tissues better than UVB. Recently, it has become apparent that UVA is also capable of causing damage to cellular DNA. This was unexpected because the DNA UV absorption spectrum indicates a negligible probability that photons of wavelengths longer than 320 nm will be directly absorbed. The most common defects induced in DNA by UVB are pyrimidine photoproducts, such as thymidine dimers. UVA photons produce defects resembling those caused by ionizing radiations: single- and double-strand breaks, and DNA-protein crosslinks. This paper also discusses the role of DNA repair mechanisms in UVA-induced defects and the molecular mechanisms of UVA damage induction. DOE

N92-17121# Miami Univ., Oxford, OH. Dept. of Zoology.

ASSESSMENT OF THE BEHAVIORAL AND NEUROTOXIC EFFECTS OF HEXACHLOROBENZENE (HCB) IN THE DEVELOPING RAT Final Report, May 1989 - Dec. 1990

D. H. TAYLOR and E. GOLDEY Dec. 1990 41 p Prepared for

NSI Technology Services Corp., Dayton, OH

(Contract F33615-85-C-0532; AF PROJ. 6302)

(AD-A243658; AAMRL-TR-90-076) Avail: NTIS HC/MF A03 CSCL 15/6

Hexachlorobenzene (HCB) is a widespread environmental contaminant. Due to its highly lipophilic nature, HCB is stored in the body adipose tissue and is released with the milk during lactation. Female Sprague-Dawley rats were given 0 (control), 10 or 100 mg HCB/kg body weight, and dosing was completed two weeks prior to breeding. We evaluated the gestational and lactational transfer of HCB from the dams to fetuses and pups and determined that HCB is present in the developing rat brain. Throughout gestation, the HCB tissue concentrations for the 10 and 100 mg HCB/kg body weight groups differed by 10 fold. The maternal body burden of HCB was quickly depleted by lactational transfer of the HCB to the suckling pups as reflected by HCB concentrations in the milk and pups. However, across treatment groups, only a 2-3 fold difference existed between tissue concentrations of HCB in both dams and pups during lactation. Subsequently, we assessed the developmental neurotoxicity of HCB using a battery of behavioral tests. The negative geotaxis response and olfactory homing were assessed in two male and two female pups from each litter between 6 and 11 days of age. GRA

N92-17142# Wellesley Coll., MA.

MELATONIN ACTION ON THE CIRCADIAN PACEMAKER IN SIBERIAN HAMSTERS Annual Report, 1 Nov. 1989 - 31 Aug. 1991

JANET M. DARROW 29 Sep. 1991 14 p

(Contract AF-AFOSR-0067-90; AF PROJ. 2312)

(AD-A243057; AFOSR-91-0911TR) Avail: NTIS HC/MF A03 CSCL 06/3

This research investigates the effect of the hormone melatonin on the circadian clock of mammals, by examining daily activity rest cycles and body temperature rhythms in melatonin-infused Siberian hamsters, under a variety of environmental lighting conditions. In experiments simulating jet-lag conditions, melatonin significantly accelerated re-adjustment of sleep/wake rhythms to phase-shifted light cycles. Within days after an 8-hr phase-advance of the light/dark cycle, all melatonin-treated hamsters, but none of the saline-treated controls, had achieved the proper phase relationship with the new photoschedule. These results are consistent with reports of melatonin treatment reducing jet lag in humans. Under conditions of constant darkness, daily melatonin

infusions synchronized the hamster activity/rest rhythm. In constant light, melatonin also acted as a weak entraining agent and prevented the internal desynchronization which occurs in Siberian hamsters and in many mammals exposed to constant light. These results offer encouragement about Siberian hamsters as an appropriate model system to investigate melatonin action on the circadian clock. GRA

N92-17224# Michigan State Univ., East Lansing.

MICROBIAL DIVERSITY: COURSE REPORT 1991

JOHN A. BREZNAK and MARTIN DWORKIN 1991 32 p

(AD-A243464) Avail: NTIS HC/MF A03 CSCL 05/2

Inasmuch as the course emphasizes nature as a tremendous reservoir of microbial diversity, a special effort is made to exploit the array of terrestrial, freshwater and marine habitats in the vicinity of Woods Hole as the source of microbes to be isolated in the laboratory portion of the course. Additional samples from unusual habitats (e.g., deep sea hydrothermal vent areas; deep subsurface cores) are obtained from other investigators. Subsequent to isolation, experiments are designed to examine some of the unique biochemical and physiological properties of the organisms in pure culture and, where appropriate, when placed in defined co-culture with other microbes. To accomplish this, students are taught various techniques for cultivation of microorganisms (including the Hungate technique for strict anaerobes), as well as various methods for observing and studying the isolated microbes (phase contrast, fluorescence, and DIC microscopy; gas-liquid and high performance liquid chromatography; spectroscopy; PCR methodology and gel electrophoresis; etc.). GRA

N92-17269# Army Aeromedical Research Lab., Fort Rucker, AL.

THE EFFECT OF IMPULSE PRESENTATION ORDER ON HEARING TRAUMA IN THE CHINCHILLA

JAMES H. PATTERSON, JR., DENNIS L. CURD, ILIA L. GAUTIER, ROGER P. HAMERNIK, WILLIAM A. AHROON, GEORGE A. TURRENTINE, and C. E. HARGETT, JR. (State Univ. of New York, Plattsburgh.) Sep. 1991 70 p
(Contract DA PROJ. 3E1-62777-A-878; DA PROJ. 3M1-61102-BS-15)

(AD-A243174; USAARL-91-21) Avail: NTIS HC/MF A04 CSCL 06/3

Existing criteria for exposure to impulse noise do not provide any explicit means for evaluating exposures for which the peak SPL (Sound Pressure Level) of the impulses varies in any given exposure day. Approaches to evaluating such exposures have included the application of a 'proportional dose' method such as used with continuous noise or use of an average level. Implicit in these approaches is the assumption that the order in which a sequence of variable intensity impulses is presented is not important. This same assumption is also implicit in any energy-based exposure criteria. This report presents results of a pilot experiment designed to test the validity of this assumption. Two groups of chinchillas were exposed to a sequence of 100 impulses. One group received 90 exposures at 138 dB peak SPL impulses followed by 10 exposures at 146 dB peak SPL impulses; the second group received the same series of impulses but in reverse order. Results from these two groups were compared to results of 100 exposures at 147 dB peak SPL impulses from a report by Patterson et al., (1986). The 139 dB peak SPL exposure had the same total energy as the two variable intensity exposures. Results of the three equivalent energy exposures showed that exposures having equal energies could produce statistically different levels of hearing trauma. However, while the mean data were very suggestive in showing an effect of the presentation order, this result did not hold up to statistical analysis because of a large intersubject variability. GRA

N92-17288# Georgia Tech Research Inst., Atlanta.

BIOPHYSICAL TECHNIQUES FOR EXAMINING METABOLIC, PROLIFERATIVE, AND GENETIC EFFECTS OF MICROWAVE RADIATION Final Report, 1 Oct. 1989 - 30 Aug. 1990

MARTIN L. MELTZ Sep. 1991 37 p Prepared in cooperation

with Texas Univ. Health Science Center, San Antonio

(Contract F33615-87-D-0626)

(AD-A241903; AL-TR-1991-0004) Avail: NTIS HC/MF A03

CSCL 06/5

This project was undertaken to prepare for a comprehensive research effort examining metabolic, proliferative, and genetic effects of microwave radiation. To accomplish this task, preliminary studies have been performed with 4 cells systems; Chinese hamster ovary (CHO) cells, AS52 Chinese hamster cells (heterozygous at the xanthine-guanine phosphoribosyl transferase (XGPR) locus), 244B proliferating human lymphoblastoid cells, and freshly isolated peripheral lymphocytes. The thermal response of the 244B cells has been carefully examined, and an initial characterization of the membrane markers, membrane permeability, and cell cycle distribution of these cells undertaken. The absence of the induction of chromosome aberrations in CHO cells, after exposure to 850 MHz pulsed wave (PW), 18mW/cm² (specific absorption rate (SAR) 14.4 W/kg) radiofrequency radiation (RFR), or after exposure to 1,200 MHz PW (220 W -300 W net forward power; SAR 24.33 W/kg RFR, is reported. The survival response of the AS52 cells, after simultaneous treatment at 37 C or 40 C, with and without mitomycin or adriamycin, is described. The survival of the AS52 cells after X-ray exposure at low and high dose rates is also described. GRA

N92-17471# Argonne National Lab., IL.

ARTIFICIAL PHOTOSYNTHESIS: PROGRESS TOWARD MOLECULAR SYSTEMS FOR PHOTOCONVERSION

M. R. WASIELEWSKI 1991 4 p Presented at the 10th Anniversary Symposium of Japan-US Cooperative Photoconversion and Photosynthesis Research Program, Okazaki, Japan, 4-6 Dec. 1991

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

(DE92-003370; ANL/CP-74610; CONF-911264-1) Avail: NTIS HC/MF A01

A great deal of progress has been made in identifying the criteria necessary to design molecular systems for the efficient photochemical separation of charge over extended periods of time. Our own research in this area has focused on preparing supramolecular assemblies of electron donors and acceptors which fulfill the biomimetic criteria dictated by photosynthetic charge separation in Nature. First, it is important that the electron donors and acceptors occupy structurally well-defined spatial relationships relative to one another. A key consequence of studying well-defined structures is the simplification of mechanistic arguments that are used to describe electron transfer events in these systems. Second, the electronic coupling between the donors and acceptors must be controlled by the structure to insure that strong coupling results in rapid charge separation from the initial donor-acceptor state, and that weak coupling in the product ion pair state slows charge recombination. Considerations of electronic structure and orbital symmetry are necessary to achieve this goal. Third, the surrounding medium plays a critical role in determining the rates of electron transfer reactions. This is especially true when charges are created or annihilated in electron transfer reactions. Once again, Nature provides a high standard to be achieved. Photosynthetic reaction centers are fully competent in the solid state, even at very low temperatures, undergoing charge separation with unity quantum yield at temperatures less than 4.2 K. In order for our artificial photosynthetic systems to have general applicability as photocatalysts, it is highly desirable to have systems that are fully functional in the solid state. DOE

N92-17474# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.

TEMPORALLY-SPECIFIC MODIFICATION OF MYELINATED AXON EXCITABILITY IN VITRO FOLLOWING A SINGLE ULTRASOUND PULSE

RICHARD T. MIHRAN, FRANK S. BARNES, and HOWARD WACHTEL 1990 26 p

(Contract N00014-87-K-0313)

(AD-A242329) Avail: NTIS HC/MF A03 CSCL 20/1

Single, short duration, low energy pulses of ultrasound were

found to elicit distinct modifications of the electrical excitability of myelinated frog sciatic nerve in vitro in a window extending 40 to 50 ms after pulse termination. These modifications include both enhancement and suppression of relative excitability, the sequence of which generally follows one of two distinct temporal response patterns. The ultrasound pulses were focused, 2.7 MHz, of 500 duration, and of peak intensities of 100 to 800 W/sq cm. Total absorbed pulse energies were generally less than 100 mJ/g, corresponding to local temperature rises of the nerve trunk of no more than 0.025 C per pulse, thereby precluding bulk heating as a basis of this effect. The observed effects cannot be elicited using either a subthreshold square wave or RF electrical prestimulus, suggesting a unique form of receptivity of the nerve trunk to mechanical perturbation. We present evidence that the low-frequency radiation pressure transient accompanying the envelope of the acoustic pulse is the active parameter in this phenomenon, and postulate that it may act by the gating of stretch sensitive channels, which have been recently reported in a variety of cell membranes. These results may demonstrate that stretch sensitive channels in neural membrane could serve to functionally modulate neuro electric signals normally mediated by voltage dependent channels, a finding which could suggest new clinical applications of high peak power, low total energy pulsed ultrasound. GRA

N92-17504# Pennsylvania Univ., Philadelphia. Dept. of Computer and Information Sciences.

COMPUTATIONAL AND NEURAL NETWORK MODELS FOR THE ANALYSIS OF VISUAL TEXTURE Annual Progress Report, 1 Sep. 1990 - 31 Aug. 1991

RUZENA BAJCSY 4 Nov. 1991 5 p
(Contract AF-AFOSR-0296-88; AF PROJ. 2313)
(AD-A243717; AFOSR-91-0986TR) Avail: NTIS HC/MF A01
CSCL 06/1

The detailed and biological realistic neural model of architectures that utilize Gabor filters for vision computations continues to be the focus of research. Additionally, some further testing of a three layer back propagation learning network for computing slat tilt was undertaken. A model has been developed which simulates the process of texture segmentation in the visual cortex according to the computational model of M. R. Turner et. al. using the McGregor high fidelity neural simulator. This system attempts to faithfully simulate the transfer functions of neurons using various numerical simulation methods. GRA

N92-17564# Miami Univ., FL. Div. of Marine Biology and Fisheries.

CHARACTERIZATION OF THE P. BREVIS POLYETHER NEUROTOXIN BINDING COMPONENT IN EXCITABLE MEMBRANES Final Report, 15 Aug. 1988 - 14 Aug. 1991

DANIEL G. BADEN 14 Sep. 1991 41 p
(Contract DAMD17-88-C-8148; DA PROJ. 3M1-62787-A-871)
(AD-A242877) Avail: NTIS HC/MF A03 CSCL 06/5

The development of a functional model, and topographic picture of how and why sodium channels act in the ways in which they gate sodium ion flux is our goal. We are developing about 20 different natural toxin derivatives based on 7 divergent chemical modifications. Each type of derivative has a specific potential once synthesized. Photoaffinity probes, affinity columns, tritiated non-exchangeable toxins, and specific intermediates are in various stages of completion. These probes are being utilized to characterize the topographic relationship of sites 1, 2, and 5 associated with voltage-sensitive sodium channels. The brevetoxin binding site has already been localized on Domain IV of VSSC, and binds to an external hydrophobic peptide located between S5 and S6 of Domain IV. Antisodium channel RIA, tritiated brevetoxin photoaffinity binding, immunoprecipitation, and SDS-polyacrylamide gel electrophoresis have all made substantial contributions to brevetoxin site localization. GRA

N92-17815# International Centre for Theoretical Physics, Trieste (Italy).

MATHEMATICS AND BIOLOGY

I. A. KHAN Jun. 1991 9 p
(DE92-611247; IC-91/115) Avail: NTIS HC/MF A02

In India and in so many other countries, the science students are generally separated into two main streams: one opting mathematical sciences and the other studying biological sciences. As a result, medicos and biologists have no adequate knowledge of mathematical sciences. Nowadays, this is a great drawback, because of the tremendous application of mathematics in the biosciences. The main aim of this article is to emphasize the need for mathematico-biologists in abundance for the better service of mankind. DOE

N92-17877# International Centre for Theoretical Physics, Trieste (Italy).

EVOLUTION AS A MOLECULAR COOPERATIVE PHENOMENON

J. CHELA-FLORES Jun. 1991 19 p
(DE92-609575; IC-91/108) Avail: NTIS HC/MF A03

We discuss an hypothesis according to which microscopic mechanisms due to cooperation, at the molecular level, may have been key factors in the evolution of life on Earth. We view our hypothesis as a natural extension to the molecular level of viewing cooperation (symbiosis) as an evolutionary driving force; this does not restrict the interpretation of the evolutionary process to be the result of slow accumulation of mutations in the DNA. Some evidence supporting this hypothesis is discussed: (1) The Salam enhancement factor. This molecular phenomenon was recently introduced in order to understand the bases of the first unifying principle of biochemistry, namely that transcription of all known genes in prokaryotes, protists, metazoan, and metaphytes are translated into L-amino acids, except for some bacterial membrane proteins. (2) The role that cooperative phenomena may have played in the origin of evolution itself, i.e., in the resolution of Sagan's ultraviolet paradox. (3) The relationship between evolution and the constraints imposed by embryonic development. This is considered from the point of view of molecular cooperative phenomena. DOE

N92-17946# International Centre for Theoretical Physics, Trieste (Italy).

GLOBAL MODELS FOR THE BIOMECHANICS OF GREEN PLANTS, PART 1

A. R. BESTMAN Dec. 1990 12 p
(DE91-641478; IC-90/473) Avail: NTIS HC/MF A03

The paper considers the biomechanics of green plants for Reynolds number flow in the stem. In particular, it is assumed that the stem is cylindrical and the flow fully-developed. So that if the aspect ratio is defined as the ratio of the stem radius to its length, then when the aspect ratio is small analytical solutions have been developed for the concentration, temperature and the axial velocity. The process of translocation and transpiration are discussed quantitatively. DOE

N92-17970# International Centre for Theoretical Physics, Trieste (Italy).

COMMENTS ON A NOVEL APPROACH TO THE ROLE OF CHIRALITY IN THE ORIGIN OF LIFE

J. CHELA-FLORES Jun. 1991 12 p
(DE92-609034; IC-91/126) Avail: NTIS HC/MF A03

We review a recent paper (Salam, 1991a) in which a specific enhancement factor (i.e., a phase transition into a condensed Bose mode) is proposed to account for the observed amplification of the ground state energies of the L- and D-amino acid enantiomers; the difference between these energies is assumed to be due to the neutral parity violating electroweak interaction. This physical effect initially shifts the enantiomer energies by about 3×10^{-19} eV. The proposed phase transition is characterized by a critical temperature ($T_{sub c}$), which may be studied theoretically by enlarging the standard electroweak theory to include either the top quark or supersymmetry (Salam, 1991b). Possible experimental means of finding $T_{sub c}$ are discussed. DOE

AEROSPACE MEDICINE

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

A92-20857**MICROCOMPUTER-BASED MONITORING OF CARDIOVASCULAR FUNCTIONS IN SIMULATED MICROGRAVITY**

K. TAHVANAINEN, E. LANSIMIES, P. TIKKANEN, J. HARTIKAINEN, T. KARKI, T. LYYRA, and M. MANTYSAARI (Kuopio University Hospital, Finland) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 227-236. refs

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A microcomputer-based system for non-invasive monitoring of cardiovascular system in simulated microgravity is described. The system evaluates automatically, accurately and interactively heart beat intervals, beat-to-beat non-invasive finger arterial blood pressure (systolic, diastolic, mean and pulse pressure) using a Finapres device and beat-to-beat changes of thoracic blood volume using impedance changes. In addition, beat-to-beat evaluation of cardiac mechanical function including left ventricular ejection time, diastolic time, systolic time intervals, left ventricular ejection fraction estimate and several other contractility parameters, left ventricular volume, stroke volume and cardiac output estimates are performed with high degree of automaticity. Author

A92-20858**THE CHARACTERISTICS OF ARM MOVEMENTS EXECUTED IN UNUSUAL FORCE ENVIRONMENTS**

O. BOCK (York University, North York, Canada) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 237-241. Research supported by NSERC. refs

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Human subjects pointed at stationary visual targets without sight of their arm while the force environment was varied by applying weight or spring loads to the hand. The path traveled by the finger, pointing accuracy, and the shape of the finger-velocity profile remained invariant across all force environments after a single practice trial. However, the magnitude and duration of the velocity profile depended consistently on the presence and size of a weight load. In contrast, velocity was not affected by spring loads. An analysis of movement dynamics in the study indicated that inertial and gravitational load components were compensated by separate mechanisms, the former employing time- and the latter magnitude-scaling of muscle force profiles. The presence of such separate mechanisms made it possible to predict little problems for movement dynamics in weightlessness. Author

A92-20860**CIRCADIAN RHYTHMS IN A LONG-TERM DURATION SPACE FLIGHT**

ALEKSEI M. ALPATOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51)

Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 249-252. refs

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The effect of long-duration isolation on the endogenous free-running circadian-rhythm (CR) period tau (which may be different from 24 hr, depending on individual and environmental parameters) was investigated. Four humans were placed singly in isolation for about 1 month and had to obey a strict 'diurnal' schedule, with a regular 8-hr shift of operator work, but following their own biological clock instead of a watch. As a result, all subjects, in spite of their full impression of living in subjective 24-hr day, demonstrated an elongation of the circadian period to an about 25-hr rhythm, suggesting that, in long-term space flights, a 25-hr day may be preferable to a 24-hr day. Results of biorhythm studies aboard the Cosmos manned satellites disclosed a lower stability of CRs in space and a shift of CR in microgravity, both leading to higher hazard of CR desynchronization. These results suggest that, in long-term space flights, a 25-hr day may be preferable to a 24-hr day and that a flexible work/rest schedule coordinated with CRs of the crew via a biofeedback loop would be beneficial. I.S.

A92-20865* Texas Univ., San Antonio.

LONG-TERM EFFECTS OF MICROGRAVITY AND POSSIBLE COUNTERMEASURES

JAMES W. WOLFE (Texas, University, San Antonio) and JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 281-284. refs

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The measures that can be taken to counteract the effect of long-term exposures to microgravity are discussed. It is noted that, although it was shown that specially designed exercise programs can counteract the effect of exposures of up to one year in space, is it questionable whether U.S. astronauts could or should have to maintain such regimes for extremely prolonged missions. The methods considered by NASA Life Sciences Division are to provide an artificial gravity environment by the generation of centrifugal forces by means of either the continuous rotation of the whole spacecraft or using a short-arm centrifuge on board a zero-g spacecraft. Results obtained in studies of these two methods are discussed, and the centrifuge research facility that is presently being developed by NASA is described. I.S.

A92-20869**SUMMING-UP COSMONAUT PARTICIPATION IN LONG-TERM SPACE FLIGHTS**

A. I. GRIGOR'EV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 323-328. refs

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Observations related to physiological changes in humans during space flights are examined in detail. Medical results obtained in short- and long-term space missions indicate that a man can adequately adapt and efficiently work in space for as long as a year. Physiological changes detected in flight were adaptive, adequate to the space flight environment, and reversible. They did not deteriorate the work capacity of the crewmembers. O.G.

A92-20870* National Aeronautics and Space Administration, Washington, DC.

DEVELOPMENT OF COUNTERMEASURES FOR MEDICAL PROBLEMS ENCOUNTERED IN SPACE FLIGHT

ARNAULD E. NICOGLOSSIAN, JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC), LAUREN LEVETON, and RON TEETER (Lockheed Corp., Washington, DC) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 329-337. refs
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Past experience with piloted space missions is reviewed to develop potential countermeasures to the medical problems associated with a long-duration space flight. Particular attention is given to the Extended Duration Orbiter Medical Program, which is aimed at ensuring crew health and safety on Space Shuttle missions; Soviet experience with long-duration space flights; and a variety of countermeasures including physiological, psychological, environmental health, radiation protection, and artificial gravity countermeasures. O.G.

A92-20872

SOME MEDICAL ASPECTS OF AN 8-MONTH'S SPACE FLIGHT
O. I. ATKOV (All-Union Cardiology Research Center, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 343-345.

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Results of medical experiments performed on the Salyut-7-Soyuz-T orbital complex and the Mir station are briefly discussed with particular attention given to cardiovascular studies and hematological examinations. It is concluded that an increase in flight time to eight months produced no qualitatively new physiological changes as compared to the previous prolonged flights. O.G.

A92-20895* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HUMAN REPRODUCTIVE ISSUES IN SPACE

PATRICIA A. SANTY and RICHARD T. JENNINGS (NASA, Johnson Space Center, Houston, TX) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 151-155. refs

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A review of reproductive functioning in animal species studied during space flight demonstrated that most species were affected significantly by the absence of gravity and/or the presence of radiation. These two factors induced alterations in normal reproductive functioning independently of, as well as in combination with, each other. Based on animal models, several potential problem areas regarding human reproductive physiology and functioning in the space environment were identified. While there are no current space flight investigations, the animal studies suggest priorities for future research in human reproduction. Such studies will be critical for the successful colonization of the space frontier. Author

A92-20896

COMBINED INJURY SYNDROME IN SPACE-RELATED RADIATION ENVIRONMENTS

R. F. DONS and U. FOHLMEISTER (USAF, Medical Center, Lackland AFB, TX) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) *Advances*

in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 157-163. refs

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The risk of combined injury (CI) to space travelers is a function of exposure to anomalously large surges of a broad spectrum of particulate and photon radiations, conventional trauma (T), and effects of weightlessness including decreased intravascular fluid volume, and myocardial deconditioning. CI may occur even at relatively low doses of radiation which can synergistically enhance morbidity and mortality from T. Without effective countermeasures, prolonged residence in space is expected to predispose most individuals to bone fractures as a result of calcium loss in the microgravity environment. Immune dysfunction may occur from residence in space independent of radiation exposure. Thus, wound healing would be compromised if infection were to occur. Survival of the space traveler with CI would be significantly compromised if there were delays in wound closure or in the application of simple supportive medical or surgical therapies. Author

A92-20897

PROTOCOL FOR THE TREATMENT OF RADIATION INJURIES

D. BROWNE, J. F. WEISS, T. J. MACVITTIE, and M. V. PILLAI (DNA, Armed Forces Radiobiology Research Institute, Bethesda, MD) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 165-168. Research supported by DNA. refs

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Despite adequate precautionary measures and high-quality safeguard devices, many accidental radiation exposures continue to occur and may pose greater risks in the future, including radiation exposure in the space environment. The medical management of radiation casualties is of major concern to health care providers. Such medical management was addressed at The First Consensus Development Conference on the Treatment of Radiation Injuries, Washington, DC, 1989. The conference addressed the most appropriate treatment for the hematopoietic and infectious complications that accompany radiation injuries and for combined radiation and traumatic/burn injuries. Based on the evidence presented at the conference, a consensus statement was formulated by expert physicians and scientists. The recommended therapies, including a suggested algorithm incorporating these recommendations for the treatment of radiation injuries, are discussed. Author

A92-20900* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

RADIATION ISSUES FOR PILOTED MARS MISSION

GAUTAM D. BADHWAR, D. S. NACHTWEY (NASA, Johnson Space Center, Houston, TX), and TRACY C. YANG (Lawrence Berkeley Laboratory, Berkeley, CA) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 195-200. refs

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Current radiation risk for a piloted Mars mission is estimated using the idea of absorbed dose and ICRP-26, LET-dependent quality factors. In a spacecraft with aluminum walls (2 g/sq cm) at solar minimum the calculated dose equivalent is 0.73 Sv for a 406-day mission. Based on the current thinking this leads to an excess cancer mortality in a 35-year male of about 1 percent. About 75 percent of the dose equivalent is contributed by HZE particles and target fragments with average quality factors of 10.3 and 20, respectively. The entire concept of absorbed dose, quality factor, and dose equivalent as applied to such missions needs to be reexamined, in light of the fact that less than 50 percent of

the nuclei in the body of the astronaut would have been traversed by a single GCR nuclei in the 406-day mission. Author

A92-20901

ROLE OF ENDOGENOUS THIOLS IN PROTECTION

O. VOS (TNO, Rijswijk; Rotterdam, University, Netherlands) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 201-207. refs Copyright

The importance of intracellular GSH in determining cellular radiosensitivity has been shown by irradiating cells that had very low GSH levels. Such cells appear to have a high radiosensitivity, especially in hypoxic conditions. On the other hand, it has been demonstrated that induction of a high GSH level (100-200 percent above the normal level) provides only a small protection. In vitro experiments with DNA indicate that thiols with a high positive charge condense in the vicinity of DNA and are effective protectors, whereas thiols with a negative charge are kept away from it and are poor protectors. In comparison with the most effective exogenous aminothiols like cysteamine and WR1065, GSH is not an effective radioprotector. Putative explanations for this relatively poor protective ability of GSH are presented. Author

A92-20903

SOME RECENT DATA ON CHEMICAL PROTECTION AGAINST IONIZING RADIATION

M. FATOME, J. D. LAVAL, and V. ROMAN (Ministere des Armees, Unite de Radioprotection, La Tronche, France) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 213-221. Research supported by Institut Henri Beaufour and DRET. refs Copyright

Once introduced into the organism, the radioprotectors decompose rapidly and that increases their toxicity, shortens their duration of action, and renders them inactive after oral delivery. An attempt was made to protect them by incorporating them in vectors. When a cysteamine-liposomal suspension was orally delivered, it showed a radioprotective activity for about 4 hours. By using S-35 cysteamine, it was noted that its plasmatic concentration was increased. Freeze-drying of these preparations was a good means of conservation if the samples were stored at 4 C. A good and sustained activity was also obtained after oral delivery of WR-2721 entrapped in microspheres. Author

A92-20905

RADIOPROTECTION BY POLYSACCHARIDES ALONE AND IN COMBINATION WITH AMINOTHIOLS

MYRA L. PATCHEN, THOMAS J. MACVITTIE, BRIAN D. SOLBERG, MICHELE M. D'ALESSANDRO, and ITZHAK BROOK (DNA, Armed Forces Radiobiology Research Institute, Bethesda, MD) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 233-248. Research supported by U.S. Army and DNA. refs Copyright

It is demonstrated that glucan, a beta-1,3 polysaccharide immunomodulator, enhances survival of mice when administered before radiation exposure. Glucan's prophylactic survival-enhancing effects are mediated by several mechanisms, including (1) increasing macrophage-mediated resistance to potentially lethal postirradiation opportunistic infections, (2) increasing the D(O) of hematopoietic progenitor cells, and (3) accelerating hematopoietic

reconstitution. In addition, even when administered shortly after some otherwise lethal doses of radiation, glucan increases survival. Glucan's therapeutic survival-enhancing effects are also mediated through its ability to enhance macrophage function and to accelerate hematopoietic reconstitution; glucan's therapeutic potential, however, is ultimately dependent on the survival of a critical number of hematopoietic stem cells capable of responding to glucan's stimulatory effects. Author

A92-20906

PROSTAGLANDIN-INDUCED RADIOPROTECTION OF MURINE INTESTINAL CRYPTS AND VILLI BY A PGE DIENE ANALOG (SC-44932) AND A PGI ANALOG (ILOPROST)

WAYNE R. HANSON (USVA, Hines Veterans Affairs Hospital, IL) and PAUL W. COLLINS (G.D. Searle and Co., Dept. of Gastrointestinal Diseases, Skokie, IL) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 249-255. refs Copyright

The aminothiols exemplified by WR-2721 are effective radioprotectors; however, their toxicity associated with hypotension, nausea, and emesis has limited their development for applications in medicine or in hazardous radiation environments. A variety of prostaglandins (PGs) have been shown to be radioprotective agents and some appear to have fewer toxic side effects than the aminothiols. Iloprost, a stable PGI analog, protects the clonogenic epithelial cells of intestinal crypts but does not protect epithelial cells of the villi. In contrast, an E-series omega chain diene analog designated SC-44932 protects epithelial cells of both crypts and villi. When the two are combined, protection of the crypts is additive and the villi are protected to the same degree as when SC-44932 is given alone. The pattern of radioprotection seen with these two analogs depend on the location of the respective receptors or on the ability of differentiated villus cells to respond to PGs. Author

A92-20912

'MIR' RADIATION DOSIMETRY RESULTS DURING THE SOLAR PROTON EVENTS IN SEPTEMBER-OCTOBER 1989

TS. P. DACHEV, IU. N. MATVICHUK, N. G. BANKOV, I. V. SEMKOVA, R. T. KOLEVA, IA. IVANOV, B. T. TOMOV (Bulgarian Academy of Sciences, Space Research Institute, Sofia, Bulgaria), V. M. PETROV, V. A. SHURSHAKOV, V. V. BENGIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 321-324. refs Copyright

Using data from dosimetry-radiometry system 'Liulin' onboard the 'Mir' Space Station, the particle flux and dose rate during September-October, 1989 has been studied. The orbit of the station was 379 km perigee, 410 km apogee and 51.6 deg inclination. Special attention has been paid to the flux and dose rate changes inside the station after intensive solar proton events (SPE) on 29 September, 1989. The comparison between the doses before and after the solar flares shows increase of the calculated mean dose per day by factors of 10 to 200. During the SPE on the 29th of September the additional dose was 310 mrad. The results of the experiment are compared with the data for the solar proton fluxes obtained on the GOES-7 satellite. Author

A92-20916* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

HUMAN EXPOSURE TO LARGE SOLAR PARTICLE EVENTS IN SPACE

L. W. TOWNSEND, J. W. WILSON, J. L. SHINN (NASA, Langley Research Center, Hampton, VA), and S. B. CURTIS (Lawrence

Berkeley Laboratory, Berkeley, CA) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 339-348. refs
Copyright

Whenever energetic solar protons produced by solar particle events traverse bulk matter, they undergo various nuclear and atomic collision processes which significantly alter the physical characteristics and biologically important properties of their transported radiation fields. These physical interactions and their effect on the resulting radiation field within matter are described within the context of a recently developed deterministic, coupled neutron-proton space radiation transport computer code (BRYNTRN). Using this computer code, estimates of human exposure in interplanetary space, behind nominal (2 g/sq cm) and storm shelter (20 g/sq cm) thicknesses of aluminum shielding, are made for the large solar proton event of August 1972. Included in these calculations are estimates of cumulative exposures to the skin, ocular lens, and bone marrow as a function of time during the event. Risk assessment in terms of absorbed dose and dose equivalent is discussed for these organs. Also presented are estimates of organ exposures for hypothetical, worst-case flare scenarios. The rate of dose equivalent accumulation places this situation in an interesting region of dose rate between the very low values of usual concern in terrestrial radiation environments and the high-dose-rate values prevalent in radiation therapy.

Author

A92-20922

RECENT ESTIMATES OF CANCER RISK FROM LOW-LET IONIZING RADIATION AND RADIATION PROTECTION LIMITS

WARREN K. SINCLAIR (National Council on Radiation Protection and Measurements, Bethesda, MD) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 375-378. refs

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Estimates of the risk of cancer induction, formerly about 1 percent/Sv, formed the basis of ICRP radiation protection limits in 1977. They have now increased to about 4-5 percent/Sv for low doses. These increases are based mainly on new data for the Japanese survivors of the A-bombs of 1945. They result from the accumulation of 11 years more of data on solid tumors, the revisions in the dosimetry of those exposed and improvement in statistical methods and projections. The application of a dose rate effectiveness factor between effects at high dose rate and those at low dose and dose rate is also an important consideration. Not only has the total risk changed but also the distribution of risk among organs. Thus, the effective dose equivalent may require modification. These changes are modifying ICRP and NCRP thinking about recommendations on protection limits, especially for radiation workers.

Author

A92-20926

RADIATION QUALITY AND RISK ESTIMATION IN RELATION TO SPACE MISSIONS

R. J. M. FRY (Oak Ridge National Laboratory, TN) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 403-406. refs

(Contract DE-AC05-84OR-21400)

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While Q is specified as a function of linear energy transfer (LET), in practice the Q for neutrons is selected by a judgment

decision based on the relative biological effectiveness (RBE) to induce stochastic effects. There are no RBE values for tumor induction by heavy ions or protons in humans. Thus, selection of Q values is based either on LET (or lineal energy) or RBEs from animal experiments. Estimates of Q for heavy ions in low earth orbit (LEO) range from about 5 to 14. The average Q value of all radiation in LEO is estimated to be about 1.3. There is a lack of experimental data for RBEs for heavy ions but RBE increases as a function of LET. In the case of the Harderian gland the RBE reaches a maximum of 25-30 between about 100-200 keV/microns but does not appear to decrease at higher LETs. The International Commission of Radiological Protection proposes the use of radiation weighting factors in lieu of quality factors. The weighting factors range from 1 to 20.

Author

A92-20927* California Univ., Berkeley. Lawrence Berkeley Lab. FLUENCE-RELATED RISK COEFFICIENTS USING THE HARDERIAN GLAND DATA AS AN EXAMPLE

S. B. CURTIS, P. POWERS-RISIUS, E. L. ALPEN (Lawrence Berkeley Laboratory, Berkeley, CA), L. W. TOWNSEND, J. W. WILSON (NASA, Langley Research Center, Hampton, VA), and R. J. M. FRY (Oak Ridge National Laboratory, TN) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 407-416. refs

(Contract DE-AC03-76SF-00098; DE-AC05-84OR-21400)

Copyright

A new concept is introduced for assessing the risk of radiation-induced cancer to space travelers: a fluence-related risk coefficient F (called the risk cross section), which is the risk of a cancer per unit particle fluence for a given particle type. Fs are functions of the LET of the particles in the radiation field and, when integrated over fluence-LET spectra and summed, yield the risk of the endpoint of interest. As an example, tumor prevalence data in mice are used to estimate the probability of the induction of mouse Harderian-gland tumor per year on an extramagnetospheric mission inside an idealized shielding configuration of a spherical 1 g/sq cm thick aluminum shell. Results indicate a yearly tumor prevalence of 0.06 at solar minimum conditions, with 60 percent of this arising from charge components with Z between 10 and 28, and two-thirds of the contribution arising from LET components between 10 and 200 keV/micron.

I.S.

A92-20929

CHROMOSOMAL DATA RELEVANT FOR Q VALUES

A. A. EDWARDS (National Radiological Protection Board, Didcot, England) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 421-430. refs

Copyright

Relationships between absorbed dose and biological effect vary with the type of radiation. The application of this knowledge to devise a scheme for specifying the quality factor (Q) in radiological protection is the subject of much debate. There are no tumor data in humans from which the quality factor can be derived. The problems of using animal and cell transformation data which are probably the next best choice are discussed. The extensive data base on chromosomal aberrations in human lymphocytes is described and discussed in terms of relevance to deducing quality factors. Particular emphasis is placed on data obtained at low doses and low dose rates.

Author

A92-20993 National Inst. of Standards and Technology, Boulder, CO.

FURTHER ANALYSES OF HUMAN KIDNEY CELL POPULATIONS SEPARATED ON THE SPACE SHUTTLE

ROBIN M. STEWART, PAUL TODD, KENNETH D. COLE (NIST, Boulder, CO), and DENNIS R. MORRISON (NASA, Johnson Space Center, Houston, TX) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 223-229. refs
(Contract NAS9-17431; NAS9-15583; NAGW-694)
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Cultured human embryonic kidney cells were separated into electrophoretic subpopulations in laboratory experiments and in two separation experiments on the STS-8 (Challenger) Space Shuttle flight using the mid-deck Continuous Flow Electrophoretic Separator (CFES). Populations of cells from each fraction were cultured for the lifetime of the cells, and supernatant medium was withdrawn and replaced at 4-day intervals. Withdrawn medium was frozen at -120 C for subsequent analysis. Enzyme assays, antibodies and gel electrophoresis were used as analytical tools for the detection and quantization of plasminogen activators in these samples. These assays of frozen-culture supernatant fluids confirmed the electrophoretic separation of plasminogen-activator-producing cells from nonproducing cells, the isolation of cells capable of sustained production, and the separation of cells that produce different plasminogen activators from one other. Author

A92-21479

EFFECTS OF REDUCED BLOOD DISTRIBUTION IN LOWER LIMBS ON WORK CAPACITY AND RESPONSES OF BLOOD LEUKOCYTE LEVELS DURING BICYCLE EXERCISE

NAOTAKE INOUE, IZUMI TABATA, and YOSHINOBU OHIRA (National Institute of Fitness and Sports, Kanoya, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 28, June 1991, p. 27-37. In Japanese. refs

The effects of decreased distribution of blood in lower limbs in humans on the physical work capacity, cardiopulmonary function, metabolism, and responses of blood leukocytes during bicycle exercise were investigated in subjects who underwent exposures to 6-deg head-down (HD) position, resulting in a decrease of the blood volume of lower extremities. A comparison of results obtained on subjects after HD position with those exposed to head-up (HU) tilt indicated that the decrease in exercise capacity observed in the HD subjects might be due to an inhibited energy metabolism in working muscles and before the cardiopulmonary function was fully stimulated. A decrease in blood distribution in working muscles is followed by a decrease in the maximal capacity for physical exercise and an increase of the physiological stress during exercise at a given submaximal work intensity, compared to those functions in normal subjects. I.S.

A92-21762* Krug Life Sciences, Inc., Houston, TX.

DETERMINING THE IV FLUIDS REQUIRED FOR A TEN DAY MEDICAL EMERGENCY ON SPACE STATION FREEDOM - COMPARISON OF PACKAGED VS. ON-ORBIT PRODUCED SOLUTIONS

GERALD J. CREAGER (Krug Life Sciences, Houston, TX) and CHARLES W. LLOYD (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs
(SAE PAPER 911333) Copyright

To aid planning for the storage of supplies onboard Space Station Freedom, an estimate was made of the amount of intravenous (IV) fluid required to support a patient who has suffered a medical emergency for a period of up to 10 days. Six different medical scenarios were evaluated, and the volume of IV fluids required for each scenario was estimated. Up to 220 liters of fluid would be required to support a patient for all of the scenarios. When optimizing the volumes to support any single scenario, a total of 123 liters is required. Use of a water polishing system to produce sterile water for injection from potable supplies and

on-station formulation of IV fluids results in a smaller mass and volume requirement for the Fluid Therapy Subsystem than carrying prepackaged bags of fluid. Author

A92-21764

LASER MEDICINE AND SURGERY IN MICROGRAVITY

RICHARD CALEEL (Chicago, University, IL), PAUL QUO (Loyola University, Chicago, IL), MICHAEL COLVARD, and COLETTE COZEAN SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs
(SAE PAPER 911336) Copyright

For space based surgery, lasers may permit methods for rapid stabilization of traumatic or emergency injuries, surgical fluid control, and hemostasis, and reduce contamination of the aircraft environment. An outline is presented of the basic concept of laser surgery in an aviation and microgravity environment utilizing carbon dioxide, ND:YAG, KTP and Excimer laser incisions within high altitude, military, aviation and microgravity aviation environments. Present research indicates that surgical lasers will play a significant role in the development and application of space medicine and surgery procedures due to their small size, reusability and ability to provide expedient control of surgical events in space. R.E.P.

A92-21765

GTR (GUIDED TISSUE REGENERATION) INCORPORATING A MODIFIED MICROGRAVITY SURGICAL CHAMBER AND KAVO-3-MINI UNIT FOR THE TREATMENT OF ADVANCED PERIODONTAL DISEASE ENCOUNTERED IN EXTENDED SPACE MISSIONS

BERNARD UNRAU (Calgary, University, Canada) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911337) Copyright

A92-21768* Rockwell International Corp., Houston, TX.

RADIATION EXPOSURE AND RISK ASSESSMENT FOR CRITICAL FEMALE BODY ORGANS

WILLIAM ATWELL, MARK D. WEYLAND (Rockwell International Corp., Houston, TX), and ALVA C. HARDY (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs
(SAE PAPER 911352) Copyright

Space radiation exposure limits for astronauts are based on recommendations of the National Council on Radiation Protection and Measurements. These limits now include the age at exposure and sex of the astronaut. A recently-developed computerized anatomical female (CAF) model is discussed in detail. Computer-generated, cross-sectional data are presented to illustrate the completeness of the CAF model. By applying ray-tracing techniques, shield distribution functions have been computed to calculate absorbed dose and dose equivalent values for a variety of critical body organs (e.g., breasts, lungs, thyroid gland, etc.) and mission scenarios. Specific risk assessments, i.e., cancer induction and mortality, are reviewed. Author

A92-21783

PRELIMINARY DESIGN OF HEALTH CARE SYSTEMS FOR SPACE EXPLORATION

BRUCE A. MCKINLEY, KAREN L. MATHES, and SCOTT C. SIMMONS (Krug Life Sciences, Inc., Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 20 p. refs
(SAE PAPER 911369) Copyright

The discussion of spaceborne health facilities addresses the need for health care for crewmembers on long-duration missions by defining such facilities and identifying protocols and related effects on hardware development. The Health Maintenance Facility (HMF) concept is described in terms of its planned support services for the SSF. Experimental medical devices are listed for studying fluid formulation, ventilator control, fluid-sample processing, and for acquiring X-ray images. Other key issues are mentioned including dedicated work volume and work-area guidelines, and

the capabilities of such health-care facilities are listed and found to be substantial. Proposed concepts for the HMF are given with graphic illustrations to specify the listed requirements and functions. C.C.S.

A92-21784* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE NASA RADIATION HEALTH PROGRAM

WALTER SCHIMMERLING (JPL, Pasadena, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 7 p. (SAE PAPER 911371) Copyright

The Space Radiation Health Program (SRHP) is defined in terms of motivation and methodology with specific reference given to the impacts of HZE particles and solar energetic particles. The biological hazards are mentioned that can be associated with the two particle types and ionizing radiation in general. The lack of data on the impact of such radiation and effective shielding countermeasures is identified as the primary motivation for worst-case assumptions. However, the resulting shielding designs can potentially overestimate the thickness by a factor of 10 and add unnecessarily to vehicle take-off mass. A space-based validation system is proposed to complement ground-based investigations of the effects of ionizing radiation in interplanetary space. The Lifesat satellite is proposed as a part of the SRHP effort to determine the requirements for protection and future shielding specifications. C.C.S.

A92-21787

UPPER BODY EXERCISE - PHYSIOLOGY AND TRAINING APPLICATION FOR HUMAN PRESENCE IN SPACE

MICHAEL N. SAWKA and KENT B. PANDOLF (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 21 p. refs (SAE PAPER 911461) Copyright

The physiological responses to the upper body exercises and the control mechanisms involved in these responses are examined. A comparison with the physiological responses to the lower-body exercise showed that the upper body exercise requires a greater oxygen uptake at a given power output and that, at a given oxygen uptake, the heart rate, the blood pressure, and the total peripheral resistance responses during the upper body exercise are greater than those during the lower body exercise, while the stroke volume responses are lower. Body-temperature responses to both types of exercise are similar, but the temperatures are regulated by different heat exchange mechanisms. It is recommended that the unique physiology associated with the upper body exercise should be considered in developing exercise regimes for the manned space program. I.S.

A92-21788* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

SKELETAL MUSCLE RESPONSES TO UNWEIGHTING IN HUMANS

GARY A. DUDLEY (NASA, Kennedy Space Center, Cocoa Beach, FL) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 7 p. refs (Contract NAS10-10285; NAS10-11624) (SAE PAPER 911462) Copyright

An overview of earth-based studies is presented emphasizing the data on muscular strength and size derived from experiments under simulated microgravity. The studies involve the elimination of weight-bearing responsibility of lower-limb human musculature to simulate the unweighting effects of space travel in the absence of exercise. Reference is given to bedrest and unilateral lower-limb suspension, both of which provide data that demonstrate the decreased strength of the knee extensors of 20-25 percent. The response is related to the decrease in cross-sectional area of the knee extensors which is a direct indication of muscle-fiber atrophy. Most of the effects of unweighting are associated with extensor muscles in the lower limbs and not with postural muscles.

Unweighting is concluded to cause significant adaptations in the human neuromuscular system that require further investigation. C.C.S.

A92-21789* Houston Univ., TX.

ASTRONAUT ADAPTATION TO 1 G FOLLOWING LONG DURATION SPACE FLIGHT

JOHN WALKER (Houston, University, TX), MICHAEL GREENISEN (NASA, Johnson Space Center, Houston, TX), LYNDIA L. COWELL (Texas College of Osteopathic Medicine, Fort Worth), and WILLIAM G. SQUIRES (Texas Lutheran College, Seguin) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 14 p. refs (SAE PAPER 911463) Copyright

The paper reviews the results of studies of changes undergone by several physiological systems (including the cardiovascular system, the fluid and electrolyte characteristics, the red blood cells, the bone and the muscle tissues, and the exercise capacity) due to the exposures to microgravity and to the adaptation to 1 G after a long-duration space flight. Special attention is given to the effects of various training protocols and countermeasures used to attenuate the physiological problems encountered upon return from space. I.S.

A92-21819

EFFECTS OF TELEOPERATOR-SYSTEM DISPLAYS ON HUMAN OCULOMOTOR SYSTEMS

SHELDON M. EBENHOLTZ (New York, State University, NY) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 23 p. refs (Contract NIH-EY-06699) (SAE PAPER 911391) Copyright

A visual interface between the central processor of a human operator and the teleoperator visual information display is considered. Particular attention is given to types of oculomotor systems, selected parameters of these systems characterized by individual differences, and problems related to potential conflict among oculomotor subsystems. The vestibulo-ocular response, optokinetic response, accommodation, vergence, and other systems are related to certain characteristics of teleoperator displays. It is concluded that, since resting levels, the rate of adaptation, and the very ability to adapt are controlled by widely varied individual parameters, preventive measures require highly specific knowledge of these visual system characteristics of individual human operators. O.G.

A92-21847* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

LOCOMOTOR EXERCISE IN WEIGHTLESSNESS

W. THORNTON (NASA, Johnson Space Center, Houston, TX) and H. WHITMORE (Whitmore Enterprises, San Antonio, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs (SAE PAPER 911457) Copyright

The requirements for exercise in space by means of locomotion are established and addressed with prototype treadmills for use during long-duration spaceflight. The adaptation of the human body to microgravity is described in terms of 1-G locomotor biomechanics, the effects of reduced activity, and effective activity-replacement techniques. The treadmill is introduced as a complement to other techniques of force replacement with reference given to the angle required for exercise. A motor-driven unit is proposed that can operate at a variety of controlled speeds and equivalent grades. The treadmills permit locomotor exercise as required for long-duration space travel to sustain locomotor and cardiorespiratory capacity at a level consistent with postflight needs. C.C.S.

A92-21848* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

EXERCISE TRAINING - BLOOD PRESSURE RESPONSES IN SUBJECTS ADAPTED TO MICROGRAVITY

VICTOR A. CONVERTINO (NASA, Kennedy Space Center, Cocoa

Beach, FL) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs (SAE PAPER 911458) Copyright

Conventional endurance exercise training that involves daily workouts of 1-2 hr duration during exposure to microgravity has not proven completely effective in ameliorating postexposure orthostatic hypotension. Single bouts of intense exercise have been shown to increase plasma volume and baroreflex sensitivity in ambulatory subjects through 24 hr postexercise and to reverse decrements in maximal oxygen uptake and syncopal episodes following exposure to simulated microgravity. These physiological adaptations to acute intense exercise were opposite to those observed following exposure to microgravity. These results suggest that the 'exercise training' stimulus used to prevent orthostatic hypotension induced by microgravity may be specific and should be redefined to include single bouts of maximal exercise which may provide an acute effective countermeasure against postflight hypotension. Author

A92-21849

EXERCISE TRAINING - BLOOD PRESSURE RESPONSE IN AMBULATORY SUBJECT

PETER B. RAVEN (Texas College of Osteopathic Medicine, Fort Worth) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs (SAE PAPER 911459) Copyright

The physiologic mechanisms involved in the human's adaptation to endurance exercise training result in the endurance exercise trained individual having high maximal oxygen uptakes and being more susceptible to orthostatic intolerance. In an attempt to delineate the primary blood pressure regulatory mechanisms affected by endurance exercise training, high fit, average fit, and low fit subjects' reflex responses emanating from the low- and high-pressure baroreceptor baroreflexes were compared during lower body negative pressure and selective stimulation of the carotid sinus baroreceptor using neck pressure and neck suction. The data from these experiments indicate a reduction in the responsiveness of the high pressure baroreceptor reflex of the endurance-trained individual and an altered interaction between the high-pressure and low-pressure baroreceptor reflexes. These alterations are detrimental during orthostatic stress. Author

A92-21850* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

EXERCISE THERMOREGULATION - POSSIBLE EFFECTS OF SPACEFLIGHT

SUZANNE M. FORTNEY (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 13 p. refs (SAE PAPER 911460) Copyright

Changes in thermoregulation during spaceflight could result in an inability to tolerate ambient conditions or exercise tasks that were readily tolerated preflight. Weightlessness may alter heat production by changing metabolic rate, circadian rhythms of heat production, or work efficiency. It may impair heat loss by reducing convective and evaporative heat exchange. In addition, crewmembers may become less fit, less heat acclimated, hypohydrated, or have altered thermal sensitivity. Three scenarios are described: exercise conditioning in the mid deck, EVA, and emergency egress. Each scenario is discussed in terms of potential thermal challenges and possible consequences on crew performance. Author

A92-21853

HEALTH RISKS FROM SAPROPHYTIC BIOAEROSOLS ON SPACE STATION FREEDOM

HARRIET A. BURGE (Michigan, University, Ann Arbor) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs (SAE PAPER 911514) Copyright

In order to develop monitoring standards for the Space Station Freedom (SSF) the health risks and standards are listed for bioaerosol disease agents. Descriptions are given for Legionnaires'

disease, hypersensitivity pneumonitis, and fungal toxicoses in terms of disease indicators and conditions for organism development. These parameters are then directly translated into requirements for control on the SSF, proposals for monitoring and standards for spaceflight, and the availability of technology for identifying the disease. High-risk organisms are identified such as Legionella pneumophila and thermophilic actinomycetes, and some of the bioaerosol-related organisms cannot be detected at present. It is emphasized that a precise monitoring technology for the SSF is needed that provides for routine samples of total fungus spores and bacterial counts. C.C.S.

A92-21854 Louisville Univ., KY.

EFFECTS OF MICROGRAVITY ON THE IMMUNE SYSTEM

GERALD SONNENFELD (Louisville, University, KY) and GERALD R. TAYLOR (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs (Contract NCC2-213; NAG9-181; NAG9-234) (SAE PAPER 911515) Copyright

Changes in resistance to bacterial and viral infections in Apollo crew members has stimulated interest in the study of immunity and space flight. Results of studies from several laboratories in both humans and rodents have indicated alterations after space flight that include the following immunological parameters: thymus size, lymphocyte blastogenesis, interferon and interleukin production, natural killer cell activity, cytotoxic T-cell activity, leukocyte subset population distribution, response of bone marrow cells to colony stimulating factors, and delayed hypersensitivity skin test reactivity. The interactions of the immune system with other physiological systems, including muscle, bone, and the nervous system, may play a major role in the development of these immunological parameters during and after flight. There may also be direct effects of space flight on immune responses. Author

A92-21865

EFFECTS ON MAN OF 46-DAY LIFE IN A CONFINED SPACE AT NORMAL PRESSURE

E. RADZISZEWSKI (Direction des Constructions Navales, Centre d'Etudes et de Recherches Techniques Sous-Marines, Toulon, France) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs (SAE PAPER 911533) Copyright

The ramifications of humans subjects being confined to a limited space is investigated with 6 subjects in a climatic chamber by studying biological parameters and psychomotor test results. The subjects spend 46 days in the controlled reference environment measuring 100 cu m, and CO₂ pressure is maintained at about zero. The examinations conducted emphasize respiratory-gas exchange, resting metabolism, acid-base balance in capillary arterialized blood, and hydromineral balance. The results indicate that urinary and electrolyte output increase dramatically during the first 2-3 days, and a slight decrease is noted throughout the experiment of red blood cells and plasma potassium. No degradation is reported in psychomotor performance, although a sensation of fatigue is noted by the subjects. The results are of value to determining the expected effects of confinement and degrees of biological variation during space missions. C.C.S.

A92-21877* Medical Coll. of Virginia, Richmond.

A QUANTITATIVE METHOD FOR STUDYING HUMAN ARTERIAL BAROREFLEXES

DWAIN L. ECKBERG, JANICE M. FRITSCH (Virginia, Medical College, Richmond), and ROSS L. GOBLE (Engineering Development Laboratory, Inc., Newport News, VA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs (Contract NAG2-408; NIH-HL-22296) (SAE PAPER 911562) Copyright

A new system is described that delivers precise, stereotyped pressure changes to the human neck and elicits neurally-mediated heart rate changes. The centerpiece of this system is a Silastic

chamber that is strapped to the anterior neck. This chamber is connected to a stepping-motor-controlled bellows assembly. A strain-gauge transducer measures the intensity of pressure changes. The entire system is controlled by microprocessors, and both stimuli and responses are displayed on a digital oscilloscope. The end-product of this system is a reproducible baroreceptor stimulus-cardiac response relation that can be recorded rapidly and safely in astronauts in space. Author

A92-21878* Texas Univ., Dallas.

CARDIOVASCULAR ADAPTATION TO O-G (EXPERIMENT 294) - INSTRUMENTATION FOR INVASIVE AND NONINVASIVE STUDIES

JAY C. BUCKEY, LYNDIA D. LANE, BENJAMIN D. LEVINE, WILLIE E. MOORE, F. A. GAFFNEY, C. G. BLOMQUIST (Texas, University, Southwestern Medical Center, Dallas), and DONALD E. WATENPAUGH (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs (SAE PAPER 911563) Copyright

Many astronauts returning from space have difficulties regulating blood pressure, some to the point of fainting during quiet standing. Experiment 294 was designed to study this and other cardiovascular effects of adaptation to microgravity and to understand the mechanisms behind it. To accomplish this several cardiovascular variables had to be measured accurately. Heart rate, blood pressure, cardiac output (blood pumped by the heart each minute), stroke volume (blood pumped by the heart with each beat), limb flow, limb compliance, heart size and central venous pressure all had to be recorded during various stresses to understand fully the adaptation to space and the readaptation to earth's gravity. Numerous pieces of equipment were used. Some were purpose-built for the Spacelab mission and others were derived from commercial hardware. Developing spaceflight hardware is challenging and costly, but can lead to significant new information in the unique environment of space. Author

A92-21879

TESTING PULMONARY FUNCTION IN SPACELAB

HAROLD J. B. GUY, G. K. PRISK, and J. B. WEST. (California, University, San Diego) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 7 p. refs

(SAE PAPER 911565) Copyright

The study of lung function in microgravity, on the Spacelab Life Science 1 mission will provide unique data. It should provide new insights into effects of normal gravitation on human lung function. It should also provide good information as to the effects of microgravity induced fluid shifts on the lung, and the extent of lung volume reduction that is predictable from the known effects of gravity on thoracic shape. The recent observation of reduced blood oxygen content in cosmonauts makes this new study especially timely. There is a constant risk of injury to the lung in space vehicles, from depressurization, and the inhalation of gases, vapors, and aerosols. Measurement of lung function in space crews has been delayed for decades. It is scheduled to occur, with increasing frequency, as plans for long duration missions advance. Author

A92-21880

SPACELAB NEUROVESTIBULAR HARDWARE

LAURENCE R. YOUNG, CHARLES M. OMAN, and WILLIAM F. MAYER (MIT, Cambridge, MA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 5 p.

(SAE PAPER 911566) Copyright

A set of devices for measurement of human balance orientation and eye movements in weightlessness was developed for neurovestibular experiments on Spacelab. The experiments involve astronaut motion, limb position changes, and moving visual fields. Measurements are made of eye movements, muscular activity and orientation perception. This joint U.S./Canadian research program represents a group of closely related experiments designed to

investigate space motion sickness, any associated changes in otolith-mediated responses occurring during weightlessness, and the continuation of changes to postflight conditions. The major objective is to determine how the body, which receives partially redundant information from several sensory mechanisms, reorganizes to account for the loss of usable information from one channel (the vestibular system) because of an environmental variation (loss of gravity). A second experiment objective is to investigate the cause of space motion sickness. The inflight experiment consist of five subexperiments, each identified as a functional objective. A sixth subexperiment, consists of the preflight and postflight testing. Each of these subexperiments is described separately. Author

A92-22261

A COMPARISON OF STATIC AND DYNAMIC CHARACTERISTICS BETWEEN RECTUS EYE MUSCLE AND LINEAR MUSCLE MODEL PREDICTIONS

JOHN D. ENDERLE (North Dakota State University, Fargo), EDWARD J. ENGELKEN (USAF, School of Aerospace Medicine, Brooks AFB, TX), and ROBERT N. STILES (Tennessee, University, Memphis) IEEE Transactions on Biomedical Engineering (ISSN 0018-9294), vol. 38, Dec. 1991, p. 1235-1245. Research supported by USAF. refs

Copyright

The muscle is modeled as a viscoelastic parallel combination connected to a parallel combination of active state tension generator, viscosity element, and length tension elastic element. Each of the elements is linear and their existence is supported with physiological evidence. The static and dynamic properties of the muscle model are compared to rectus eye muscle data. The length-tension characteristics of the model are in good agreement with the data within the operating region of the muscle. With the muscle model incorporated into a lever system to match the isotonic experiment paradigm, simulation results for this linear system yield a nonlinear force-velocity curve. Moreover, the family of force-velocity curves generated with different stimulus rates reported in the literature match the predictions of the model without parametric changes. I.E.

A92-22843

BRAIN TISSUE PH AND VENTILATORY ACCLIMATIZATION TO HIGH ALTITUDE

S. V. GOLDBERG, R. B. SCHOENE, D. HAYNOR, B. TRIMBLE, E. R. SWENSON, J. B. MORRISON, and E. J. BANISTER (Washington, University, Seattle; Simon Fraser University, Burnaby, Canada) Journal of Applied Physiology (ISSN 0161-7567), vol. 72, Jan. 1992, p. 58-63. Research supported by American Heart Association, NSERC, and University of Washington. refs

Copyright

The brain cross sections of four human subjects before and after seven days in a hypobaric chamber at 447 torr have been examined using P-13 nuclear magnetic resonance spectroscopy (P-31 NMRS). Experiments were aimed at testing the hypothesis that brain intracellular pH decreases in response to hypobaric hypoxia and increased ventilation is partly due to neural responses to the acidosis which are specific to medullary chemoreceptors. At the end of one week of hypobaria, brain intracellular pH was 7.023 ± 0.046 , unchanged from the preexposure pH of 6.998 ± 0.029 . The ventilatory response to hypoxia increased from 0.35 ± 0.11 (l/min)/(-percent O₂ saturation) before exposure to 0.69 ± 0.19 after, $P = 0.06$. It is suggested that brain intracellular acidosis is probably not a supplemental stimulus to ventilatory acclimatization to high altitude. However, brain intracellular acidosis develops on return to normoxia from chronic hypoxia, suggesting that brain pH may follow changes in blood and cerebrospinal fluid pH as they are altered by changes in ventilation. O.G.

A92-22844*

National Aeronautics and Space Administration, Washington, DC.

VENTILATION-PERFUSION RELATIONSHIPS IN THE LUNG DURING HEAD-OUT WATER IMMERSION

TONIANN DERION, HAROLD J. B. GUY, KOICHI TSUKIMOTO,

WALTER SCHAFFARTZIK, RENATO PREDILETTO, DAVID C. POOLE, DOUGLAS R. KNIGHT, and PETER D. WAGNER (California, University, La Jolla) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 72, Jan. 1992, p. 64-72. Research supported by American Lung Association of California. refs (Contract NIH-HL-07212; NIH-HL-17731; NAGW-897) Copyright

Mechanisms of altered pulmonary gas exchange during water immersion were studied in 12 normal males: 6 young (aged 20-29) and 6 older (aged 40-45). It is concluded that, in young subjects with closing volume (CV) less than expiratory reserve volume (ERV), gas exchange was enhanced during immersion, because normal ventilation-perfusion relations were preserved, and by mass balance, the ventilation/O₂ uptake changes elevated arterial P(O₂). In older males with CV greater than ERV and 52 percent of tidal volume below CV, immersion-induced airways closure during tidal breathing was associated with minimally increased shunt that did not significantly impair gas exchange. It is suggested that airways closure of this degree is of little importance to gas exchange.

O.G.

A92-22845 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EFFECT OF DEHYDRATION ON THIRST AND DRINKING DURING IMMERSION IN MEN

S. SAGAWA, K. MIKI, F. TAJIMA, H. TANAKA, J. K. CHOI, L. C. KEIL, K. SHIRAKI, and J. E. GREENLEAF (NASA, Ames Research Center, Moffett Field, CA; University of Occupational and Environmental Health, Kitakyushu, Japan) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 72, Jan. 1992, p. 128-134. Research supported by University of Occupational and Environmental Health and NASA. refs Copyright

The effect of water immersion on voluntary water intake, subjective evaluations of thirst and gastrointestinal state, and associated fluid-electrolyte and hormonal interaction were investigated. Eight men (19-25 yrs of age) were immersed to the neck while sitting for three hours at 34.5°C or in air at 28°C when euhydrated and hypohydrated by 3.6 percent body weight loss. Within the first ten minutes of immersion the significant reduction in drinking in the hypo-H₂O experiment was associated with unchanged plasma Na(+), plasma osmolality, heart rates, and mean arterial pressures. Different responses increased cardiac output, plasma volume, and atrial natriuretic peptides and decreased plasma renin activity and arginine vasopressin. It is concluded that the extracellular pathway, as opposed to the osmotic pathway, appears to be the major mechanism for immersion-induced suppression of drinking.

O.G.

A92-22846 LONG-LASTING VENTILATORY RESPONSE OF HUMANS TO A SINGLE BREATH OF HYPERCAPNIA IN HYPEROXIA

MOHAMMAD MODARRESZADEH and EUGENE N. BRUCE (Case Western Reserve University, Cleveland, OH) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 72, Jan. 1992, p. 242-250. Research supported by USVA. refs (Contract NIH-HL-25830; NIH-HL-44889) Copyright

A92-23307 AEROBIC FITNESS AND HORMONAL RESPONSES TO PROLONGED SLEEP DEPRIVATION AND SUSTAINED MENTAL WORK

M. W. RADOMSKI, L. E. M. HART, J. M. GOODMAN, and M. J. PLYLEY (Defence and Civil Institute of Environmental Medicine; Toronto, University, Canada) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, Feb. 1992, p. 101-106. Research supported by Defence and Civil Institute of Environmental Medicine. refs Copyright

This study examined the influence of aerobic fitness on the responses of selected hormones to the combined stressors of sleep deprivation (SD) and sustained mental work. Six aerobically

high fit (HF) and six average fit (AF) female subjects were subjected to a period of sleep loss of 60 h during which time they performed sustained mental tasks with no physical activity component. Venous blood samples were drawn every 12 h at 1330 hours and 0130 hours and plasmas analyzed for cortisol, growth hormone (hGH), prolactin, thyroxine (T₄), triiodothyronine (T₃), and reverse-triiodothyronine (rT₃). The results suggest that aerobic fitness may influence the peripheral metabolism of T₄ during SD, but that aerobic fitness does not influence the regulation of the classical stress hormones during SD. Author

A92-23308

FURTHER EVIDENCE TO SUPPORT DISCONJUGATE EYE TORSION AS A PREDICTOR OF SPACE MOTION SICKNESS

CHARLES H. MARKHAM and SHIRLEY G. DIAMOND (California, University, Los Angeles) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, Feb. 1992, p. 118-121. refs Copyright

Disconjugate eye torsion in hypo- and hypergravity of parabolic flight was examined in four former astronauts and four previously tested ex-astronauts to replicate an earlier study and to further test the asymmetry hypothesis of otolith function. Results in the new subjects supported the asymmetry hypothesis and confirmed previous findings that those with low scores of torsional disconjugacy on the KC-135 did not suffer space motion sickness in their prior Shuttle missions while those with high scores did. Tilting subjects with high disconjugacy scores slightly to one side and the other failed to find a position that decreased disconjugacy in hypergravity, leading to the conclusion that a simple planar asymmetry about the y-axis was probably not the cause of the observed torsional differences in the two eyes. Disconjugacy increased at 0 G with increasing parabolas, much more so in subjects who had suffered SMS. Because of this, 10 to 20 parabolas were deemed to be a more certain discriminator than a fewer number. Author

A92-23309

THE MEDICAL ACCEPTABILITY OF SOFT CONTACT LENS WEAR BY USAF TACTICAL AIRCREWS

RICHARD J. DENNIS, ROBERT P. GREEN, JR., and NORMA S. KETCHUM (USAF, Aerospace Vision Laboratory, Brooks AFB, TX) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, Feb. 1992, p. 122-127. refs Copyright

Seventy-two Tactical Air Command (TAC) aircrew members completed one full year of soft contact lens (SCL) wear. A daily-wear regimen, using extended-wear lenses, was used to minimize corneal stress. Baseline measurements of visual acuity with SCLs and with spectacles after SCL removal and ocular indicator gradings were compared to measurements at 5-d, 10-d, 1-month, 3-month, 6-month, and 12-month examinations. Visual acuity did not decrease during the test. No aircrew member developed corneal ulcers or other serious complications requiring elimination from the test. Two aircrew members lost a total of 9 'duties not to include flying' (DNIF) days: one flyer was grounded for 1 d with a corneal abrasion and another for 8 d with epithelial microcysts. The TAC SCL Test, as designed, was generally successful. The conservative approach to SCL wear during the test and the meticulous follow-up care by United States Air Force eye care professionals most likely contributed to the low ocular complication rate. Author

A92-23310

SPATIAL DISORIENTATION IN NAVAL AVIATION MISHAPS - A REVIEW OF CLASS A INCIDENTS FROM 1980 THROUGH 1989

A. BELLENKES, R. BASON, and D. W. YACAVONE (U.S. Navy, Naval Safety Center, Norfolk, VA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, Feb. 1992, p. 128-131. refs Copyright

The contribution of three specific types of spatial disorientation (SD) to aviation accidents is examined from 33 accidents in which

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SD was a causal factor. The relationships between SD and mission-related factors are studied with attention given to type-I (unrecognized) SD, type-II (recognized) SD, and type-III (overwhelming) SD. The pertinent factors investigated include aircraft type, phase of flight, time of day, pilot experience, and flight topography. Types I and II are found to be causal factors in all mishaps studied; type I SD is shown to primarily affect helicopter pilots whereas type-II SD is suffered by jet pilots during the day.

C.C.S.

A92-23312* National Aeronautics and Space Administration, Washington, DC.

EVALUATION OF TESTS FOR VESTIBULAR FUNCTION

Aviation, Space, and Environmental Medicine, Supplement (ISSN 0095-6562), vol. 63, Feb. 1992, p. A1-A34. Research supported by NSF and NASA. refs

(Contract N00014-87-C-0342)

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Vestibular testing methodologies are examined in terms of their clinical value and applicability to the assessment of astronaut candidates and human responses to microgravity. Classical and novel testing approaches are examined in terms of nine functions such as otolith organs, vestibular neural processing, and ocular motor systems. The tests reviewed include the basic vestibular-function test battery, postural stability testing, visual-vestibular interaction, reactions to off-axis rotation, and vestibular evoked responses. The basic test battery is shown to be essential for astronaut and inertial-environment baseline-data evaluations, whereas the newer and research tests are only recommended in special cases. Stimulus rearrangement and motion-sickness tests are indicated for testing adaptation to inertial environments. Postural stability and visual-vestibular interaction are recommended for evaluating one's suitability for being an astronaut.

C.C.S.

A92-23392* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

DESCENDING MOTOR PATHWAYS AND THE SPINAL MOTOR SYSTEM - LIMBIC AND NON-LIMBIC COMPONENTS

GERT HOLSTEGE (NASA, Ames Research Center, Moffett Field; California, University, San Francisco) Progress in Brain Research, vol. 87, 1991, p. 307-412. refs

(Contract NCC2-491)

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Research on descending motor pathways to caudal brainstem and spinal cord in the spinal motor system is reviewed. Particular attention is given to somatic and autonomic motoneurons in the spinal cord and brainstem, local projections to motoneurons, bulbospinal interneurons projecting to motoneurons, descending pathways of somatic motor control systems, and descending pathways involved in limbic motor control systems.

O.G.

A92-23854

THE ROLE OF NUTRITION IN THE PREVENTION OF +G-INDUCED LOSS OF CONSCIOUSNESS

ALBERT A. HARTZELL (USAF, Andrews AFB, MD) Aeromedical and Training Digest, vol. 6, Jan. 1992, 4 p. refs

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The USAF has reported that during the period of 1975 through fiscal year 1989 almost 88 percent of the G-induced loss of consciousness, physiological related accidents had an improper anti-G straining maneuver (AGSM) as a contributing factor. It is indicated that improper nutritional practices may have an effect on both the ability to perform an effective AGSM and on a pilot's G-tolerance. While a significant proportion of USAF fighter crews have followed the approved muscular strength and endurance program, only superficial advice is offered on how to properly replenish the body's energy stores. It is noted that aircrew who miss meals may be at risk for fatigue and/or a transient hyperglycemic period, particularly during repeated exposures to the high-G environment.

R.E.P.

N92-16547# Woods Hole Oceanographic Inst., MA.

ABSTRACTS OF MANUSCRIPTS SUBMITTED IN 1990 FOR PUBLICATION Abstracts Only

ALORA K. PAUL, ed. May 1991 184 p Submitted for publication

(PB91-218347; WHOI-91-08) Avail: NTIS HC/MF A09 CSCI 05B

The volume contains the abstracts of manuscripts submitted for publication during calendar year 1990 by the staff and students of the Woods Hole Oceanographic Institution. They identify the journal of those manuscripts which are in press or have been published. The volume is intended to be informative, but not a bibliography. The abstracts are listed by title in the table of contents and are grouped into one of the five departments: Marine Policy Center, Coastal Research Center, or the student category. An author index is presented in the back to facilitate locating specific papers.

Author

N92-16548# Cryopharm Corp., Pasadena, CA.

FREEZE-DRIED HUMAN RED BLOOD CELLS Progress Report

8 Nov. 1991 31 p

(Contract N00014-90-C-0053)

(AD-A242696) Avail: NTIS HC/MF A03 CSCI 06/5

This progress report summarizes Cryopharm's basic red cell research since the last report submitted to the Naval Medical Research and Development Command on 12 Jul. 1991. As outlined in the Summary from the 12 Jul. 1991 report, an initial clinical evaluation of in vivo circulation of autologous, lyophilized human red cells was undertaken to establish a baseline level of in vivo performance. The cell survival results suggested that the lyophilized reconstituted cells were removed intact from peripheral blood via a splenic sequestration route. We observed this mechanism of cell clearance by the body in spite of the high in vitro osmotic stability and improved cell deformability as measured by in vitro ektacytometry. Thus, although our lyophilized reconstituted red cells maintain normal levels of metabolic, cytoskeletal, and hemoglobin function, they do appear to sustain damage to their membranes which compromises deformability to an extent that their ability to pass through small splenic or capillary sinuses is greatly reduced.

GRA

N92-16549# Japan Atomic Energy Research Inst., Tokyo.

DEEP CODE TO CALCULATE DOSE EQUIVALENTS IN HUMAN PHANTOM FOR EXTERNAL PHOTON EXPOSURE BY MONTE CARLO METHOD

YASUHIRO YAMAGUCHI (Japan Atomic Energy Research Inst., Ibaraki.) Jan. 1991 75 p

(DE91-780319; JAERI-M-90-235) Avail: NTIS HC/MF A04

The present report describes a computer code, DEEP, which calculates the organ dose equivalents and the effective dose equivalent for external photon exposure by the Monte Carlo method. MORSE-CG, a Monte Carlo radiation transport code, is incorporated into the DEEP code to simulate photon transport phenomena in and around a human body. The code treats an anthropomorphic phantom represented by mathematical formulae and user has a choice for the phantom sex: male, female, and unisex. The phantom can wear personal dosimeters on it and user can specify their location and dimension. This document includes instruction and sample problem for the code as well as the general description of dose calculation, human phantom, and computer code.

DOE

N92-16550# Pacific Northwest Lab., Richland, WA.

IMPROVING IN VIVO CALIBRATION PHANTOMS

T. P. LYNCH and P. C. OLSEN Oct. 1991 6 p Presented at

the 37th Annual Conference on Bioassay Analytical and Environmental Radiochemistry, Ottawa (Canada), 7-11 Oct. 1991 (Contract DE-AC06-76RL-01830)

(DE92-002157; PNL-SA-20013; CONF-911032-4) Avail: NTIS HC/MF A02

Anthropomorphic phantoms have been the basis for quantification of radioactive material in the body using in vivo measurements. The types of phantoms used and the degree of

anthropomorphic detail vary depending on the counting application, the radioactive material to be measured, phantom availability, and cost. Consequently, measurement results for the same types of radioactive material from different facilities are not always comparable. At a February 1990 meeting at the National Institute of Standards and Technology (NIST) the need to develop the 'gold standards' or primary reference standards for in vivo phantoms was discussed in detail. The consensus of the attendees at the meeting was that the state of the art in phantoms was adequate as a starting point and that there was no need to start phantom development from scratch. In particular, the torso phantom developed at the Lawrence Livermore National Laboratory (LLNL) and its commercial progeny, the bottle manikin absorption (BOMAB) phantom and the American National Standards Institute (ANSI) Standard N44.3 thyroid phantom, were identified as the starting points for the development of the primary reference standards. Working groups at the meeting subsequently recommended design improvements for the existing phantom designs. The implementation of these recommendations is the subject of this paper. DOE

N92-16551# Slovak Technical Univ., Bratislava (Czechoslovakia). Spolocnost Nuklearnej Mediciny a Radiacnej Hygieny.

PROGRAMME AND ABSTRACTS OF CONTRIBUTIONS PRESENTED AT THE NATIONAL RADIOBIOLOGY CONFERENCE

Nov. 1990 79 p In CZECH Conference held in Tatranska Lomnica, Czechoslovakia. Prepared in cooperation with Univerzita Pavla Jozefa Safarika, Kosice, Czechoslovakia and Ceskoslovenska Vedeckotechnicka Spolecnost, Prague (DE91-641203; INIS-MF-12891; CONF-9011228) Avail: NTIS HC/MF A05

The publication contains 63 abstracts of contributions and posters, all of which fall within the INIS scope; they deal with radiation damage at the level of animal cells, pathology of radiation injuries and biochemical changes following irradiation, radiation protection, radiation-induced changes of blood formation, and clinical radiobiology and oncology. Attention is paid to somatic and genetic damage and to metabolic changes. DOE

N92-16552# Johns Hopkins Univ., Baltimore, MD. **REGIONAL AEROSOL DEPOSITION IN HUMAN UPPER AIRWAYS.**

D. L. SWIFT 1 Nov. 1991 10 p (Contract DE-FG02-88ER-60655) (DE92-002779; DOE/ER-60655/4) Avail: NTIS HC/MF A02

During the current report, experimental studies of upper respiratory deposition of radon progeny aerosols and stimulant aerosols were carried out in replicate casts of nasal and oral passages of adults and children. Additionally, preliminary studies of nasal passage deposition of unattached Po-218 particles was carried out in four human subjects. Data on nasal inspiratory deposition in replicate models of adults and infants from three collaborating laboratories were compared and a best-fit curve of deposition efficiency for both attached and unattached particles was obtained, showing excellent inter-laboratory agreement. This curve demonstrates that nasal inspiratory deposition of radon progeny is weakly dependent upon flow rate over physiologically realistic ranges of flow, does not show a significant age effect, and is relatively independent of nasal passage dimensions for a given age range. Improved replicate models of the human adult oral passage extending to the mid-trachea were constructed for medium and higher flow mouth breathing states; these models were used to assess the deposition of unattached Po-218 particles during oronasal breathing in the oral passage and demonstrated lower deposition efficiency than the nasal passage. Measurements of both Po-218 particle and attached fraction particle size deposition were performed in replicate nasal passage of a four week old infant. DOE

N92-16553*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

EVALUATION OF NONINVASIVE CARDIAC OUTPUT METHODS DURING EXERCISE

ALAN D. MOORE, LINDA H. BARROWS (Krug Life Sciences, Inc., Houston, TX.), MICHAEL RASHID, and STEVEN F. SICONOLFI Jan. 1992 10 p (NASA-TP-3174; S-657; NAS 1.60:3174) Avail: NTIS HC/MF A02 CSCL 06/16

Noninvasive techniques to estimate cardiac output (Qc) will be used during future space flight. This retrospective literature survey compared the Qc techniques of carbon dioxide rebreathing (CO₂-R), CO₂ single breath (CO₂-S), Doppler (DOP), impedance (IM), and inert gas (IG: acetylene or nitrous oxide) to direct (DIR) assessments measured at rest and during exercise. Author

N92-16554*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

FUEL UTILIZATION DURING EXERCISE AFTER 7 DAYS OF BED REST

LINDA H. BARROWS, BERNARD A. HARRIS, ALAN D. MOORE (Krug Life Sciences, Inc., Houston, TX.), and STEVEN F. SICONOLFI Washington Jan. 1992 11 p (NASA-TP-3175; S-658; NAS 1.60:3175) Avail: NTIS HC/MF A03 CSCL 06/19

Energy yield from carbohydrate, fat, and protein during physical activity is partially dependent on an individual's fitness level. Prolonged exposure to microgravity causes musculoskeletal and cardiovascular deconditioning; these adaptations may alter fuel utilization during space flight. Carbohydrate and fat metabolism during exercise were analyzed before and after 7 days of horizontal bed rest. Author

N92-17022*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TECHNIQUES FOR DETERMINATION OF IMPACT FORCES DURING WALKING AND RUNNING IN A ZERO-G ENVIRONMENT

MICHAEL GREENISEN, MARLEI WALTON, PHILLIP BISHOP, and WILLIAM SQUIRES (Texas Lutheran Coll., Seguin.) Washington Jan. 1992 18 p (NASA-TP-3159; S-651; NAS 1.60:3159) Avail: NTIS HC/MF A03 CSCL 06/16

One of the deleterious adaptations to the microgravity conditions of space flight is the loss of bone mineral content. This loss appears to be at least partially attributable to the minimal skeletal axial loading concomitant with microgravity. The purpose of this study was to develop and fabricate the instruments and hardware necessary to quantify the vertical impact forces (F_z) imparted to users of the space shuttle passive treadmill during human locomotion in a three-dimensional zero-gravity environment. The shuttle treadmill was instrumented using a Kistler forceplate to measure vertical impact forces. To verify that the instruments and hardware were functional, they were tested both in the one-G environment and aboard the KC-135 reduced gravity aircraft. The magnitude of the impact loads generated in one-G on the shuttle treadmill for walking at 0.9 m/sec and running at 1.6 and 2.2 m/sec were 1.1, 1.7, and 1.7 G, respectively, compared with loads of 0.95, 1.2, and 1.5 G in the zero-G environment. Author

N92-17084# Army Aeromedical Research Lab., Fort Rucker, AL.

EFFECTS OF THE CHEMICAL DEFENSE ANTIDOTE ATROPINE SULFATE ON HELICOPTER PILOT PERFORMANCE: AN IN-FLIGHT STUDY

JOHN A. CALDWELL, JR., DAVID J. CARTER, ROBERT L. STEPHENS, LEWIS W. STONE, and DARCELLE M. DELRIE Jun. 1991 209 p (AD-A241966; USAARL-91-17) Avail: NTIS HC/MF A10 CSCL 06/15

The effect of 2 mg and 4 mg injections of atropine sulfate on helicopter pilots was investigated using a specially instrumented UH-1H helicopter and several laboratory tests. A counterbalanced,

within-subjects design was employed in which flight performance, vision, electroencephalographic activity, cognitive skill, and tracking performance were assessed on each of three different drug administration days (placebo, 2 mg, and 4 mg) separated by control days. Results indicated numerous atropine-related difficulties, seen most often with the 4 mg dose. Measurements of flight performance revealed decrements on at least one measure (i.e., heading, air speed, vertical speed) in both visual- and instrument-referenced straight and level flight, standard-rate turns, a straight climb and descent, steep turns, a climbing turn, and an instrument landing system (ILS) approach. Also, there were degradations in performance of a confined area approach and an out-of-ground-effect hover maneuver. Vision tests showed atropine-related increases in pupil diameter and double vision, concurrent with decreases in accommodation and depth perception. Cognitive tests revealed decrements in visual search, logical reasoning, quantitative ability, short-term memory, and response times. Psychomotor tracking tasks indicated atropine-induced increases in tracking errors across three levels of tracking complexity, and these sometimes were accompanied by deficits in responding to a secondary task. Various other results from this investigation are presented. GRA

N92-17089# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

EVALUATION OF SCALAR VALUE ESTIMATION TECHNIQUES FOR 3D MEDICAL IMAGING M.S. Thesis

ROB W. PARROTT Dec. 1991 187 p
(AD-A243687; AFIT/GE/ENG/91D-17) Avail: NTIS HC/MF A09 CSDL 12/5

Scalar value estimation in 3D medical imaging increases data resolution for enhanced renditions and corrects inaccurate surface formations. Accurate estimations are vital because clinical assessment is often aided by examination of 3D medical images. This thesis explores different estimation techniques and introduces the geostatistical estimation technique called kriging to the field of 3D imaging. Kriging theory claims to be the optimal estimator—better than the standard deterministic methods commonly used. The techniques investigated are linear interpolation, trilinear interpolation, tricubic interpolation, and kriging. This research investigates scalar value estimation in the volume preprocessing operation of slice interpolation and in a surface extraction method called cell subdivision. Tricubic interpolation is shown to be most useful in artificially created volumes of smooth functions. It is also shown to produce poor results in medical volumes and in slice interpolation. More importantly, this research demonstrates that kriging subsumes the deterministic methods investigated and can estimate much better than tricubic interpolation. GRA

N92-17120# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

A TOPOGRAPHICAL ANALYSIS OF THE HUMAN ELECTROENCEPHALOGRAM FOR PATTERNS IN THE DEVELOPMENT OF MOTION SICKNESS M.S. Thesis

GEORGE S. VOGEN Dec. 1991 87 p
(AD-A243656; AFIT/GSO/ENG/91D-17) Avail: NTIS HC/MF A05 CSDL 06/10

A topographical analysis was performed on 12 electroencephalograms (EEG's) collected from 10 volunteers who experienced motion sickness through cross-coupled Coriolis stimulation. Seven males and three females participated in the research conducted at the Air Force Institute of Technology, Wright-Patterson AFB. Two male volunteers participated in double-blind placebo/phenytoin trials. Static brain maps and dynamic EEG's which focused on delta (below 3Hz) activity during the development of motion sickness revealed a seizure-like propagation pattern. With initial symptoms, a clear left parietal focus was seen in all records. A less dominant left fronto-temporal focus was present in 11 of the 12 records. As symptoms grew there was a contralateral spread (possibly occipitally) to the right temporal region. A steady increase in power was noticeable during the evolution of motion sickness. The 2 phenytoin trials showed

less overall power when compared to their respective placebo trials. The report of this seizure-like propagation pattern during motion sickness is believed to be the first of its kind. GRA

N92-17124# Naval Medical Research Inst., Bethesda, MD.
STATISTICALLY-BASED DECOMPRESSION TABLES. 6: REPEAT DIVES ON OXYGEN/NITROGEN MIXES Technical Report, Sep. 1988 - Nov. 1989

G. W. ALBIN and P. K. WEATHERSBY Oct. 1991 67 p
(Contract NMRI PROJ. M00-99)
(AD-A243667; NRMI-91-84) Avail: NTIS HC/MF A04 CSDL 06/10

The risk of decompression sickness (DCS) during dives on various nitrogen/oxygen breathing mixes is analyzed using likelihood maximization. Risk is treated as cumulative, resulting from periods during which the partial pressure of dissolved N₂ exceeds the hydrostatic pressure in one or more hypothetical separate tissues. Gas uptake and release are assumed to follow either mono- or bi-exponential kinetics. The database consists of 2006 well-documented wet man-dives. No statistical evidence is found to justify the use of different models or different parameter values for single dives versus repeat dives or for dives on different N₂/O₂ mixes. Under these models, then, the single and repeat dives in our database should be considered as belonging to the same population. However, the models do not adequately predict the probability of DCS associated with a series of 128 multilevel dives (which feature ascents to 20-30 fsw interspersed with deeper excursions) while simultaneously making a plausible prediction of the risk of any other type of dive in the database. GRA

N92-17190# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

THE EFFECTS OF STORAGE ON IRRADIATED RED BLOOD CELLS: AN IN VITRO AND IN VIVO STUDY M.S. Thesis

SUSAN E. KNOLL Aug. 1991 111 p
(AD-A24387; AFIT/CI/CIA-91-073) Avail: NTIS HC/MF A06 CSDL 06/5

Irradiation of red blood cell units has recently become a topic of special concern as the result of increasing reports of graft versus host disease in immunocompetent blood transfusion recipients. This study was designed to evaluate the potassium elevations observed in stored irradiated red blood cells and to evaluate the in vivo survival of stored irradiated red blood cells using a dog model. In the in vitro study, ten units of human CPDA-1 packed red blood cells were made into paired aliquots; one aliquot of each pair was irradiated with 3000 rads of gamma radiation and the potassium content measured at points throughout 35 days of storage. A significant increase in potassium levels in the irradiated aliquots was observed from the first day after irradiation and continued through the entire storage period. GRA

N92-17194# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

INFLUENCE OF KNEE JOINT EXTENSION ON SUBMAXIMAL OXYGEN CONSUMPTION AND ANAEROBIC POWER IN CYCLISTS M.S. Thesis

JESSE GARCIA 5 Jun. 1991 57 p
(AD-A243467; AFIT/CI/CIA-91-070) Avail: NTIS HC/MF A04 CSDL 06/10

This study was designed to assess the effect of alterations of maximal knee joint extension on submaximal VO₂, anaerobic peak power, and the anaerobic mean power in cycling. Eleven amateur male bicycle racers between the ages of 19 and 35 years were selected for participation in this study. The subjects were randomly assigned to one of four groups. All subjects performed a five minute submaximal exercise test and a Wingate anaerobic power test at maximal knee extensions. The subjects rode an ergometer which allowed the subjects to maintain their normal riding position as saddle height was altered to position the knee at the test angles. In order to assure a random testing sequence, each group was tested with a different order of presentation of the test positions according to a 4 X 4 Latin Square design. GRA

N92-17299# Army Aeromedical Research Lab., Fort Rucker, AL.

THE HAZARD OF EXPOSURE TO 2.075 KHZ CENTER FREQUENCY NARROW BAND IMPULSES

JAMES H. PATTERSON, JR., ROGER P. HAMERNIK, WILLIAM A. AHROON, GEORGE TURRENTINE, and C. E. HARGETT, JR.
Sep. 1991 72 p
(Contract DAMD17-86-C-6139; DA PROJ. 3E1-62777-A-878; DA PROJ. 3M1-61102-BS-15)
(AD-A242997; USAARL-91-20) Avail: NTIS HC/MF A04 CSCL 06/4

A previous report derived a frequency weighting function from audiometric and histological data gathered on 118 chinchillas exposed to a variety of narrow band impulses at various peak intensities. The weighting function clearly demonstrated that equivalent amounts of impulsive energy concentrated at different frequencies is not equally hazardous to the auditory system. However, on the basis of a preliminary analysis of a large amount of audiometric data obtained from chinchillas exposed to high level blast waves there appeared to be some inconsistencies between the narrow band impulse data and the blast wave data in the region of 2.0 kHz. To resolve this discrepancy, two additional groups of animals were exposed to narrow band impulses with a center frequency of 2.075 kHz and peak intensities of 134 dB and 139 dB. The results of these two additional groups confirm the shape of the original P-weighting function and indicate that changes must be made in our approach to the analysis of the blast wave data referred to above. GRA

N92-17473# Army Research Inst. of Environmental Medicine, Natick, MA.

UPPER BODY EXERCISE: PHYSIOLOGY AND TRAINING APPLICATION FOR HUMAN PRESENCE IN SPACE

MICHAEL N. SAWKA and KENT B. PANDOLF Jul. 1991 21 p
(AD-A242033) Avail: NTIS HC/MF A03 CSCL 06/10

In the weightless state astronauts do a substantial amount of work with their arms and hands. Upper body exercise elicits a peak oxygen uptake approximately 70 pct. of that obtained during lower body exercise; in addition, upper body exercise requires a greater oxygen uptake at a given power output than low body exercise. Therefore, when performing exercise at a given power output, both the absolute and relative exercise intensity is greater during upper body exercise. Although cardiac output responses for a given oxygen uptake are similar, the heart rate, blood pressure and total peripheral resistance responses are greater, and the stroke volume responses are lower at a given oxygen uptake during upper than lower body exercise. Body temperature responses to both exercise type are similar, but the temperature are achieved by different heat exchange mechanisms. During upper body exercise, there is a greater reliance on torso dry heat loss for temperature regulation. Exercise training programs can improve aerobic exercise capabilities for the upper body, but there are minimal cross-training benefits between the arms and legs. Space physiologists and engineers in the manned space program should consider the unique physiology associated with upper body exercise for: (1) assuring that astronauts are prepared to perform mission related tasks; (2) developing effective exercise countermeasures programs; and (3) engineering of adequate life support systems. GRA

N92-17476# Pacific-Sierra Research Corp., Los Angeles, CA.
BIOLOGICAL EFFECTS OF PROTRACTED EXPOSURE TO IONIZING RADIATION: REVIEW, ANALYSIS, AND MODEL DEVELOPMENT Technical Report, 15 Sep. 1986 - 20 Jul. 1990
GEORGE H. ANNO, GENE E. MCCLELLAN, MICHAEL A. DORE, and SIEGMUND J. BAUM 1 Nov. 1991 280 p
(Contract DNA001-86-C-0307; DNA001-87-C-0104)
(AD-A242981; PSR-2040; DNA-TR-90157) Avail: NTIS HC/MF A13 CSCL 06/7

Two basic approaches are developed to mathematically model biological responses to ionizing radiation exposure, including upper gastrointestinal (UG) distress (nausea, vomiting), lower gastrointestinal (LG) distress (diarrhea, fluid loss), and GI-syndrome

lethality. Models are constructed to accommodate arbitrary histories of protracted exposure. Sets of coupled differential equations are employed to simulate dynamics of the biological processes involved. The modeling approaches are guided by a comprehensive review and analysis of relevant literature, including radiation-induced symptomatology, response dynamics, physiological changes, morphological changes, cell/tissue damage and recovery mechanisms, and existing radiobiological injury and recovery models. The upper gastrointestinal distress model (UGIDM) is a two-compartment toxicokinetic model to simulate radiation-induced production and clearing of humoral substances involved in triggering UG distress. GRA

N92-17557# Ohio State Univ., Columbus. Div. of Pharmaceutics.

EVALUATION OF LIPOSOME-ENCAPSULATED HEMOGLOBIN/LR16 FORMULATIONS AS A POTENTIAL BLOOD SUBSTITUTE Performance Report No. 3, period ending 8 Nov. 1991

THOMAS G. BURKE 8 Nov. 1991 12 p
(Contract N00014-90-J-1648)
(AD-A243075) Avail: NTIS HC/MF A03 CSCL 06/1

Two summary sheets show the structures of several new LR16 analogues recently synthesized. Preliminary testing has shown compounds 19, 22, and 25 to be active, achieving P50 values in LEH suspensions of 29.5, 28.5, and 21.0 mm Hg, respectively, at drug concentrations of 3 mM. The two lists of structures are followed by the experimental section outlining synthetic methodologies. The final three pages summarize a synthetic scheme and NMR data concerning our first analogue which contains a quaternary, permanently-charged nitrogen moiety (which should significantly reduce drug leakage from liposome). We are presently testing the ability of this agent to modulate the P50 value of hemoglobin. GRA

N92-17567# Vector Research, Inc., Ann Arbor, MI.

FATIGUE EFFECTS ON HUMAN PERFORMANCE IN COMBAT: A LITERATURE REVIEW, VOLUME 1 Final Report, Sep. 1986 - Oct. 1988

SUSAN M. EVANS, ROBERT R. MACKIE, and DENNIS C. WYLIE
Aug. 1991 253 p
(Contract MDA903-86-C-0428)
(AD-A242887; VRI-ARI-9; FR89-1(R)-VOL-1; ARI-RN-91-90)
Avail: NTIS HC/MF A12 CSCL 06/10

For this report, a literature review was conducted to assess the knowledge of the effects of fatigue and related stressors on the performance of military personnel engaged in diverse military tasks. The objective was to determine whether there are sufficient objective, quantifiable data on the effects and time-course of fatigue to justify incorporation into combat models. Both mental and physical fatigue were considered. More than 500 articles, reports, and books were reviewed for this effort. A summary table of the results of sleep deprivation studies was organized. Prediction equations for physical activity are discussed. GRA

N92-17599# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

ALLEVATION OF THERMAL STRAIN IN ENGINEERING SPACE PERSONNEL ABOARD CF SHIPS WITH THE EXOTEMP PERSONAL COOLING SYSTEM

J. FRIM and K. GLASS Jun. 1991 54 p
(AD-A242889; DCIEM-91-62) Avail: NTIS HC/MF A04 CSCL 06/6

The engineering spaces aboard Canadian Forces (CF) ships operating in warm climate can become very hot working environments. Some of these areas, notably the boiler room, are outside the citadel, and personnel working in these areas during periods of chemical threat must wear chemical defence (CD) clothing. The extra insulation and the increased resistance to sweat evaporation of this clothing, coupled with the heat of the environment, can impose a severe heat stress on the engineering personnel. A field trial was conducted aboard the HMCS Ottawa while en route from Halifax to Puerto Rico to see if the Exotemp

liquid-based personal cooling system, could alleviate thermal stress under the above simulated conditions. Twelve engine room personnel from three watches participated in the trial, conducting their normal engine-room duties while being monitored for thermal physiological strain in four clothing ensembles: normal work dress (WD); normal work dress with cooling (WC); chemical defence clothing (CD); and chemical defence clothing with cooling (CC). Heat stress conditions of 45-50 C dry-bulb temperature were created. Rectal temperatures at 90 minutes of elapsed time clearly indicated statistically significant benefits of cooling with the chemical defence clothing. Heart rates were generally above 120 bpm without cooling (condition WD and CD) while they generally remained below 120 bpm with cooling (conditions WC and CC).

GRA

N92-17645*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ECCENTRIC AND CONCENTRIC MUSCLE PERFORMANCE FOLLOWING 7 DAYS OF SIMULATED WEIGHTLESSNESS

JUDITH C. HAYES, MARY L. ROPER, AUGUSTUS D. MAZZOCCA, JOHN J. MCBRINE, LINDA H. BARROWS (Krug Life Sciences, Inc., Houston, TX.), BERNARD A. HARRIS, and STEVEN F. SICONOLFI Washington Feb. 1992 13 p (NASA-TP-3182; S-665; NAS 1.60:3182) Avail: NTIS HC/MF A03 CSDL 06/16

Changes in skeletal muscle strength occur in response to chronic disuse or insufficient functional loading. The purpose of this study was to examine changes in muscle performance of the lower extremity and torso prior to and immediately after 7 days of simulated weightlessness (horizontal bed rest). A Biodex was used to determine concentric and eccentric peak torque and angle at peak torque for the back, abdomen, quadriceps, hamstring, soleus, and tibialis anterior. A reference angle of 0 degrees was set at full extension. Data were analyzed by ANOVA. Author

N92-17712# Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.

PRELIMINARY ASSESSMENT OF THE RELATIVE TOXICITY OF TETRAGLYCINE HYDROPERIODIDE, PHASE 1 Report, Jan. 1988 - Aug. 1991

JOSEPH A. MACKO, JR. Aug. 1991 29 p (AD-A243334; AEHA-75-51-0742-91) Avail: NTIS HC/MF A03 CSDL 06/4

Toxicity of Technical Grade Tetraglycine Hydroperiodide (TGHP), the active ingredient in a military water purification tablet (MIL-W-283) has been completed. TGHP is moderately toxic by ingestion when prepared as a aqueous slurry. The compound has no potential for causing sensitization. However, TGHP did produce mild but reversible primary skin irritation, and the technical grade powder did cause severe and nonreversible injury to the eye. TFHP did not exhibit mutagenic activity in three of the four mutagenicity assays performed. In the Chromosome Aberration Assay, TGHP did produce a significant increase in chromosomal aberrations in CHO cells in the presence, but not in the absence, of metabolic activation. This single positive finding in the Chromosome Aberration Assay, in the presence of metabolic activation, is not considered sufficient to classify TGHP a potential human-cell mutagen. GRA

N92-17714# Lawrence Livermore National Lab., CA. Environmental Sciences Div.

THE EFFECT OF SHOWER/BATH FREQUENCY ON THE HEALTH AND OPERATIONAL EFFECTIVENESS OF SOLDIERS IN A FIELD SETTING: RECOMMENDATION OF SHOWERING FREQUENCIES FOR REDUCING PERFORMANCE-DEGRADING NONSYSTEMIC MICROBIAL SKIN INFECTIONS Final Report, Aug. 1990 - Sep. 1991

L. C. HALL, J. I. DANIELS, R. ALY, H. I. MAIBACH, and S. A. SCHAUB 30 Sep. 1991 119 p Sponsored by Army (AD-A242923; UCRL-CR-107449) Avail: NTIS HC/MF A06 CSDL 06/9

Historically, military personnel deployed in the field, particularly in hot regions or humid environments, have suffered disabling

microbial infections of the skin severe enough to contribute to significant reductions in combat-troop strength. Currently, the U.S. Army makes facilities available to field personnel for showering on a weekly basis to prevent infestations of the body louse and the subsequent spread of louse-borne disease. However, a weekly showering frequency has never been evaluated for its efficacy in preventing microbial infections of the skin - a significant cause of man-days lost from combat in modern-day military conflicts. Consequently, field showers may be more important for maintaining combat effectiveness of military personnel than previously thought; however, providing such facilities requires tremendous logistical support. Therefore, we developed shower frequencies for troops in field environments that should minimize or prevent microbial skin infections. According to our calculations, the optimum showering frequency can range from as often as four times per day to as little as once every seven days, depending on skin integrity, environmental conditions, and cleansing agent. We also reviewed the scientific and regulatory information concerning the efficacy and safety of skin-cleansing products; the antimicrobial and antiseptic compounds, triclocarban and chlorhexidine, may be the most suitable for routine use by U.S. military personnel.

GRA

N92-17798# Michigan Univ., Ann Arbor.

HARD-SURFACE CONTAMINATION DETECTION EXERCISE Ph.D. Thesis

S. KAWA 1991 200 p (Contract DE-AC05-76OR-00033) (DE92-004750; DOE/OR-00033/T455) Avail: NTIS HC/MF A09

The purpose of this thesis is to create a practical exercise which demonstrates the techniques used by Health Physicists to detect surface contamination, including both instrumentation and smear survey techniques. By understanding the basic principles of the most commonly found instruments, the intent is that a new Health Physics graduate can correctly choose and apply an instrument to their detection situation. The exercise is also intended to acquaint students with the very basic principles of smear techniques. Smear surveys are probably the most universally applied technique in this industry, however, very little literature exists on the subject. The techniques are usually taught, on-the-job and by demonstration. By their seeing and participating in this presentation, it is intended that Health Physics students can accelerate their first few weeks at their new careers, and enable them to recognize common mistakes. Health Physicists are expected to have knowledge of the basic practices of their profession. This exercise will allow Health Physics students to become familiar with the use of hand-held detection devices and the technique of smear surveys. Adequate measurement and recording of surface contamination information is necessary to: meet licensing requirements; protect the health and safety of the workers; maintain accurate records in the case of litigation or dose reconstruction; and maintain high levels of professional competency. This exercise will assist students in obtaining the skills necessary to adequately measure and record levels of surface contamination. DOE

N92-17800# Oak Ridge Associated Universities, Inc., TN.

LABOR MARKET TRENDS FOR HEALTH PHYSICISTS

Nov. 1991 18 p (Contract DE-AC05-76OR-00033) (DE92-004770; DOE/OR-00033/T462) Avail: NTIS HC/MF A03

Information is presented on the recent trends in enrollments, degrees and US civilian, non-medical employment for health physicists. This information is combined with other data such as salary comparisons, indicators of hiring difficulties by the Federal government, and information received from employers to assess the current labor market status for health physicists. This information indicates that for the last several years demands for new graduate health physicists have been greater than supplies. An assessment of projected enrollment and degree trends and employment trends through the mid-1990s is presented. This assessment indicates that the current labor market situation is not likely to change. The number of job openings will continue to

exceed the number of new graduates available for employment. Moreover, information is presented which indicates that there are several factors at work in the general economy which will make it difficult to enhance health physics enrollments and degrees. Thus, while the recent increase in enrollments in health physics programs and the addition of two new programs in 1990 is encouraging, these are not enough to meet future employment needs. Employers will, in all likelihood, continue to have difficulties in hiring health physicists, and salaries will continue to be relatively high through the mid-1990s. DOE

N92-17802# Kyoto Univ., Kumatori (Japan). Research Reactor Inst.

PROCEEDINGS OF THE CONFERENCE ON HEALTH PHYSICS
TADASHI TSUJIMOTO, ed. and MITSUO MIZUMA, ed. Mar. 1991 35 p. In JAPANESE; ENGLISH summary Conference held in Kumatori, Japan, 20 Mar. 1990 (DE92-704335; KURRI-TR-347; CONF-9003295) Avail: NTIS HC/MF A03

This booklet presents nine talks given at the Conference on Health Physics, which was held on March 20, 1990, at Research Reactor Institute of Kyoto University (KURRI), Japan. The first talk discusses future trends in health physics, focusing on the application of computers, development of new techniques, energy industries, and administrative regulations. The second talk discusses the importance of health physics in relation to nuclear energy. The third one addresses importance of health physics in relation to medical treatment. The fourth and fifth ones discuss the present status and future trends in education in health physics. The sixth one focuses on education in health physics, placing emphasis on grass-roots activities in this field. The seventh and eighth talks discuss various activities to be carried out in the future by the Health Physics Research Center. The ninth one describes major developments leading to the establishment of the Health Physics Research Center. Three appendices are attached which respectively summarize major subjects at a meeting on the budget for the Health Physics Research Center, outlines some studies for radiation control in space aircraft and space bases, and describes major reasons for the necessity of the Health Physics Research Center. DOE

53

BEHAVIORAL SCIENCES

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

A92-20867

AN ATTEMPT TO DETERMINE THE IDEAL PSYCHOLOGICAL PROFILES FOR CREWS OF LONG TERM SPACE MISSIONS
H. URSIN (Bergen, University, Norway), B. COMET (CNES, Toulouse, France), and C. SOULEZ-LARIVIERE (ESTEC, Noordwijk, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 301-314. refs Copyright

Possible psychological criteria for selection at individual and crew levels are reviewed for a Mars type mission. Psychological criteria at an individual level include strong adaptability, resistance to psychological stress, psychological stability, and social skills. At a crew level the criteria include crew size, gender, compatibility, and group homeostasis. It is concluded that for the crew selection it is necessary to take into account group dynamics, personal preferences, and compatibility between astronauts. O.G.

A92-20873

SELECTION AND BIOMEDICAL TRAINING OF COSMONAUTS
S. A. BUGROV, L. I. VORONIN, I. I. VORONKOV, M. M. KOROTAEV, and I. A. SENKEVICH (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 347-350. refs Copyright

A Soviet concept of cosmonaut selection and training based on twenty-eight years experience of supporting the safety of manned space missions is reviewed. Major stages of medical selection system and biomedical preparation of cosmonauts for long-duration missions are discussed. It is concluded that the existing systems for selection and biomedical training made it possible to provide safety for space missions lasting up to a year. Training programs aimed at cosmonaut preparation for long-duration interplanetary flights will reflect a significant shift toward biomedical aspects. O.G.

A92-21763

SHUTTLE SLEEP SHIFT OPERATIONS SUPPORT PROGRAM
KAREN L. MATHES and JOANNA WOOD (Krug Life Sciences, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs (SAE PAPER 911334) Copyright

A program is described that aims to improve sleep and physiological adaptation and to mitigate the negative impact of sleep-schedule shifts on the performance of shuttle crewmembers. The program is based on the conceptual work by Czeisler et al. (1990) in which alternating periods of very bright light and complete darkness are employed to enhance sleep during rapid shifts of crewmembers. Physiological adaptation to the artificial sleep schedules required for shuttle operations is facilitated by the exposure to bright light during the 'daytime' portion of the circadian schedule. The STS-35 crew provides subjective evidence of the improvement provided by environmental light; this conclusion indicates that devices for improving performance during sleep-schedule shifting merit further investigation to optimize performance. C.C.S.

A92-21785* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE ROLE OF HUMAN FACTORS IN MISSIONS OF EXPLORATION

MARY M. CONNORS (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 12 p. refs (SAE PAPER 911373) Copyright

A framework is developed for considering human-factors issues in space-exploration missions and in relation to the Space Exploration Initiative. The special conditions of space exploration are set forth including multiple environments and duration and with respect to mission architecture. Human-factors research needs are outlined which relate to an overall mission analysis and subsequent categories of consideration. The analysis identifies the incorporation of individual, group, and vehicle/habitat architectures, the human/automation tradeoff, and the ability to provide special-circumstance performance requirements through selection, training, and support. An integrated research plan can include such options as flight experiments, analog environments, testbeds, field research, simulation, modeling, laboratory experiments, and/or analysis. C.C.S.

A92-21807* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SHIFTWORK IN SPACE - BRIGHT LIGHT AS A CHRONOBIOLOGIC COUNTERMEASURE

PHILIPPA H. GANDER (NASA, Ames Research Center, Moffett Field, CA) and ALEXANDER SAMEL (DLR, Institut fuer Flugmedizin,

Cologne, Federal Republic of Germany) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 17 p. refs
(SAE PAPER 911496) Copyright

The potential of timed exposures to bright light as a countermeasure to the changes in the work/rest schedules during space missions was investigated. In the experiments, four human subjects were exposed to two sessions of eleven days of simulated weightlessness (6-deg head-down-tilt bedrest) with 6-hr extensions of the scheduled wake time on days 3 and 4 (a 12-hr phase delay). In a blind crossover design, subjects were exposed to bright light (greater than 3500 lux) for 5 hrs on each of the two shift days and on the following day, at times expected to accelerate adaptation to the phase delay (experimental group), or have no phase shifting effect (control group). Results indicate that bright light may accelerate the rate of adaptation to work/rest schedule delays under simulated weightlessness conditions. However, such effect was found to be largely independent of the timing of the light exposure. I.S.

A92-21863

APPLIED ETHOLOGICAL STUDY OF ASTRONAUT BEHAVIOR DURING EVA SIMULATIONS WITH A WET SUIT PROTOTYPE

C. TAFFORIN (Toulouse III, Universite, France) and L. DECRAMER (CNES, Toulouse, France) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 14 p. refs

(SAE PAPER 911531) Copyright

An analytical method is applied to EVA training in which a Soviet flight suit serves as the basis for a wet-suit prototype that offers neutral buoyancy and a breathing apparatus. The simulations of weightlessness are described in terms of the zero-g test apparatus and the experimental protocol as well as the method of ethological analysis. Numerous donning/doffing tests are conducted with 11 subjects, and video recordings are analyzed in terms of body movements and orientations. The results of the observations are analyzed by quantitatively processing the data and calculating the frequency of occurrence of each item, the frequency of transitions between items, and activity durations. The descriptive and comparative analyses demonstrate that in parabolic flights there are diverse behavioral indicators of high performance levels. In immersion tests the data suggest more homogeneous and routine actions, and key differences are noted between male and female subjects. C.C.S.

A92-22074

SPATIAL FILTERING PRECEDES MOTION DETECTION

M. J. MORGAN (Edinburgh, University, Scotland) Nature (ISSN 0028-0836), vol. 355, Jan. 23, 1992, p. 344-346. Research supported by SERC. refs

Copyright

A possible mechanism for the ability of humans to track moving objects on a television or cinema screen involves low-level motion detectors with a limited spatial range that tend to be stimulated over time by the same object. This model predicts that the direction of displacement of random patterns cannot be detected reliably above a critical absolute displacement value D(max) that is independent of the size or density of elements in the display. Other studies, however, have shown that D(max) increases with element size, in which case the most likely interpretation is that D(max) depends on the probability of false matches between pattern elements following a displacement. These conflicting accounts are reconciled here by showing that D(max) is indeed determined by the spacing between the elements in the pattern, but only after fine detail has been removed by a physiological prefiltering stage: the filter required to explain the data has a similar size to the receptive field of neurons in the primate magnocellular pathway. The model explains why D(max) can be increased by removing high spatial frequencies from random patterns and simplifies the present view of early motion detection. C.D.

A92-22098* Illinois Univ., Urbana.

STRATEGIC BEHAVIOR, WORKLOAD, AND PERFORMANCE IN TASK SCHEDULING

NEVILLE MORAY, MOHAMED I. DESSOUKY, BRIAN A. KIJOWSKI, and RAVI ADAPATHYA (Illinois, University, Urbana) Human Factors (ISSN 0018-7208), vol. 33, Dec. 1991, p. 607-629. refs

(Contract NAG2-567)

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Scheduling theory is proposed as a normative model for strategic behavior when operators are confronted by several tasks, all of which should be completed within a fixed time span, and when they are free to choose the order in which the tasks should be done. Three experiments are described to investigate the effect of knowing the correct scheduling rule on the efficiency of performance, subjective workload, and choice of strategy under different conditions of time pressure. The most potent effects are from time pressure. The reasons for the weak effect of knowing the rules are discussed, and implications for strategic behavior, displays, and decision aids are indicated. Author

A92-23425* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PERCEPTS OF RIGID MOTION WITHIN AND ACROSS APERTURES

MAGGIE SHIFFRAR (Stanford University, CA) and M. PAVEL (New York University, NY) Journal of Experimental Psychology: Human Perception and Performance (ISSN 0096-1523), vol. 17, no. 3, 1991, p. 749-761. refs

(Contract AF-AFOSR-84-0308; NCC2-269)

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Humans consistently err in their percepts of rotational motion, viewed through an aperture. Such errors provide insight into the constraints observers use to interpret retinal images. In the first of two experiments, the subjects consistently perceived the fixed center of rotation for an unmarked line viewed through an aperture as located on the line, regardless of its actual location. Accuracy greatly improved with visible line endings. This finding was extended to explain why a square appears nonrigid when it rotates behind a partial occluder. This illusion is theorized to result from observers misperceiving the center of rotation of the unmarked square sides. In this situation, the subjects seemed unable to apply an object rigidity constraint across apertures. These findings support a conceptualization of the visual system in which consistent local information must be clearly present before prior knowledge can be used to interpret retinal stimulation. Author

N92-16555# Naval Postgraduate School, Monterey, CA.

THE IMPACT OF VERBAL REPORT PROTOCOL ANALYSIS ON A MODEL OF HUMAN-COMPUTER INTERFACE COGNITIVE PROCESSING M.S. Thesis

BARBARA L. TREHARNE Mar. 1991 103 p
(AD-A242671) Avail: NTIS HC/MF A06 CSCL 25/2

This exploratory study used the 'think-aloud' protocol to demonstrate the effectiveness of Kieras and Polson's Goals, Operators, Methods, and Selection Rules and the Cognitive Complexity Model. An experiment comparing the cognitive processes of users on two file management interfaces, a command language and direct manipulation interface, was conducted. The think-aloud process was chosen as the methodology for conducting this experiment because of its insights into the user's perceptions of both the task and device representations. The experimental results provide implications for the study of cognitive processes--the nature of the interface design influences the users' mental models of a system, which has a direct affect on the users' performance on a given interface. This methodology also provides an evaluation technique which may improve the design process of the user interfaces. Finally, the results support the think-aloud protocol as an effective evaluation tool of user interface designs. GRA

N92-16556# Navy Personnel Research and Development Center, San Diego, CA.

EMPIRICAL COMPARISON OF ALTERNATIVE VIDEO TELETRAINING TECHNOLOGIES Interim Report

HENRY SIMPSON, H. L. PUGH, and STEVEN W. PARCHMAN
Oct. 1991 64 p
(AD-A242200; NPRDC-TR-92-3) Avail: NTIS HC/MF A04
CSCS 05/6

The overall objective of the project was to explore technologically cost-effective ways to train personnel who are geographically remote from training resources. An empirical study was conducted to compare (1) training effectiveness and (2) user acceptance of live instruction and six different alternative Video Teletraining (VTT) technologies: multi-channel 2-way video with 2-way audio, single-channel 2-way video with 2-way audio, 1-way video with 2-way audio, 1-way video with 1-way audio, 1-way video with intermittent 2-way audio, and audiographics. Findings were that VTT in several different forms was effective both in terms of student performance and student and instructor acceptance. The most successful VTT technologies were those allowing continuous 2-way audio communication between classrooms with either 2-way or 1-way video. Using 2-way video does not appear to improve student performance as compared to 1-way video, but instructors prefer 2-way video and students expressed the desire to see their cohorts in other classes, which requires 2-way video. Student test performance was poorer with VTT systems that restricted remote students' ability to converse with or see the instructor and the performance decrement was evident in both local and remote classrooms. Evidence suggests that student acceptance of such VTT technologies was lower than with fully-interactive VTT. Similar results would be expected with video-taped instruction. Students adapted to compensate for the video and audio shortcomings of VTT technologies. GRA

N92-17052# Human Engineering Labs., Aberdeen Proving Ground, MD.

THE EFFECTS OF SPEECH INTELLIGIBILITY LEVEL ON CONCURRENT VISUAL TASK PERFORMANCE Final Report

DAVID G. PAYNE, LESLIE J. PETERS, DEBORAH P. BIRKMIER, and GEORGES R. GARINIER Sep. 1991 33 p
(Contract DA PROJ. 1L1-61102-B-74-A)
(AD-A243015; HEL-TM-17-91) Avail: NTIS HC/MF A03 CSCS 25/4

Two experiments were performed to determine if changes in speech intelligibility level can impact performance levels in concurrent visual tasks. The auditory task used in both experiments was the auditory memory search task in which subjects memorized a set of words and then decided whether auditorially presented probe items were members of the memorized set. Experiment 1 used an unstable tracking task as the visual task, and experiment 2 used a spatial decision-making task. Results showed that unstable tracking performance was unaffected by the level of speech intelligibility during the auditory task, whereas accuracy in the spatial decision-making task was significantly worse at low speech intelligibility levels. These results have clear implications for the design of communications systems. The findings are interpreted within the framework of multiple resource theory, and future directions for research are described. GRA

N92-17115# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

NEURAL NETWORK CLASSIFICATION OF MENTAL WORKLOAD CONDITIONS BY ANALYSIS OF SPONTANEOUS ELECTROENCEPHALOGRAMS M.S. Thesis

GRETCHEN D. LIZZA 1991 92 p
(AD-A243369; AFIT/CI/CIA-91-095) Avail: NTIS HC/MF A05
CSCS 06/1

Artificial neural networks were explored in this study to determine their capability to discriminate workload tasks on the basis of electroencephalograms (EEGs) recorded during task performance. EEG traces were recorded by placing electrodes at the occipital (Oz), parietal (Pz), central (Cz), and frontal (Fz) midline positions during workload tasks. Two conditions of workload were

presented to the subjects. The first condition, an eye condition, varied whether eyes were open or closed while subjects counted or sat quietly. In the second condition, the workload conditions presented to the subjects were high and low levels of display monitoring and math processing tasks. GRA

N92-17145# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

RAPID NONCONJUGATE ADAPTATION OF VERTICAL VOLUNTARY PURSUIT EYE MOVEMENTS Ph.D. Thesis

GERALD A. GLEASON 1991 241 p
(AD-A243358; AFIT/CI/CIA-91-022D) Avail: NTIS HC/MF A11
CSCS 06/5

The precise yoking of the two eyes during vertical eye movements is normally preserved throughout life. This preservation is due in part to adaptive processes that adjust the relative neural innervations sent to each eye's extraocular muscles (nonconjugate adaptation). This behavioral study investigates adaptive processes that maintain conjugacy along the vertical meridian during three types of ocular motor behavior: voluntary pursuit, saccade, and steady fixation. Binocular yoking was quantified by binocular recordings of vertical eye position (dual-Purkinje eye tracker) while vertical eye movements were monocularly stimulated. Properties of nonconjugate adaptive processes were inferred from changes in pre- and post-adaptation binocular yoking. GRA

N92-17336# Florida State Univ., Tallahassee. Dept. of Psychology.

MECHANISMS OF TEMPORAL PATTERN DISCRIMINATION BY HUMAN OBSERVERS Annual Technical Report, 1 Oct. 1990 - 30 Sep. 1991

ROBERT D. SORKIN 31 Oct. 1991 11 p
(Contract AF-AFOSR-0065-91; AF PROJ. 2313)
(AD-A243051; AFOSR-91-0915TR) Avail: NTIS HC/MF A03
CSCS 06/4

Several studies of temporal pattern perception were conducted, using tasks where the listener discriminated whether or not two tonal sequences formed the same temporal pattern. Performance was modeled using the Pattern Correlation Model, which assumes that the listener estimates the correlation between the pattern of intervals marked by the tones in each sequence. The model was applied to experiments where the sequences were compressed or expanded in time; presented at different frequencies and to different ears; onset delayed from 1 to 1500 ms; and subject to cyclic repetitions within each sequence. Other experiments have concerned: (1) the discrimination of rhythmicity; (2) visual information processing as a function of spatial position and time stress; and (3) modeling and computer simulation of systems for group signal detection. GRA

N92-17450# Air Force Systems Command, Brooks AFB, TX. Armstrong Lab.

COMPARISON OF EXPERIMENTAL US AIR FORCE AND EURO-NATO PILOT CANDIDATE SELECTION TEST

BATTERIES Interim Report, 21 May - 4 Jun. 1991

THOMAS R. CARRETTA Oct. 1991 26 p
(AD-A242358; AL-TP-1991-0034) Avail: NTIS HC/MF A03
CSCS 05/8

Air Force personnel from several countries currently are evaluating computerized test batteries as an adjunct to current pilot candidate selection procedures. This paper describes and compares proposed U.S. Air Force (USAF) and Euro-NATO Aircrew Selection Working Group (ACSWG) pilot candidate selection test batteries. A validation strategy for the ACSWG test battery is described that focuses on test item analyses (e.g., evaluating internal consistency), evaluation of test scoring procedures, evaluation of test battery factor structure, and evaluation of test scores against training performance criteria. GRA

N92-17458# Carnegie-Mellon Univ., Pittsburgh, PA. Artificial Intelligence and Psychology Project.

ATTENTION, AUTOMATICITY AND PRIORITY LEARNING

PRAHLAD GUPTA and WALTER SCHNEIDER 1991 8 p

(Contract N00014-86-K-0678; N00014-87-K-0397;
MDA903-89-K-0174)
(AD-A242226; CMU-AIP-148) Avail: NTIS HC/MF A02 CSCL
05/8

It is widely held that there is a distinction between attentive and automatic cognitive processing. In research on attention using visual search tasks, the detection performance of human subjects in consistent mapping paradigms is generally regarded as indicating a shift, with practice, from serial, attentional, controlled processing to a parallel, automatic processing, while detection performance in varied mapping paradigms is taken to indicate that processing remains under attentional control. This paper proposes a priority learning mechanism to model the effects of practice and the development of automaticity, in visual search tasks. A connectionist simulation model implements this learning algorithm. Five prominent features of visual search practice effects are simulated. These are: (1) in consistent mapping tasks, practice reduces processing time, particularly the slope of reaction times as a function of the number of comparisons; (2) in varied mapping tasks, there is no change in the slope of the reaction time function; (3) both the consistent and varied effects can occur concurrently; (4) reversing the target and distractor sets produces strong interference effects; and (5) the benefits of practice are a function of the degree of consistency. GRA

N92-17500# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS OF VISUAL ILLUSIONS USING MULTIREOLUTION WAVELET DECOMPOSITION BASED MODELS M.S. Thesis
JOHN S. LAING Dec. 1991 244 p
(AD-A243712; AFIT/GE/ENG/91D-34) Avail: NTIS HC/MF A11 CSCL 23/2

This thesis provides alternatives to the explanation that spatial filtering is responsible for the perception of illusory contours in the Kanisza Triangle illusion. Specifically, we use a Multiresolution Wavelet Decomposition to divide an image into spatial-frequency bands that are used as inputs to three biologically motivated models. The thesis includes a brief tutorial of Wavelet theory and an in-depth explanation of our implementation of recently published algorithms for Multiresolution Wavelet Analysis. The first model is based on the saccadic movements of the human eye. It demonstrates the importance of the high spatial-frequency content of an image in the formulation of the illusion. The second model is based on the serial architecture of the data transmission channel between the retina and the visual world model. The third model considers only the high spatial-frequency content of the image. It consists of lateral excitation networks that serve to simulate the local high spatial-frequency energy interactions that contribute to illusory contours. GRA

N92-17503# Yale Univ., New Haven, CT. Dept. of Psychology.
SIGNAL- AND LISTENER-BASED FACTORS IN COMPLEX AUDITORY PATTERN PERCEPTION Final Report, 1 Oct. 1990 - 30 Sep. 1991
ARTHUR G. SAMUEL 7 Oct. 1991 22 p
(Contract AF-AFOSR-0020-91; AF PROJ. 2313)
(AD-A243716; AFOSR-91-0283TR) Avail: NTIS HC/MF A03 CSCL 05/8

The research conducted during the one year funding period was a subset of the original three year study of the perception of complex auditory patterns, including speech and music. One set of experiments explored two early stages in the perception of complex signals, using adaptation procedures. This research investigated effects of varying signal amplitude, and the effects of more cognitive factors: lexical knowledge, and the listener's level of attention to the adapting sound. A second set of experiments perceptual restoration effects. Those experiments investigated how knowledge of particular words influenced the perceptual restoration of deleted or degraded portions of the word. The two lines of research represent progress toward understanding the analyses conducted on complex auditory patterns by human listeners. GRA

N92-17554# Boston Univ., MA. Center for Adaptive Systems.
THE COGNITIVE, PERCEPTUAL, AND NEURAL BASES OF SKILLED PERFORMANCE Annual Technical Report, 15 Mar. 1990 - 14 Mar. 1991

STEPHEN B. GROSSBERG 14 Mar. 1991 36 p
(Contract AF-AFOSR-0175-90; AF PROJ. 3484)
(AD-A243052; AFOSR-91-0913TR) Avail: NTIS HC/MF A03 CSCL 05/8

This report reviews progress from the Boston University, Northeastern University, and Harvard University/Cambridge University research groups of our AFOSR University Research Initiative grant. The report lists books and articles, summaries of research, and selected abstracts of key articles. The report also encloses the program and the abstract book of an AFOSR-supported conference that was held at the Wang Institute of Boston University on May 11-13, 1990. The topic of the conference was Neural Networks for Automatic Target Recognition. There were fifteen invited speakers and thirty-eight contributed posters. Three-hundred scientists and students attended from twenty countries and thirty-five states of the United States. GRA

N92-17634# North Carolina Univ., Chapel Hill. Dept. of Computer Science.

ELECTRONIC EXPANSION OF HUMAN PERCEPTION

WARREN ROBINETT 1991 7 p
(Contract N00014-86-K-0680)
(AD-A242028) Avail: NTIS HC/MF A02 CSCL 06/1

The true potential of this new field comes from the ability of a head mounted display to induce a synthetic experience in its wearer. The ability to artificially create and design experience enables possibilities and powers that were formerly impossible. If experience can be captured and transmitted, then you can 'travel' instantaneously to a distant location and see the trees, feel the wind, hear the birds, and smell the flowers. If electronic instruments can sense things that you cannot perceive, such as the inside of opaque objects, then you can be shown images of these invisible things. There are, however, things which are invisible to all of your senses. Examples of these imperceptible phenomena are X-rays, infrared radiation, radio waves, magnetic fields, radioactivity, ultrasound, electricity, the inside of opaque objects, microscopic objects, and events occurring too fast to see. Even though you cannot directly perceive these things, you can indirectly measure and observe them with various instruments and electronic sensors. GRA

N92-17648# Texas Univ. Health Science Center, San Antonio.
BRAINMAP: A DATABASE OF FUNCTIONAL NEUROANATOMY DERIVED FROM HUMAN BRAIN IMAGES Quarterly Report No. 2

14 Nov. 1991 6 p
(Contract N00014-91-J-1903)
(AD-A243161) Avail: NTIS HC/MF A02 CSCL 06/4

Our efforts during the second quarter were again primarily devoted to the Macintosh version of BrainMap. The status of the four main components of BrainMap software are: (1) Search Windows (fully conceived, fully designed and awaiting SQL interface); (2) SQL interface (mostly conceived; partly designed; not operational); (3) Review Windows (mostly conceived, mostly designed, and awaiting SQL interface), and (4) Report Generation (partly conceived, partly designed, and awaiting SQL interface). Software development is proceeding in a timely fashion, and at present we see no major problems with completing the project on time. Work on BrainMap-SQL has begun and more focus on that portion of the project will be given when BrainMap-Mac is operational. GRA

N92-17758# Dayton Univ., OH.
EFFECT OF TWO TYPES OF SCENE DETAIL ON DETECTION OF ALTITUDE CHANGE IN A FLIGHT SIMULATOR Interim Report, Jun. 1989 - Feb. 1991

JAMES A. KLEISS and DAVID C. HUBBARD Jul. 1991 48 p
(Contract F33615-90-C-0005)

(AD-A242034; AL-TR-1991-0043) Avail: NTIS HC/MF A03
CSCL 01/2

The effect of two types of simulator scene detail on detection of change in altitude was evaluated. The first type was the density of three dimensional objects in scenes, which ranged from 11 objects per square mile to 175 objects per square mile. The second was the detail/realism of three-dimensional objects, which ranged from simple, untextured tetrahedrons (i.e., three-sided pyramids) to a mix of highly detailed and realistic appearing oak trees, pine trees, and bushes. A group of pilots and a group of non-pilots viewed short segments of flight over simulated terrains and responded by pushing one of three buttons to indicate whether they were descending, remaining level at 150 ft above ground level or ascending. Results of experiment one showed that accuracy and reaction times for both groups improved significantly with increases in object density. However, a significant effect of object type was obtained only for the non-pilot group with the accuracy dependent measures. Interestingly, the advantage favored tetrahedrons over realistic objects. In experiment two, these effects persisted even after four sessions of practice. These results suggest that available computer-image generator processing capacity may be used most effectively by maximizing object density rather than object realism.

GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A92-20862

A COMPACT BODY MASS MEASURING DEVICE FOR SPACE FLIGHT APPLICATIONS

P. V. PISTECKY, H. F. VAN BEEK (Delft University of Technology, Netherlands), J. F. F. KLINKHAMER (TNO, Delft, Netherlands), and F. BRECHIGNAC (ESTEC, Noordwijk, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 259-262. refs

(Contract ESA-3-6399/89/NL/PB)

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A device developed for measuring an astronaut's body mass in space is described. The body-mass measuring device is based on initiating an artificial acceleration; it is compact and user friendly and has an absolute measuring accuracy better than 60 g. The device is battery operated and consumes less than 20 W. The measurement accuracy is restricted only by the way a human body is configured by nature and not by the instrument itself.

I.S.

A92-20864

HUMAN FACTOR IN MANNED MARS MISSION

EVGENII A. IL'IN, SERGEI F. KHOLIN, VADIM I. GUSHCHIN, and IURI R. IVANOVSKII (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 271-279. refs

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The specific human-factor-related problems that are expected to arise in a manned mission to Mars are discussed together with

the approaches designed for the resolution of these problems. Special attention is given to the concept of multifunctional on-board instrumental and informational medical complex for a Martian spacecraft. The medical complex designed for Mars missions consists of a mainframe computer, a physician's computerized work station, an operator's computerized work station, a unified registrar of biophysical information, the facilities for physiological testing and training and for biophysical correction, and an individual autonomous recorder and transmitter of biophysical information. The operation principles of the complex are discussed, and its functional scheme is presented. I.S.

A92-20868

HABITABILITY CONSTRAINTS/OBJECTIVES FOR A MARS MANNED MISSION - INTERNAL ARCHITECTURE CONSIDERATIONS

F. WINISDOERFFER (Aerospatiale, Les Mureaux, France) and C. SOULEZ-LARIVIERE (ESTEC, Noordwijk, Netherlands) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 315-320. refs

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Internal spacecraft architecture for a Mars manned mission is addressed using zoning analysis. Common, service, and personal zones need to be adapted to the constraints associated with an extremely long duration mission. It is suggested to implement a so-called recreational zone because of the nature of the mission itself (relative autonomy, communication problems, and monotony) and the type of the crew selected. The internal architecture proposals and recommendations on volumetric requirements are presented. O.G.

A92-20874* National Aeronautics and Space Administration, Washington, DC.

DEVELOPMENT OF LIFE SUPPORT REQUIREMENTS FOR LONG-TERM SPACE FLIGHT

JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC) (Life sciences and space research XXIV/1/ - Gravitational biology; Proceedings of the Symposia 10 and 13 of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F1 and F2/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20827 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 1, 1992, p. 351-353.

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Life support system requirements for future long-term space flights are discussed. These requirements include overall reliability in the space environment, providing maintenance and component replacement in space; reduced supply mass of consumables and spares; the ability to utilize local resources for increased self-sufficiency on planetary surfaces; and minimized mass power and volume requirements necessary for all space flight systems. O.G.

A92-20932

EFFECTS OF INCREASED SHIELDING ON GAMMA-RADIATION LEVELS WITHIN SPACECRAFT

P. S. HASKINS, J. E. MCKISSON, A. G. WEISENBERGER, D. W. ELY, T. A. BALLARD (Florida, University, Gainesville), C. S. DYER, P. R. TRUSCOTT (Royal Aerospace Establishment, Farnborough, England), R. B. PIERCEY (Mississippi State University, Mississippi State), A. V. RAMAYYA (Vanderbilt University, Nashville, TN), and D. C. CAMP (Lawrence Livermore National Laboratory, Livermore, CA) (Life sciences and space research XXIV/2/ - Radiation biology; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F3, F4, F5, F6 and F1/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20879 07-51) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 2-3, 1992, p. 461-464. Research

sponsored by SDIO. refs

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The Shuttle Activation Monitor (SAM) experiment was flown on the Space Shuttle Columbia from 8-13 August, 1989 in a 57-deg, 300-km orbit. One objective of the SAM experiment was to determine the relative effect of different amounts of shielding on the gamma-ray backgrounds measured with similarly configured sodium iodide and bismuth germanate detectors. To achieve this objective, twenty-four hours of data were taken with each detector in the middeck of the Shuttle on the ceiling of the airlock (a high-shielding location) as well as on the sleep-station wall (a low-shielding location). For the cosmic-ray induced background, the results indicate an increased overall count rate in the 0.2 to 10 MeV energy range at the more highly shielded location, while in regions of trapped radiation the low shielding configuration gives higher rates at the low-energy end of the spectrum. Author

A92-20969 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LIFE SCIENCES AND SPACE RESEARCH XXIV(4) - NATURAL AND ARTIFICIAL ECOSYSTEMS; PROCEEDINGS OF THE TOPICAL MEETING OF THE INTERDISCIPLINARY SCIENTIFIC COMMISSION F (MEETINGS F10, F11, F1 AND F12) OF THE COSPAR 28TH PLENARY MEETING, THE HAGUE, NETHERLANDS, JUNE 25-JULY 6, 1990

R. D. MACELROY, ED. (NASA, Ames Research Center, Moffett Field, CA), M. M. AVERNER, ED. (NASA, Washington, DC), T. W. TIBBITTS, ED. (Wisconsin, University, Madison), B. B. BUGBEE, ED. (Utah State University, Logan), G. HORNECK, ED. (DLR, Cologne, Federal Republic of Germany), and E. H. DUNLOP, ED. (Dunlop Biotechnological Associates, Englewood, CO) Meeting sponsored by COSPAR and IAF. Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, 275 p. For individual items see A92-20970 to A92-20996.

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The present conference on natural and artificial ecosystems and their application to space research encompasses both in-flight and ground-based issues of recycling and control in regenerative life support, the relationships of productivity and facility design in higher plant growth, life-support systems for manned missions to Mars, and biochemical engineering applications in space. Specific issues addressed include interface problems between material recycling systems and plants, temperature and humidity control on a lunar base, the CELSS Test-Facility Project, achieving closure in plant-growth facilities, and life-support systems for Mars transit. Also addressed are a closed equilibrated biological aquatic system, a simulated Mars outpost in the Antarctica dry valleys, analyses of human kidney-cell populations separated on the space shuttle, and the evolution of a phase-separated gravity-independent bioreactor. C.C.S.

A92-20970
COMMERCIAL INVOLVEMENT IN THE DEVELOPMENT OF SPACE-BASED PLANT GROWING TECHNOLOGY

R. J. BULA, T. W. TIBBITTS, R. C. MORROW, and W. R. DINAUER (Wisconsin, University, Madison) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 5-10. refs

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Considerable technological progress has been made in the development of controlled environment facilities for plant growth. Although not all of the technology used for terrestrial facilities is applicable to space-based plant growth facilities, the information resident in the commercial organizations that market these facilities can provide a significant resource for the development of the plant growing component of a CELSS. In 1985, NASA initiated an effort termed the Centers for the Commercial Development of Space (CCDS). This program endeavors to develop cooperative research and technology development programs with industrial

companies that capitalize on the strengths of industry-university working relationships. One of these CCDSs, the Wisconsin Center for Space Automation and Robotics (WCSAR), deals with developing automated plant growth facilities for space, in cooperation with several industrial partners. Concepts have been developed with industrial partners for the irradiation, water and nutrient delivery, nutrient composition control and automation and robotics subsystems of plant growing units. Spaceflight experiments are planned for validation of the concepts in a space environment. Author

A92-20971

INTERFACE PROBLEMS BETWEEN MATERIAL RECYCLING SYSTEMS AND PLANTS

KEIJI NITTA, MITSUO OGUCHI, and KOJI OTSUBO (National Aerospace Laboratory, Chofu, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 11-19. refs

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The requirements are identified of material-recycling subsystems for the plant-cultivation modules (PCMs) of CELSS systems. A review is given of metabolic data for human beings as well as plants to be utilized in a CELSS project. The paper then examines the material-recycling systems proposed for Habitat modules and PCMs by means of flow charts that identify such components as element synthesizers, recovery and reclamation vessels, and CO₂ and O₂ separators. Testing of the material-recycling techniques is described in a small closed chamber with five subsystems for lighting, growth, air conditioning, gas measurement, and gas-concentration control. Metabolic-balance data is shown to be the most important reference for evaluating control methods for PCMs and material-recycling systems and their interfaces. C.C.S.

A92-20972

EVALUATIONS OF CATALYSTS FOR WET OXIDATION WASTE MANAGEMENT IN CELSS

MITSUO OGUCHI and KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 21-27.

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The applicability of wet oxidation to CELSS systems is assessed in terms of catalysts for activating effective oxidation levels and reducing residual levels of acetic acid and ammonia. The experimental setup is described in which a catalytic reactor is introduced for the wet oxidation of rabbit waste. Noble metals are employed as catalysts such as Ru, Rh, and Pd via Al₂O₃ or TiO₂ pellets and a stainless-steel honeycomb that provides high oxidation resistance. The waste is decomposed for 30 minutes in both the reactor with and without catalysts, and levels are determined of the subsequent CO₂, total organic C and N, and other chemical contents. The organic wastes are fully decomposed, and the resulting gas is harmless; however, the postoxidation sludge is found to contain concentrations of Al, Pd, Ru, and Rh due to degradation of the aluminum oxide catalyst vessel. C.C.S.

A92-20973

A STUDY OF BIOHAZARD PROTECTION FOR FARMING MODULES OF LUNAR BASE CELSS

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and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 29-32. refs

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For the Closed Ecological Life Support System (CELSS) of a manned lunar base which is planned to be built on the moon early in the 21st century, several proposed programs exist to grow vegetables inside a farming module. At the 40th IAF (Malaga, 1989) a proposal is presented for supplying food and nutrients to a crew of eight members, a basic concept which is based on growing four kinds of vegetables. This paper describes measures for biohazard protection in farming modules. In this study, biohazard protection means prevention of the dispersion of plant diseases to other plant species or other portions of farming beds. Author

A92-20974

PILOT CELSS BASED ON A MALTOSE-EXCRETING CHLORELLA - CONCEPT AND OVERVIEW ON THE TECHNOLOGICAL DEVELOPMENTS

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A typical ecosystem is composed of three compartments: photosynthetic producer (anabolizing processes), consumer, and decomposer (catabolizing processes). It is too complex, however, to form the basis for establishing an engineered artificial ecosystem dedicated to support life (of the consumer) in space. A simpler two-compartment pilot model to start with is selected. It is based on a symbiotic Chlorella which can be tuned, at low pH, to produce maltose. This feature prevents the accumulation of useless biomass, not readily edible by the consumer. Being excreted, maltose is easily recoverable, and constitutes a direct source of carbon suitable for many consumers. Since they totally catabolize it back to CO₂, the necessity for a decomposer compartment is avoided. The present status of the technological concept designed to support life of small consumers (animals, microorganisms) is presented, taking into account the space compatibility of the technologies developed. Author

A92-20975

TEMPERATURE AND HUMIDITY CONTROL SYSTEM IN A LUNAR BASE

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The objective of the present work is to evaluate a temperature and humidity control system which will allow man to live and work on the moon while developing lunar resources. The results of thermal load calculation show that the load of electric lighting is 80 to 90 percent of the cooling load in the habitat module and that only the cooling function is required for temperature control. Due to this, a fluorocarbon refrigerant heat pump system was selected to satisfy reliability, energy consumption, size, and weight requirements for the lunar base equipment. According to the load calculation, occupants will feel discomfort due to radiant heat from lighting fixtures. To resolve this problem, an air conditioning system, used in combination with forced convective cooling and panel

cooling on the ceiling, was adopted in the living space. Moreover, the experiment on the ground was carried out to evaluate the effects of panel cooling. Author

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THE BREADBOARD PROJECT - A FUNCTIONING CELSS PLANT GROWTH SYSTEM

W. M. KNOTT (NASA, Kennedy Space Center, Cocoa Beach, FL) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 45-52. refs

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The primary objective of the Breadboard Project for the next 3-4 years is to develop, integrate and operate a Controlled Ecological Life Support System (CELSS) at a one-person scale. The focus of this project over the past two years has been the development of the plant growth facility, the first module of the CELSS. The other major modules, food preparation, biomass processing, and resource recovery, have been researched at the laboratory scale during the past two years and facilities are currently under construction to scale-up these modules to an operational state. This paper will outline the design requirements for the Biomass Production Chamber (BPC), the plant growth facility for the project, and the control and monitoring subsystems which operate the chamber and will present results from both engineering and biological tests of the facility. Three production evaluations of wheat, conducted in the BPC during the past year, will be described and the data generated from these tests discussed. Author

A92-20977

CATALYTIC WET-OXIDATION OF HUMAN WASTES PRODUCED IN SPACE - THE EFFECTS OF TEMPERATURE ELEVATION

N. TAKEDA and Y. TAKAHASHI (Niigata University, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 53-56. refs

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The filtrate of noncatalytical wet-oxidized sewage sludge was wet-oxidized again at 290 C and 300 C with a Ru-Rh catalyst. At each temperature, repeated batch tests were carried out. Both oxidation and denitrification efficiency of organic matter in the raw material were studied. In the 16 times batch tests at 300 C, high and stable oxidation occurred; 98.0 percent of organic carbon in the raw material was oxidized and 98.3 percent of organic nitrogen was denitrified. At 290 C, though high and stable denitrification occurred, oxidation did not occur highly and stably. A catalytic wet-oxidation system studied at 300 C will be useful as a waste management system for a human life support system, where almost all food is resupplied from the earth. This system can prevent organic waste accumulation in the life support system. Author

A92-20978

MATERIAL RECYCLING IN A REGENERATIVE LIFE SUPPORT SYSTEM FOR SPACE USE - ITS ISSUES AND WASTE PROCESSING

Y. TAKAHASHI and KAZUHIRO TANAKA (Niigata University, Japan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p.

65-73. refs

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Sources of wastes produced in future human activities in space are discussed. The quantity and quality of each source is evaluated. Water quality requirements for human safety are shown. Then, techniques to be used for processing and/or recycling the wastes to attain the requirements are listed. Specific characteristics and limitations of each are explained. Examples of system configurations of the techniques are shown. The material balances are calculated.

Author

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THE CELSS TEST FACILITY PROJECT - AN EXAMPLE OF A CELSS FLIGHT EXPERIMENT SYSTEM

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The design of the facility is described in terms of its use as an investigation tool for evaluating crop growth in space with reference to required emerging technologies. NASA's CELSS Test Facility (CTF) is designed to permit the measurement of crop-plant productivity under microgravity conditions including biomass production, food production, water transpiration, and O₂/CO₂ exchanges. Crucial hardware tests and qualifications are identified to assure the operation of CTF technologies in space including the nutrient-delivery, water-condensation, and gas-liquid-mixing subsystems. The design concept and related scientific requirements are described and shown to provide microgravity crop research. The CTF is expected to provide data for plant research and for concepts for bioregenerative life-support systems for applications to Martian, lunar, and space-station missions.

C.C.S.

A92-20980* Utah State Univ., Logan.

DETERMINING THE POTENTIAL PRODUCTIVITY OF FOOD CROPS IN CONTROLLED ENVIRONMENTS

BRUCE BUGBEE (Utah State University, Logan) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 85-95. Research supported by NASA and Utah Agricultural Experiment Station. refs

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The quest to determine the maximum potential productivity of food crops is greatly benefitted by crop growth models. Many models have been developed to analyze and predict crop growth in the field, but it is difficult to predict biological responses to stress conditions. Crop growth models for the optimal environments of a Controlled Environment Life Support System (CELSS) can be highly predictive. This paper discusses the application of a crop growth model to CELSS; the model is used to evaluate factors limiting growth. The model separately evaluates the following four physiological processes: absorption of PPF by photosynthetic tissue, carbon fixation (photosynthesis), carbon use (respiration), and carbon partitioning (harvest index). These constituent processes determine potentially achievable productivity. An analysis of each process suggests that low harvest index is the factor most limiting to yield. PPF absorption by plant canopies and respiration efficiency are also of major importance. Research concerning productivity in a CELSS should emphasize: (1) the development of gas exchange techniques to continuously monitor plant growth rates and (2) environmental techniques to reduce plant height in communities.

Author

A92-20981

GROWTH OF PLANTS AT REDUCED PRESSURES - EXPERIMENTS IN WHEAT-TECHNOLOGICAL ADVANTAGES AND CONSTRAINTS

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Procedures and results are presented concerning the growth of wheat plants with variable partial pressures of O₂ and N₂. Data demonstrate that some growth occurs in pressures as low as 0.1 atmosphere. The growth was similar or higher at 200 mb (0.2 atmosphere) than in normal atmosphere but the development was different. Advantages of the low pressure cultivation, especially in the absence of nitrogen, are discussed, including better ratio volume/mass of plant cultivation module, lower losses of gases by leakage, easier management of photosynthetic oxygen produced by plants.

Author

A92-20982

GAS EXCHANGE AND GROWTH OF PLANTS UNDER REDUCED AIR PRESSURE

H.-J. DAUNICHT and H.-J. BRINKJANS (Berlin, Technische Universitaet, Federal Republic of Germany) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 107-114. refs

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This paper begins with a brief review of the few reports on methods and results on growing plants at reduced air pressure. Then a new experimental set-up is described and discussed. This set-up permits growth of plants to a total height of 35 cm. Climatic conditions and gas pressures are carefully controlled and CO₂ consumption is measured. Results with tomato plants by lowering air pressure to 400 and 700 hPa are reported and compared to plants maintained at 1000 hPa. These studies showed some growth reductions, morphological changes, and enhanced transpiration at 400 hPa.

Author

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ACHIEVING AND DOCUMENTING CLOSURE IN PLANT GROWTH FACILITIES

W. M. KNOTT, JOHN C. SAGER, and RAY WHEELER (NASA, Kennedy Space Center, Cocoa Beach, FL) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 115-123. refs

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As NASA proceeds with its effort to develop a Controlled Ecological Life Support System (CELSS) that will provide life support to crews during long duration space missions, it must address the question of facility and system closure. The concept of closure as it pertains to CELSS and engineering specifications, construction problems and monitoring procedures used in the development and operation of a closed plant growth facility for the CELSS program are described. A plant growth facility is one of several modules required for a CELSS. A prototype of this module at Kennedy Space Center is the large (7m tall x 3.5m diameter) Biomass Production Chamber (BPC), the central facility of the CELSS Breadboard Project. The BPC is atmospherically

sealed to a leak rate of approximately 5 percent of its total volume per 24 hours. This paper will discuss the requirements for atmospheric closure in the facility, present CO₂ and trace gas data from initial tests of the BPC with and without plants, and describe how the chamber was sealed atmospherically. Implications that research conducted in this type of facility will have for the CELSS program are discussed. Author

A92-20984* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
GROWING ROOT, TUBER AND NUT CROPS HYDROPONICALLY FOR CELSS

W. A. HILL, D. G. MORTLEY, P. A. LORETAN, C. K. BONSI, C. E. MORRIS (Tuskegee University, AL), C. L. MACKOWIAK, R. M. WHEELER (NASA, Kennedy Space Center, Bionetics Corp., Cocoa Beach, FL), and T. W. TIBBITTS (Wisconsin, University, Madison) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 125-131. refs
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Among the crops selected by NASA for growth in controlled ecological life-support systems are four that have subsurface edible parts: potatoes, sweet potatoes, sugar beets and peanuts. These crops can be produced in open and closed (recirculating), solid media and liquid, hydroponic systems. Fluorescent, fluorescent plus incandescent, and high-pressure sodium-plus-metal-halide lamps have proven to be effective light sources. Continuous light with 16-C and 28/22-C (day/night) temperatures produce highest yields for potato and sweet potato, respectively. Dry weight yields of up to 4685, 2541, 1151 and 207 g/sq m for potatoes, sweet potatoes, sugar beets and peanuts, respectively, are produced in controlled environment hydroponic systems. Author

A92-20985* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
APPLICATION OF SUNLIGHT AND LAMPS FOR PLANT IRRADIATION IN SPACE BASES

J. C. SAGER and R. M. WHEELER (NASA, Kennedy Space Center, Cocoa Beach, FL) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 133-140. refs
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The radiation sources used for plant growth on a space base must meet the biological requirements for photosynthesis and photomorphogenesis. In addition, the sources must be energy and volume efficient, while maintaining the required irradiance levels, spectral, spatial and temporal distribution. These requirements are not easily met, but as the biological and mission requirements are better defined, then specific facility designs can begin to accommodate both the biological requirements and the physical limitations of a space-based plant growth system. Author

A92-20987
BIOSPHERE 2 TEST MODULE - A GROUND-BASED SUNLIGHT-DRIVEN PROTOTYPE OF A CLOSED ECOLOGICAL LIFE SUPPORT SYSTEM

MARK NELSON (Institute of Ecotechnics, London, England), LINDA LEIGH, ABIGAIL ALLING, TABER MACCALLUM, JOHN ALLEN, and NORBERTO ALVAREZ-ROMO (Space Biospheres Ventures, Oracle, AZ) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances

in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 151-156. refs

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The test facility is described in a discussion of technological advances and an overview of its components, applications, and previous results. The subsystems described include: life systems for the uptake of CO₂, air-purification systems based on soil-bed reactors, water recycling systems, and technogenic outgassing. An atmospheric connection to a variable volume chamber insures exclusively outward leakage, and 65-percent photosynthetically active radiation is admitted to the module through double-laminated glass. Experiments are mentioned including studies of higher plants and human-isolation tests of up to 21 days in which all wastes were recycled and all food produced within the Biosphere 2 Test Module. Analytic technologies are employed to monitor eleven atmospheric gases during the tests, and system water quality can be studied during all phases of the tests. C.C.S.

A92-20988* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LIFE SUPPORT SYSTEMS FOR MARS TRANSIT

R. D. MACELROY, M. KLISS (NASA, Ames Research Center, Moffett Field, CA), and C. STRAIGHT (Bionetics Corp., Moffett Field, CA) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 159-166. refs

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The structural elements of life-support systems are reviewed in order to assess the suitability of specific features for use during a Mars mission. Life-support requirements are estimated by means of an approximate input/output analysis, and the advantages are listed relating to the use of recycling and regeneration techniques. The technological options for regeneration are presented in categories such as CO₂ reduction, organics removal, polishing, food production, and organics oxidation. These data form the basis of proposed mission requirements and constraints as well as the definition of what constitutes an adequate reserve. Regenerative physical/chemical life-support systems are championed based exclusively on the mass savings inherent in the technology. The resiliency and 'soft' failure modes of bioregenerative life-support systems are identified as areas of investigation. C.C.S.

A92-20989

BIOLOGICAL LIFE-SUPPORT SYSTEMS FOR MARS MISSION

IOSIF I. GITEL'SON (AN SSSR, Institut Biofiziki, Krasnoyarsk, USSR) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 167-192. refs

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A comparison of biological and physical/chemical life-support systems (LSSs) is made in the context of a Martian mission with reference to experimental methods. A biological LSS and the basic subsystems are presented, and the feasibility is discussed of continuously cultivating algae. A second biological LSS is described which relies on the use of hydrogen-oxidizing bacteria for air and H₂O regeneration. The last biological LSS is discussed in which agricultural plants are utilized, and the three systems are intercompared and contrasted with physical/chemical LSSs. Technological feasibility is established for the biological LSSs based on the use of single-cell organisms, and the importance is emphasized of the selection of the energy source. It is recommended that an international consortium develop physical/chemical and biological LSSs in parallel for subsequent comparison and selection. C.C.S.

A92-20990

C.E.B.A.S., A CLOSED EQUILIBRATED BIOLOGICAL AQUATIC SYSTEM AS A POSSIBLE PRECURSOR FOR A LONG-TERM LIFE SUPPORT SYSTEM?

V. BLUEM (Bochum, Ruhr-Universitaet, Federal Republic of Germany) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 193-204. refs

(Contract BMFT-01-QV-85474; BMFT-01-QV-87180; BMFT-01-QV-88466)

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CEBAS-Aquarack is a long-term multigeneration experimental device for aquatic organisms which is disposed for utilization in a Space Station. It results from the basic idea of a space aquarium for maintaining aquatic animals for longer periods integrated in an Aquarack which consists of a modular animal-holding tank, a semibiological/physical water-recycling system and an electronic control unit. The basic idea to replace a part of the water-recycling system by a continuous culture of unicellular algae primarily leads to a second system for experiments with algae, a botanical Aquarack consisting of an algal reactor, a water recycling and the electronic control unit. The combination of the zoological part, and the botanical part with a common control system in the Aquarack, however, results in a Closed Equilibrated Biological Aquatic System' (CEBAS) representing a closed artificial ecosystem. Although this is disposed primarily as an experimental device for basic zoological, botanical, and interdisciplinary research, it opens the theoretical possibility to adapt it for combined production of animal and plant biomass on ground or in space. The basic conception of the hardware construction of the zoological part of the system is explained, with the corresponding scientific frame program including the choice of the experimental animals, and gives some selected examples of the hardware-related research. It further discusses the practical and economical relevance of the system in the development of a controlled aquatic life-support system in general.

Author

A92-20992

BIOSPHERE 2 - A PROTOTYPE PROJECT FOR A PERMANENT AND EVOLVING LIFE SYSTEM FOR MARS BASE

MARK NELSON (Institute of Ecotechnics, London, England), JOHN P. ALLEN, and WILLIAM F. DEPSTER (Space Biospheres Ventures, Oracles, AZ) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 211-217. refs

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As part of the ground-based preparation for creating long-term life systems needed for space habitation and settlement, Space Biospheres Ventures is undertaking the Biosphere 2 project near Oracle, Arizona. Biosphere 2, currently under construction, is scheduled to commence its operations in 1991 with a two-year closure period with a crew of eight people. Biosphere 2 is a facility which will be essentially materially-closed to exchange with the outside environment. It is open to information and energy flow. Biosphere 2 is designed to achieve a complex life-support system by the integration of seven areas or 'biomass' - rainforest, savannah, desert, marsh, ocean, intensive agriculture and human habitat. Unique bioregenerative technologies, such as soil bed reactors for air purification, aquatic waste processing systems, real-time analytic systems and complex computer monitoring and control systems are being developed for the Biosphere 2 project. Its operation should afford valuable insight into the functioning of complex life systems necessary for long-term habitation in space.

It will serve as an experimental ground-based prototype and testbed for the stable, permanent life systems needed or human exploration of Mars.

Author

A92-20994

DESIGN AND OPERATION OF AN ALGAL PHOTOBIOREACTOR SYSTEM

MINOO JAVANMARDIAN and BERNHARD O. PALSSON (Michigan, University, Ann Arbor) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 231-235. refs

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A photobioreactor system was designed, constructed, and implemented to achieve efficient oxygen production for a CELSS. The special features of this system are the optical transmission system, uniform light distribution, continuous cycling of cells, gravity-independent gas exchange, and an ultrafiltration unit. The fiber-optic-based optical transmission system illuminates the reactor internally and includes a light source which is external to the reactor, preventing heat-generation problems. Uniform light distribution is achieved throughout the reactor without interfering with the turbulent regime inside. The ultrafiltration unit exchanges spent with fresh media, and its use results in very high cell densities, up to 10 exp 9 cells/ml for *Chlorella vulgaris*. The prototype photobioreactor system was operated in a batch and continuous mode for over two months. The oxygen production rate measured at 4-6 mmoles per liter of the culture per hour under continuous operation is consistent with the expected performance of the unit for the provided light intensity.

Author

A92-20995* Colorado State Univ., Fort Collins.

EVOLUTION OF A PHASE SEPARATED GRAVITY INDEPENDENT BIOREACTOR

PETER E. VILLENEUVE and ERIC H. DUNLOP (Colorado State University, Fort Collins) (Life sciences and space research XXIV/4/ - Natural and artificial ecosystems; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F10, F11, F1 and F12/ of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20969 07-54) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 5, 1992, p. 237-245. refs

(Contract JPL-958853)

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The evolution of a phase-separated gravity-independent bioreactor is described. The initial prototype, a zero head-space manifold silicone membrane based reactor, maintained large diffusional resistances. Obtaining oxygen transfer rates needed to support carbon-recycling aerobic microbes is impossible if large resistances are maintained. Next generation designs (Mark I and II) mimic heat exchanger design to promote turbulence at the tubing-liquid interface, thereby reducing liquid and gas side diffusional resistances. While oxygen transfer rates increased by a factor of ten, liquid channeling prevented further increases. To overcome these problems, a Mark III reactor was developed which maintains inverted phases, i.e., media flows inside the silicone tubing, oxygen gas is applied external to the tubing. This enhances design through changes in gas side driving force concentration and liquid side turbulence levels. Combining an applied external pressure of 4 atm with increased Reynolds numbers resulted in oxygen transfer intensities of 232 mmol O₂/l per hr (1000 times greater than the first prototype and comparable to a conventional fermenter). A 1.0 liter Mark III reactor can potentially deliver oxygen supplies necessary to support cell cultures needed to recycle a 10-astronaut carbon load continuously.

Author

A92-21151

SMART END EFFECTOR FOR DEXTEROUS MANIPULATION IN SPACE

KAZUO MACHIDA, YOSHITSUGU TODA, TOSHIKI IWATA (MITI,

Electrotechnical Laboratory, Tsukuba, Japan), and TADASHI KOMATSU (Toshiba Corp., Kawasaki, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, Jan.-Feb. 1992, p. 10-16. Previously cited in issue 21, p. 3423, Accession no. A90-47687. refs
Copyright

A92-21177**OPTIMUM VEHICLE ACCELERATION PROFILE FOR MINIMUM HUMAN INJURY**

CHARLES P. HATSELL (USAF, Armstrong Laboratory, Brooks AFB, TX) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, Jan.-Feb. 1992, p. 215-221. refs

Incidence of human injury during rapid vehicular accelerations may be reduced by employing an acceleration profile that is impulsive and of high amplitude near the beginning and end of the acceleration period and relatively smooth and of low amplitude during the interposed major time segment. This result from optimum control theory, when applied to a validated aircraft ejection seat/human occupant model, reduced by an order of magnitude the injury probability predicted by that model. An idealized acceleration model retains the essential features of the optimum solution and provides rule-of-thumb guidelines for incorporation in system design. Author

A92-21453**10 YEAR UPDATE - DIGITAL TEST TARGET FOR DISPLAY EVALUATION**

S. J. BRIGGS (Boeing Aerospace and Electronics, Seattle, WA), DAVID HEAGY (Central Intelligence Agency, Office of Development and Engineering, Washington, DC), and RON HOLMES (National Photographic Interpretation Center, Washington, DC) IN: Infrared technology XVI; Proceedings of the Meeting, San Diego, CA, July 11-13, 1990. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1990, p. 395-409. refs
Copyright

The BTP No. 4 test target is described, and evidence is presented for the hypothesis that target scores can be used to evaluate the quality of a monitor which presents images for exploitation. A correlation of 0.74 is found between average BTP No. 4 scores and image interpretability quality ratings on a monitor calibrated and set to 12 operating characteristics. Some examples of the BTP No.4 applications are given, and the advantages and drawbacks of this test target are commented on. C.D.

A92-21755* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HUMAN LIFE SUPPORT DURING INTERPLANETARY TRAVEL AND DOMICILE. IV - MARS EXPEDITION TECHNOLOGY TRADE STUDY

NARESH K. ROHATGI, JOSEPH F. FERRALL, and P. K. SESHAN (JPL, Pasadena, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 24 p. refs

(SAE PAPER 911324) Copyright

Results of trading processing technologies in a closed-loop configuration, in terms of power and weight for the Mars Expedition Mission, are presented. The technologies were traded and compared to a baseline set for functional elements that include CO₂ removal, H₂O electrolysis, potable H₂O cleanup, and hygiene H₂O cleanup. These technologies were selected from those being considered for Space Station Freedom and represent only chemical/physical technologies. Attention is given to the technology trade calculation scheme, technology data and selection, the generic modular flow schematic, and life support system specifications. R.E.P.

A92-21756* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

CONCEPTUAL DESIGNS FOR LUNAR BASE LIFE SUPPORT SYSTEMS

LIESE DALL-BAUMAN, MARYBETH EDEEN, and MARIANN BROWN (NASA, Johnson Space Center, Houston, TX) SAE,

International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 17 p. refs
(SAE PAPER 911325) Copyright

Three designs for lunar-base life support are described emphasizing the choices of individual processes for initial, intermediate, and advanced systems. Mass balances for the systems are employed to demonstrate the interactions of air, water, and waste loops, and several waste-treatment processes are considered for the initial life-support system. NASA space-station technologies are adopted for the start-up air, water, and waste treatment subsystems, and the intermediate subsystems provide enhanced capabilities. The intermediate waste-management subsystem permits the recovery of reusable waste, and the advanced system provides biological waste treatment. The reduction of resupply requirements and power use are identified as critical issues as is the ability to operate over extended periods. C.C.S.

A92-21757**PRELIMINARY ASSESSMENT OF BIOLOGICALLY-RECLAIMED WATER**

D. S. JANIK (Cetus Research, El Cerrito, CA), J. DEMARCO, S. KRISHNAN (Pyraconics Industries, Inc., San Diego, CA), and B. BENSON (Alabama, University, Huntsville) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911326) Copyright

Organic, inorganic and physical water quality data are reported for water transpired by several species of higher plants using an engineering and scientific testbed for high-fidelity, biological water reclamation and recycling. Biologically-reclaimed water met NASA Shuttle potable and Space Station/Manned Systems Integration hygiene standards with regard to parameters tested without post-treatment. Water reclaimed from 10-percent urine showed a 100-fold reduction in organics and inorganics, demonstrating the efficiency of biological water reclamation and the usefulness of this testbed for scientific and engineering studies. Author

A92-21758**BIOSPHERE 2 - DESIGN APPROACHES TO REDUNDANCY AND BACK-UP**

W. F. DEMPSTER (Space Biosphere Venture, Oracle, AZ) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs
(SAE PAPER 911328) Copyright

Biosphere 2 is a large closed ecological system nearing completion in Arizona. Various subsystems are critical to the operation and the approach to redundancy and back-up systems for synergistic advantages is described in several instances. Author

A92-21759**U.S. NAVY SUBMARINE LIFE SUPPORT SYSTEMS**

TRACY SHADLE (U.S. Navy, Naval Sea Systems Command, Washington, DC) and THOMAS DALEY (U.S. Navy, Naval Ship Systems Engineering Station, Philadelphia, PA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 12 p. refs
(SAE PAPER 911329) Copyright

Due to new technology, new requirements, and poor fleet performance the Naval Sea Systems Command has developed new life support equipment that improves safety, reliability, capability, and operability. A new atmosphere analyzer has been developed, prototyped, tested, and placed into production. Attention is given to an overview of the existing life support system, design parameters, reasons for change, concept development, testing of new equipment, transition to production, and production and fleet implementation. R.E.P.

A92-21760**A SUBMARINE ADVANCED INTEGRATED LIFE SUPPORT SYSTEM**

H. A. CARLSON and R. N. SEXAUER, II (Hamilton Standard,

Windsor Locks, CT) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p.

(SAE PAPER 911330) Copyright

An overview of the existing submarine life support equipment is presented and the payoffs offered to a submarine by implementing the Submarine Advanced Integrated Life Support System (SAILS) technologies into a next generation life support system are described. SAILS is organized around the projected capability of an electrochemical cell which simultaneously converts CO₂ to liquid organics and water to pure oxygen without the presence of gaseous hydrogen. Other technologies used in the SAILS system include a liquid CO₂ absorber, an organic water separator, and a catalytic contaminant removal system. R.E.P.

A92-21761

THE EFFECT OF REDUCED CABIN PRESSURE ON THE CREW AND THE LIFE SUPPORT SYSTEM

KRISTIN B. MCCARTHY and JAMES A. GREEN (Rockwell International Corp., El Segundo, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 7 p. refs

(SAE PAPER 911331) Copyright

The impacts of reduced atmospheric pressures on crew health, safety, and operations have been evaluated. There are no known long-term physiological or psychological impediments to living at low pressure. Cabin pressures less than 8 psi (55.16 kPa) permit the use of low pressure suits without pre-breathing, which enhances Extra-Vehicular Activity (EVA) and contingency response. Fire hazards at reduced pressures are not as severe as once feared due to the reduced thermal capacity of the gases, lack of convection, and the tendency of the flame to 'cocoon' around the 'fuel'. These factors tend to make the fire self-extinguishing. Cold plating may be necessary for thermal control of components. Analysis of gas volume, leakage, and EVA show a significant resupply cost savings and EVA operations simplification. Additional studies are required to establish the optimum cabin pressure.

Author

A92-21773* National Aeronautics and Space Administration, Washington, DC.

PROCESS CONTROL INTEGRATION REQUIREMENTS FOR ADVANCED LIFE SUPPORT SYSTEMS APPLICABLE TO MANNED SPACE MISSIONS

PAUL SPURLOCK, JACK M. SPURLOCK (S & A Automated Systems, Boca Raton, FL), and PEGGY L. EVANICH (NASA, Washington, DC) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs

(SAE PAPER 911357) Copyright

An overview of recent developments in process-control technology which might have applications in future advanced life support systems for long-duration space operations is presented. Consideration is given to design criteria related to control system selection and optimization, and process-control interfacing methodology. Attention is also given to current life support system process control strategies, innovative sensors, instrumentation and control, and innovations in process supervision. R.E.P.

A92-21777

ON-LINE MONITORING OF WATER QUALITY AND PLANT NUTRIENTS IN SPACE APPLICATIONS BASED ON PHOTODIODE ARRAY SPECTROMETRY

KENNETH J. SCHLAGER (Biotronics Technologies, Inc., Wauwatosa, WI) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 23 p. refs

(SAE PAPER 911361) Copyright

Significant needs exist for on-line real-time monitoring of water quality and hydroponic plant nutrients in regenerative life support systems. Toxic metals and organic pollutants in recirculated water are more effectively controlled by on-line monitoring. Biomass production of various crops may be enhanced by optimal control of plant nutrients. A new on-line fiberoptic spectrometer is in development that uses a combination of ultraviolet-visible

absorption measurements in combination with liquid atomic emission spectra to assay a wide variety of chemical compounds and ions in solution. Problems created by interfering, overlapping spectra are solved through the use of pattern recognition methods for multicomponent chemical analysis. This analytical instrument has been successfully applied to the analysis of 15-component plant nutrient solutions. Author

A92-21779* Lockheed Engineering and Sciences Co., Houston, TX.

ADSORBENT TESTING AND MATHEMATICAL MODELING OF A SOLID AMINE REGENERATIVE CO₂ AND H₂O REMOVAL SYSTEM

F. F. JENG, R. G. WILLIAMSON (Lockheed Engineering and Sciences Co., Houston, TX), F. A. QUELLETTE, M. A. EDEEN, and C. H. LIN (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 13 p. refs

(SAE PAPER 911364) Copyright

The paper examines the design and the construction details of the test bed built for testing a solid-amine-based Regenerable CO₂ Removal System (RCRS) built at the NASA/Johnson Space Center for the extended Orbiter missions. The results of tests are presented, including those for the adsorption breakthrough and the adsorption and desorption of CO₂ and H₂O vapor. A model for predicting the performance of regenerative CO₂ and H₂O vapor adsorption of the solid amine system under various operating conditions was developed in parallel with the testing of the test stand, using the coefficient of mass transfer calculated from test results. The results of simulations are shown to predict the adsorption performance of the Extended Duration Orbiter test bed fairly well. For the application to the RCRS at various operating conditions the model has to be modified. I.S.

A92-21782* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

FLIGHT TEST OF AN IMPROVED SOLID WASTE COLLECTION SYSTEM

W. THORNTON, H. BRASSEAU (NASA, Johnson Space Center, Houston, TX), and H. WHITMORE (Whitmore Enterprises, San Antonio, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs

(SAE PAPER 911367) Copyright

A system for human waste collection is described and evaluated on the basis of a prototype employed for the shuttle flight STS-35. The manually operated version of the unit is designed to collect, compact, and store human waste and cleaning material in replaceable volumes. The system is presented with illustrations and descriptions of the disposable pads that are used to clean the cylinder and occlusive air valves as well as seal the unit. Temporary retention and waste entrainment are provided by the variable airflow in the manual unit tested. The prototype testing indicates that sufficient airflow is achieved at 45 CFM and that the stowage volume (18.7 cu in.) is adequate for storing human waste with minimal logistical support. Higher compaction pressure and the use of a directed airstream are proposed for improving the packing efficiency of the unit. C.C.S.

A92-21790

ECLSS CONTAMINATION MONITORING STRATEGIES AND TECHNOLOGIES

S. KLINGELE (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) and G. B. TAN (ESTEC, Noordwijk, Netherlands) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. Research supported by ESA. refs

(SAE PAPER 911464) Copyright

A mobile trace gas monitoring system, consisting of a combined gaschromatograph/mass spectrometer, employing air as carrier gas, was modified and tested. Performance test results, obtained in ECLSS testbed trials and recorded during a four weeks isolation experiment of a six man crew in a test chamber, are reported. Intermediate results of a trace gas monitoring study, in which

various monitoring strategies and applicable state-of-the-art methods are investigated for their applicability to near-term and long-term manned space missions are presented. R.E.P.

A92-21792

COLUMBUS CABIN VENTILATION CONCEPT - FIRST TEST RESULTS

KARL-OTTO HIENERWADEL (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. Research supported by ESA. (SAE PAPER 911466) Copyright

Two ventilation concepts are investigated for conformity with the stringent air velocity requirements for the cabin of the Columbus module. The ventilation concepts are tested for a rectangular volume with a cross section of 2.2 x 2.2 m and a length of 4.24 m. The first concept examined utilizes the velocity of the air passing through inlet diffusers into the volume. The second concept is based on the same technique but employs additional fans within the volume to accelerate air motion. The relevant performance requirements are set forth including air velocity, maximum flow rate per diffuser, and generally uniform distribution throughout the module mock-up. Despite the difficult boundary conditions the ventilation concept in most areas of the cabin with deviations in the range of 25 percent of the allowable minimum. The test results serve as the basis for the Columbus project selecting the system without recirculation fans to be operated at the nominal flow rate during human occupancy. C.C.S.

A92-21794

CONTROL SYSTEM FOR ARTIFICIAL ECOSYSTEMS - APPLICATION TO MELISSA

CH. LASSEUR and ROGER A. BINOT (ESTEC, Noordwijk, Netherlands) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs (SAE PAPER 911468) Copyright

ESA has been investigating the design of highly compartmentalized man-made model ecosystems together with associated mathematical modelling and control functions. The advantages of compartmentalized artificial ecosystems from the viewpoint of the control system are discussed. Control requirements are formulated and an effort is made to translate these requirements into a preliminary design concept for the Micro-Ecological Life Support System Alternative (MELISSA).

R.E.P.

A92-21796* Minnesota Univ., Minneapolis.

AIRBORNE PARTICULATE MATTER AND SPACECRAFT INTERNAL ENVIRONMENTS

BENJAMIN Y. H. LIU, KENNETH L. RUBOW, PETER H. MCMURRY, THOMAS J. KOTZ (Minnesota, University, Minneapolis), and DANE RUSSO (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 13 p. refs (SAE PAPER 911476) Copyright

Instrumentation, consisting of a Shuttle Particle Sampler (SPS) and a Shuttle Particle Monitor (SPM), has been developed to characterize the airborne particulate matter in the Space Shuttle cabin during orbital flight. The SPS size selectively collects particles in four size fractions (0-2.5, 2.5-10, 10-100, and greater than 100 microns) which are analyzed postflight for mass concentration and size distribution, elemental composition, and morphology. The SPM provides a continuous record of particle concentration through photometric light scattering. Measurements were performed onboard Columbia, OV-102, during the flight of STS-32 in January 1990. No significant changes were observed in the particle mass concentration, size distribution, or chemical composition in samples collected during flight-day 2 and flight-day 7. The total mass concentration was 56 microg/cu cm with approximately half of the particles larger than 100 microns. Elemental analysis showed that roughly 70 percent of the particles larger than 2.5 microns were carbonaceous with small amounts of other elements present.

The SPM showed no temporal or spatial variation in particle mass concentration during the mission. Author

A92-21798* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

USING VAPEPS FOR NOISE CONTROL ON SPACE STATION FREEDOM

GLORIA BADILLA, THOMAS BERGEN, and TERRY SCHARTON (JPL, Pasadena, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs

(SAE PAPER 911478) Copyright

Noise environmental control is an important design consideration for Space Station Freedom (SSF), both for crew safety and productivity. Acoustic noise requirements are established to eliminate fatigue and potential hearing loss by crew members from long-term exposure and to facilitate speech communication. VAPEPS (VibroAcoustic Payload Environment Prediction System) is currently being applied to SSF for prediction of the on-orbit noise and vibration environments induced in the 50 to 10,000 Hz frequency range. Various sources such as fans, pumps, centrifuges, exercise equipment, and other mechanical devices are used in the analysis. The predictions will be used in design tradeoff studies and to provide confidence that requirements will be met. Preliminary predictions show that the required levels will be exceeded unless substantial noise control measures are incorporated in the SSF design. Predicted levels for an SSF design without acoustic control treatments exceed requirements by 25 dB in some one-third octave frequency bands. Author

A92-21804

DEVELOPMENT OF A CAPILLARY STRUCTURE FOR THE HERMES WATER EVAPORATOR ASSEMBLY

RUEDIGER MEYER and ROBERT MUELLER (MBB-ERNO Bremen, Federal Republic of Germany) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs

(SAE PAPER 911484) Copyright

An aluminum surface with capillary grooves of rectangular cross-section has been designed to enhance the axial distribution of liquid water evaporant inside the Hermes water evaporator assembly, one of the heat sinks of the active thermal control systems water cooling loop. A mathematical model was employed to predict the liquid transport performance and the heat transfer coefficients of the grooves. The evaporative heat exchanger is described; the requirements for the capillary structure are given; and a description of the setup and results of a subscale test are presented. R.E.P.

A92-21806* National Aeronautics and Space Administration, Washington, DC.

RECENT TECHNOLOGY PRODUCTS FROM SPACE HUMAN FACTORS RESEARCH

JAMES P. JENKINS (NASA, Washington, DC) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs

(SAE PAPER 911495) Copyright

The goals of the NASA Space Human Factors program and the research carried out concerning human factors are discussed with emphasis given to the development of human performance models, data, and tools. The major products from this program are described, which include the Laser Anthropometric Mapping System; a model of the human body for evaluating the kinematics and dynamics of human motion and strength in microgravity environment; an operational experience data base for verifying and validating the data repository of manned space flights; the Operational Experience Database Taxonomy; and a human-computer interaction laboratory whose products are the display software and requirements and the guideline documents and standards for applications on human-computer interaction. Special attention is given to the 'Convolutron', a prototype version of a signal processor for synthesizing the head-related transfer functions. I.S.

A92-21809

ARCHITECTURAL IDEAS RELATING TO THE QUESTION OF HUMAN BODY MOTION IN MICROGRAVITY

REGIS S. FAUQUET and JUN OKUSHI SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 23 p. refs
(SAE PAPER 911498) Copyright

Architectural issues relating to the human experience in space are considered focusing on orientation, mobility, and environmental interfaces as primary elements of architectural specifications. It is concluded that the architecture shapes the relationship between man and his environment through geometry. A geometry which differs from the rectilinearity characterizing a one-G world must be based on the human body envelope morphology. A taxonomy of body envelopes and their corresponding mobility aids constitute the primary design tools contouring the transformation of anthropomorphic body envelopes of human movements in weightlessness. O.G.

A92-21811 Lockheed Engineering and Sciences Co., Houston, TX.

MODELING OF ADVANCED ECLSS/ARS WITH ASPEN

M. KOLODNEY, K. E. LANGE (Lockheed Engineering and Sciences Co., Houston, TX), and M. A. EDEEN (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 14 p. Research supported by NASA. refs
(SAE PAPER 911506) Copyright

System-level ASPEN models were developed for the CO2 partial reduction subsystem and a bioregenerative life support subsystem (BRLSS). The individual component and subsystem models were integrated into three different system-level atmospheric revitalization subsystem (ARS) models: baseline physico-chemical, BRLSS, and partial reduction of Martian CO2. The Aspen models were based on FORTRAN interfaces necessary for integration with another program, G189A, to perform quasi-transient modeling. Detailed reactor models were prepared for the two CO2 reduction reactors (Bosch and Advanced Carbon Formation), and the low-temperature trace contaminant oxidation reactor. O.G.

A92-21812* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPUTER SIMULATION OF WATER RECLAMATION PROCESSORS

JOHN W. FISHER, T. M. HIGHTOWER, and MICHAEL T. FLYNN (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 21 p. refs
(SAE PAPER 911507) Copyright

The development of detailed simulation models of water reclamation processors based on the ASPEN PLUS simulation program is discussed. Individual models have been developed for vapor compression distillation, vapor phase catalytic ammonia removal, and supercritical water oxidation. These models are used for predicting the process behavior. Particular attention is given to methodology which is used to complete this work, and the insights which are gained by this type of model development. O.G.

A92-21814

A STUDY OF THE EFFECTS OF BIOREGENERATIVE TECHNOLOGY ON A REGENERATIVE LIFE SUPPORT SYSTEM

STEPHEN R. GUSTAVINO (McDonnell Douglas Space Systems Co., Huntington Beach, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 13 p. refs
(SAE PAPER 911509) Copyright

Computer simulations for modeling a functioning controlled ecological life support system (CELSS) based on bioregenerative technology are discussed, and the effects of bioregenerative technology on an initial lunar outpost are examined. Computer simulations provide a mathematical test-bed for life support system design concepts. A general understanding of human and plant

physiology was used to develop a mathematical relationship describing the performance of these bioprocessors. Computer models were constructed for advanced environmental control and life support system configurations. It is concluded that the implementation of CELSS in a lunar outpost will result in increased self-sufficiency. O.G.

A92-21815

PLANT GROWTH MODELING AND THE DESIGN OF EXPERIMENTS IN THE DEVELOPMENT OF BIOREGENERATIVE LIFE SUPPORT SYSTEMS

ROBERT J. SIRKO (McDonnell Douglas Space Systems Co., Huntington Beach, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 15 p. refs
(SAE PAPER 911510) Copyright

An approach to plant modeling that incorporates plant and environment interactions and that is driven by the requirements of designing and evaluating controlled ecological life support systems (CELSS) has been developed. The approach described in this paper takes advantages of well-known analytical features of smoothly varying functions to construct an empirical model of the physiological response of plants to their environment. The model combines an emphasis on empirical data gathering to specify the plant response to nominal and near-normal values of environmental control variables with general analytical relations that strictly hold for well-defined and behaved functions. Thus the same model is used for a variety of plant species and growing conditions, and numerical coefficients within the model define specific plant characteristics. The model development also suggests efficient experimental designs for collecting controlled environment plant response data. Examples of these experimental designs are also presented. Author

A92-21816

OPTIMIZATION OF CROP GROWING AREA IN A CONTROLLED ENVIRONMENTAL LIFE SUPPORT SYSTEM

GARY W. GLOVER, LAURA E. DYER, and JAMES B. BLACKMON (McDonnell Douglas Space Systems Co., Huntington Beach, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 12 p. Research supported by McDonnell Douglas Space Systems Co. refs
(SAE PAPER 911511) Copyright

Numerical optimization techniques based on the OPTDES code were applied to optimal crop selection for a controlled environmental life support system (CELSS). The OPTDES code used in conjunction with the crop production data and nutritional requirements is considered to be an effective means of assessing CELSS options and determining the types of crops which best meet nutritional needs and have minimum growing area. Eleven candidate crops were combined with a nutritional code and selected nutritional requirements. Soybean, tomato, potato, and peanut crops are found to be the best suppliers of energy nutrients, and carrot, chard, and lettuce provide higher amounts of vitamin A and calcium in a smaller area. O.G.

A92-21817 California Univ., Berkeley.

VISUAL FACTORS AFFECTING HUMAN OPERATOR PERFORMANCE WITH A HELMET-MOUNTED DISPLAY

ANDREW LIU, GREGORY THARP, MICHITAKA HIROSE, and LAWRENCE STARK (California, University, Berkeley) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs
(Contract NCC2-86; JPL-956873)
(SAE PAPER 911389) Copyright

Three factors are discussed that could alter human operators' perceptions of a remote worksite and adversely affect their task performance. The effect is discussed of image degradation on task performance. The experimental results are similar to corresponding visual-psychophysical experimental results, suggesting that the psychophysical results might be helpful for predicting the performance under other viewing conditions. The second factor is the control of the different viewing parameters.

Dynamic control can be disorienting, but if the parameters are fixed the operator need not feel telepresent. The interface through which the parameters are controlled is considered, including the advantages of using a helmet-mounted display. The third factor, the display-update rate, can be affected by hardware limitations, transmission delays, or long-rendering times. By understanding the effects of these factors, interfaces that efficiently convey information about the remote environment to the operator can be built.

Author

A92-21818* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THREE-DIMENSIONAL TRACKING WITH MISALIGNMENT BETWEEN DISPLAY AND CONTROL AXES

STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field, California, University, Berkeley, CA), MITCHELL TYLER, WON S. KIM, and LAWRENCE STARK (California, University, Berkeley) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs (SAE PAPER 911390) Copyright

Consideration is given to experiments for examining 3D pursuit tracking when operators of teleoperation simulations are faced with misalignment between the display and control frames of reference. It is concluded that manual 3D pursuit tracking errors produced by display-control rotational misalignments have two linearly separable components: a purely visual component and a visual-motor component. Both components may independently influence the tracking performance. Human subjects can simultaneously adapt to a variety of display-control misalignments if position control during pursuit tracking is used with a simulation update rate of at least 30 Hz. This capability will enable trained operators to quickly adapt to changes in the position and orientation of viewing cameras during teleoperation and telemanipulation.

O.G.

A92-21820
IMAGE CYCLOTROTATION, CYCLOVERGENCE AND PERCEIVED SLANT

IAN P. HOWARD (York University, Toronto, Canada) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs (SAE PAPER 911392) Copyright

Dynamics of human cyclovergence has been measured and shown to compensate well for low amplitude, low frequency a torsional misalignments of binocular images. It is concluded that torsional misalignment of binocular images of a few degrees and up to a frequency of about 0.2 Hz will be largely corrected by the cyclovergence of the eyes. Uncorrected torsional misalignments of images will not cause large textured scenes to appear slanted but may cause vertical lines or objects to appear slanted. The perceived slant of a vertical test line is a valid measure of the relative cyclodisparity between the test line and the cyclorotated background. Torsionally misaligned images can be most precisely brought into orientational alignment by rotating them until a vertical line viewed binocularly through semisilvered mirrors has zero slant.

O.G.

A92-21821* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ADVANCED TELEOPERATION - PROGRESS AND PROBLEMS

ANTAL K. BEJCZY (JPL, Pasadena, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs (SAE PAPER 911393) Copyright

A dual-arm Advanced Teleoperation System (ATOPS) was developed at JPL to demonstrate and evaluate performance capabilities of computer and sensing aided teleoperation. This paper gives a brief overview of the system and briefly describes some of the generic and application-oriented performance experiments together with the major results. A major conclusion is that the new advanced technical features of the system should be properly integrated with or interfaced to the natural features of

human operations in order to produce an improved overall system and task performance capability.

Author

A92-21822 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALYSIS OF AN INITIAL LUNAR OUTPOST LIFE SUPPORT SYSTEM PRELIMINARY DESIGN

MARK G. BALLIN, WILLIAM C. LIKENS, CORY K. FINN, VINCENT J. BILARDO, JR. (NASA, Ames Research Center, Moffett Field, CA), and YAT S. NG (Sterling Federal Systems, Inc., Palo Alto, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 19 p. Research sponsored by NASA. refs (SAE PAPER 911395) Copyright

A preliminary design of a life-support system (LSS) was developed as part of an ongoing comprehensive trade study of advanced processor technologies and system architectures for an initial lunar outpost. The design is based on a mission scenario requiring intermittent occupation of a lunar-surface habitat by a crew of four. It incorporates physiochemical process technologies that were considered for Space Station Freedom. A system-level simulation model of the design was developed to obtain steady-state material balances for each LSS processor. The mass-flow rate predictions were used to obtain estimates of the LSS mass, volume, and power consumption by means of processor-sizing correlations that were extrapolated from Space Station Freedom processor designs. The results were used to analyze the impacts of varying crew size, mission duration, processor-operation strategy, and crew-cabin loads on the LSS mass, average power consumption, volume, periodic resupply mass, and waste-accumulation rates. The merits of the design were quantified relative to an open-loop LSS, and the implications of this assessment for future LSS research and technology development were identified.

Author

A92-21823 Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HARDWARE SCALEUP PROCEDURES FOR P/C LIFE SUPPORT SYSTEMS

ROHATGI NARESH, P. K. SESHAN, JOSEPH FERRALL (JPL, Pasadena, CA), MARK G. BALLIN, and VINCENT J. BILARDO (NASA, Ames Research Center, Moffett Field, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 17 p. refs (SAE PAPER 911396) Copyright

This paper compares scaleup correlations developed at the Jet Propulsion Laboratory and at the Langley Research Center for various life-support hardware to estimate mass, volume, and power-consumption values as a function of feed or product-mass flow rates. The scaleup correlations are provided for a few selected advanced life-support technologies developed for the Space Station Freedom. In addition, correlation-validity limits and sources of data on various life-support hardware are also discussed.

Author

A92-21824
USING SIMULATION MODELING FOR COMPARING THE PERFORMANCE OF ALTERNATIVE GAS SEPARATOR-FREE CELSS DESIGNS AND CROP REGIMENS

MELVIN N. COBB and STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 15 p. refs (SAE PAPER 911397) Copyright

A general-purpose life support system simulator was used to evaluate several CELSS design and operation approaches. The simulator was used to investigate CO₂ generation and removal interactions occurring between the CELSS food production subsystem and the rest of the system. It is concluded that crops with a short maturation time are desirable for minimizing the amplitude and duration of most CELSS transients. Various kinds of CO₂ transients (startup, crop failure, or crew size change) may be mitigated by scheduling a special large planting of fast growing vegetative crops. The large initial planting will give an increased

CO2 removal capacity initially, and continual harvesting will gradually thin the number of growing plants to an appropriate number for steady state conditions. O.G.

A92-21825**PRIORITIZING AUTOMATION AND ROBOTICS APPLICATIONS IN LIFE SUPPORT SYSTEM DESIGN**

STEVEN H. SCHWARTZKOPF (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs
(SAE PAPER 911398) Copyright

Operational, servicing, and maintenance tasks anticipated for a controlled ecological life support system are described using data from the Soviet Bios experiments. The data show that the Bios higher plant culture system operations required about 6.2 crew-hours per day, the algal culture system operations required approximately 7.5 crew-hours per day, and miscellaneous domestic operations required about 7.5 crew-hours per day. Based upon potential reduction in crew time requirements, a recommended prioritization for the automation and robotics applications for a plant growth system includes nutrient solution maintenance, plant observation, planting/harvesting, and preventive maintenance. A recommended prioritization for the application of automation and robotics to algal reactor procedures includes nutrient solution preparation, culture observation, culture sampling and analysis, and preventive maintenance. O.G.

A92-21826**PRELIMINARY ANALYSIS OF LIFE SUPPORT RESOURCES AND WASTES AS RADIATION SHIELDING**

SUSAN C. DOLL and MATTHEW H. APPLEBY (Boeing Defense and Space Group, Seattle, WA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs
(SAE PAPER 911399) Copyright

Life support and radiation shielding are two critical technologies for manned exploration missions. For long duration missions, life support resources, such as water and food, must be provided to keep the crew alive and shelter must be provided to protect the crew from radiation. The large amounts of food and water required for long duration missions have been the major reason for developing closed loop life support systems. However, preliminary findings indicate that food and water can be effective as radiation shielding and may result in significant mass savings over dedicated shielding. This dual use of life support resources overall system mass as well as the mass penalty associated with open loop life support. Author

A92-21832**SMALL LIFE SUPPORT SYSTEM FOR FREE FLYER**

TOSHIYOSHI KIMURA, HARUHI SHIMIZU, YOSHIHITO NISHIO, MASAHIRO TAKAYANAGI, NAOTO KAWASE (Fujitsu, Ltd., Tokyo, Japan), MASAMICHI YAMASHITA, and AKEMI IZUMI-KUROTANI (Institute of Space and Astronautical Science, Sagami-hara, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911428) Copyright

A self-contained closed-loop life support system has been developed for biological experiments conducted on the Japanese Space Flyer Unit (SFU). The modular and flexible system design is described, and the experiment's objectives regarding the effects of microgravity and space environment on the development of fertilized eggs are reviewed. The life support system and the control and information system are described. C.D.

A92-21833**STUDY OF OXYGEN GENERATION SYSTEM FOR SPACE APPLICATION**

H. ISHIDA, T. SHOJI (Kawasaki Heavy Industries, Ltd., Kobe, Japan), and Y. KITAZAWA (Chlorine Engineers Corp., Ltd., Japan) SAE, International Conference on Environmental Systems,

21st, San Francisco, CA, July 15-18, 1991. 8 p. refs
(SAE PAPER 911429) Copyright

The development status of an oxygen generation system for space applications which uses a new solid polymer electrolyte and simplified cell structure is described. A tradeoff study of water feed methods and the combination of electrodes with electrolyte membranes is reviewed, and the selection of a cathode liquid feed and the use of the zero-gap technique to make electrode membranes is explained. C.D.

A92-21834**CONCEPTUAL DESIGN OF SNAIL BREEDER ABOARD SPACE VEHICLE**

T. FUJII, Y. MIDORIKAWA (JGC Corp., Tokyo, Japan), A. OHIRA (Institute of Highland Agriculture, Japan), and KEIJI NITTA (National Aerospace Laboratory, Tokyo, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911430) Copyright

A snail-breeding module is described which will serve as a subsystem of the Closed Ecological Life Support System (CELSS), providing the space crew with animal nutrients. Automated operations for feeding the animals, treating their wastes, and taking care of their offspring are described. A submodule which processes the snails for food production is also presented. C.D.

A92-21835**LIFE SUPPORT CONCEPT IN LUNAR BASE**

KEIJI NITTA (National Aerospace Laboratory, Tokyo, Japan) and HISAO HABUKA (Institute for Future Technology, Tokyo, Japan) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911431) Copyright

In order to support NASA's Space Exploration Initiative, an independent conceptual study of a man-tended lunar outpost has been conducted by a NASDA group. This paper discusses the required area for habitation, the structure of a permanent lunar base, and the life support system to be installed in each module. The designs of the modules are shown, including plantation module, habitat modules, and a closed ecological experimental facility. A material recycling system for the plantation module is shown and module subsystems are listed. C.D.

A92-21838**THE IMPACT OF ADVANCED GARMENTS ON PILOT COMFORT**

GARY T. RUNGE (McDonnell Aircraft Co., Saint Louis, MO) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs
(SAE PAPER 911442) Copyright

A combined physiological and cockpit model was used to study temperatures and perspiration rates of pilots wearing (1) a counterpressure vest, and (2) a chemical and biological warfare suit. Flow velocities at the pilots were also considered, and an advanced personal equipment cooling concept was investigated in addition to traditional methods of air-cooling the pilots. The results show that the garments insulate the pilot to such an extent that traditional air cooling is not adequate to maintain pilot comfort, in that the pilot could not adequately perform his mission duties due to impairment by thermal discomfort or stress. The advanced personal equipment concept provided adequate cooling without extremely high-velocity air impinging on the pilot. C.D.

A92-21840**COLUMBUS ECS AND RECENT DEVELOPMENTS IN THE INTERNATIONAL IN-ORBIT INFRASTRUCTURE**

H. P. LEISEIFER, G. SARRI (ESTEC, Noordwijk, Netherlands), S. VENERI, S. DOLCE (Alenia Spazio S.p.A., Turin, Italy), and K. O. HIENERWADEL (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 16 p. refs
(SAE PAPER 911444) Copyright

The role of the Environmental Control System in the international

in-orbit infrastructure, including the Space Station Freedom with the Columbus Attached Laboratory, the Free-Flying Laboratory, Hermes, and the Ariane-5 launcher, is discussed in the context of recent developments. Recent development objectives for these infrastructures are reviewed, giving special attention to resource management for payload and housekeeping heat loads, the use of the recirculation fans in cabin ventilation, and the distributed air cooling concept for the Columbus Attached Laboratory. C.D.

A92-21841

THE COLUMBUS FREE FLYER THERMAL CONTROL AND LIFE SUPPORT

U. LAUX, B. BEHRENS, H. P. HAFKEMEYER, and B. MIEDZA (MBB-ERNO, Bremen, Federal Republic of Germany) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 15 p. Research supported by ESA.

(SAE PAPER 911445) Copyright

The thermal control and life support design of the Columbus Free Flyer (FF) are described. The design and functioning of the FF active and passive thermal control are examined, and the FF thermal and atmosphere condition requirements are given. The design and function of the FF environmental control and life support subsystem are described. C.D.

A92-21852

ZOONoses AND ENCLOSED ENVIRONMENTS

GARY N. JOINER (Texas A & M University, College Station) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 6 p. refs

(SAE PAPER 911513) Copyright

The likelihood of transmission of potential disease agents between animals and man during spaceflight is a real concern. Development of disease exclusion lists for animals and refinement of animal containment units have been the principal means of providing protection to the crew members. Awareness of potential latent infections and a judicious use of the higher risk category of animals such as wild-caught nonhuman primates provides another level of protection. Use of high efficiency filters, gasketing, and differential air pressures have all enabled increasing levels of safety through containment of potential aerosol escape from animal habitats. Author

A92-21855* Krug Life Sciences, Inc., Houston, TX. DISINFECTANTS FOR SPACECRAFT APPLICATIONS - AN OVERVIEW

DAVID W. KOENIG, LAURA L. MALLARY (Krug Life Sciences, Inc., Houston, TX), and DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 17 p. refs

(SAE PAPER 911516) Copyright

The review of disinfectants for use on manned missions emphasizes the need for contamination control to prevent the detrimental effects of bacteria growth on crew health. Microbial control is possible by means of biocides, but the selected product has to meet stringent toxicity requirements for the small environments in spacecraft. The testing and evaluation is described of four biocide candidates: hydrogen peroxide, quaternary ammonium compounds, iodine, and glutaraldehyde. The effectiveness of the disinfectants are analyzed in terms of the ability to treat typical microbial counts from Skylab missions in a closed environment. It is shown that many biocide candidates are not compatible with the ECLSS, water-recovery management, and air-revitalization subsystems of the Space Station Freedom. The use of hydrogen peroxide is proposed with a secondary stronger agent for microbial spills from biological experiments. C.C.S.

A92-21856

RATIONALE FOR COMMON CONTAMINATION CONTROL GUIDELINES FOR CREW HABITATION AND LIFE SCIENCES RESEARCH

TERI SCHNEPP, PAUL WARD-DOLKAS, and CYNTHIA HAVENS

(Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 8 p. refs
(SAE PAPER 911517) Copyright

The Augustine advisory committee on the future of the U.S. Space Program has recommended that 'Space Station Freedom be revamped to emphasize life sciences and human space operations'. An important component of life sciences research involves the housing, care and maintenance of research specimens. Microbial and odor contamination control measures are necessary to ensure that cross contamination between the crew and specimens is controlled and limited. The bioisolation requirements being applied to life sciences specimen handling facilities are more stringent than those applied in the past. This paper examines the designs and operational features which have been used during previous spaceflight missions to contain and control crew and research specimen wastes. Because crew wastes also require microbial and odor control, the same measures which are used to control crew wastes may be directly applied in a cost-effective, minimal-risk manner to controlling contamination generated by research specimens. Author

A92-21857

THE APPLICATION OF STERILE FILTRATION TECHNOLOGY IN THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS OF SPACE STATION FREEDOM

PAUL I. KEYSER and GLENN W. HOWARD (Pall Corp., Glen Cove, NY) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 9 p. refs
(SAE PAPER 911518) Copyright

The major subsystems for air, water, and temperature and humidity control of the Environmental Control and Life Support Systems designed for Space Station Freedom will require control of particulate and microbial contaminants, that can be achieved by appropriately placed microbially retentive filters. This paper reviews state of the art technologies of gas and liquid filtration used in the semiconductor, pharmaceutical, health-care, and food/beverage industries and discusses the ways in which similar advanced filtration technology can be adapted for Space Station Freedom. Using these technologies, liquids can be filtered to exclude particles that are 0.04 micron in size, and gases can be filtered to exclude particles as small as 0.01 micron. I.S.

A92-21858* Harvard Univ., Cambridge, MA. CORROSION CONSEQUENCES OF MICROFOULING IN WATER RECLAMATION SYSTEMS

TIM FORD and RALPH MITCHELL (Harvard University, Cambridge, MA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p. refs
(Contract NCC8-17)

(SAE PAPER 911519) Copyright

This paper examines the potential fouling and corrosion problems associated with microbial film formation throughout the water reclamation system (WRS) designed for the Space Station Freedom. It is shown that the use of advanced metal sputtering techniques combined with image analysis and FTIR spectroscopy will present realistic solutions for investigating the formation and function of biofilm on different alloys, the subsequent corrosion, and the efficiency of different treatments. These techniques, used in combination with electrochemical measurements of corrosion, will provide a powerful approach to examinations of materials considered for use in the WRS. I.S.

A92-21859

TPX - TWO-PHASE EXPERIMENT FOR GET AWAY SPECIAL G-557

A. A. M. DELIL, J. F. HEEMSKERK (National Aerospace Laboratory, Amsterdam, Netherlands), and W. SUPPER (ESTEC, Noordwijk, Netherlands) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs
(SAE PAPER 911521) Copyright

Mechanically and capillary pumped two-phase heat transport systems are currently developed to meet the high power and long

transport distance requirements of thermal management systems for future spacecraft. As two-phase flow and heat transfer in a low-gravity environment is expected to (considerably) differ from terrestrial behavior, the technology of two-phase heat transport systems and their components has to be demonstrated in orbit. Therefore a Dutch-Belgian two-phase experiment (TPX) is being developed within the ESA In-Orbit Technology Demonstration Program TDP1. TPX concerns a two-phase ammonia system in the Get Away Special canister G-557. The system is a downscaled capillary pumped two-phase loop. It includes downscaled versions of mechanically pumped two-phase loop components: multichannel condensers and vapor quality sensors (plus a controllable 3-way valve for control exercises). The critical design review status of TPX is discussed. Author

A92-21864

COLOURS: FROM THEORY TO ACTUAL SELECTION - AN EXAMPLE OF APPLICATION TO COLUMBUS ATTACHED LABORATORY INTERIOR ARCHITECTURAL DESIGN

ENRICO GAIA, FABIANA BOBBA, and DAVID ANTONELLI (Alenia Spazio S.p.A., Turin, Italy) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 11 p. refs

(SAE PAPER 911532) Copyright

The paper presents an analysis of the color concept and discusses color systems and physiological processes related to the shape and color perception, followed by the topological analysis of the Columbus Attached Laboratory internal architecture based on the application of the theory of color to the system configuration. The methodology of tests carried out to assess the color choices is described. The results are used to design two palettes of colors for interior surfaces, on the basis of which a list of seven colors is selected for the application to the Columbus Attached Pressurized Module habitability mock-up. I.S.

A92-21870

MODELLING APPROACH FOR THE THERMAL/ENVIRONMENTAL SYSTEM OF THE COLUMBUS ATTACHED PRESSURISED MODULE

RUGGERO VENERI, VINCENZO PUGLIESE, EUGENIO GARGIOLI, and CESARE LOBASCIO (Alenia Spazio S.p.A., Turin, Italy) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 15 p.

(SAE PAPER 911546) Copyright

The modeling approach selected for the Thermal/Environmental Control System of the Columbus Attached Pressurized Module is described. The approach uses an integrated overall thermal mathematical model (TMM) together with a set of additional TMMs for detailed tasks. The overall TMM, (up to 900 nodes, written in ESATAN) allows the element thermal balance verification and the provision of the sink and interface temperatures for the equipment thermal design. Other TMMs include the simplified active TMM (up to 150 nodes, written in ESACAP) and the local thermohydraulic models (up to 250 nodes each, written in ESATAN-FHTS). It is shown that the use of a set of several models for an extensive analysis task on a complex station is preferable to the use of one very large model. I.S.

A92-21896

SPACE STATION FREEDOM RESOURCE NODE STATUS - FIRST QUARTER 1991

RAYMOND J. LEVESQUE, II and JOHN B. LAUGER (McDonnell Douglas Space Systems Co., Space Station Div., Huntington Beach, CA) SAE, International Conference on Environmental Systems, 21st, San Francisco, CA, July 15-18, 1991. 10 p.

(SAE PAPER 911595) Copyright

The paper discusses the outfitting of the Resource Nodes for Space Station Freedom. The driving functional and design requirements are discussed briefly in relation to the current overall configuration and internal outfitting. The major features of the Resource-Node internal architecture, distributed system packaging, crew accommodations, utility distribution, and the centrifuge facility are described. This current design approach meets the program

requirements for crew accommodations, on-orbit maintainability, and growth of the re-structured Space Station Freedom over its projected 30-year life. Author

A92-22099

EMERGENT FEATURES IN VISUAL DISPLAY DESIGN FOR TWO TYPES OF FAILURE DETECTION TASKS

MARY A. BUTTIGIEG and PENELOPE M. SANDERSON (Illinois, University, Urbana) Human Factors (ISSN 0018-7208), vol. 33, Dec. 1991, p. 631-651. refs

Copyright

Visual display design for dynamic systems may be helped by exploiting emergent features that allow subjects to easily distinguish different states of the system. Three different types of displays were compared - two object displays and one separated display - each in a version that had a salient emergent feature that distinguished normal and failed states and in a version that did not have such an emergent feature. Subjects are monitored for global and local failures simultaneously, which presented demands similar to integrated and separated tasks, respectively. Displays with salient emergent features supported superior global failure detection and may also have helped local failure detection. An object display with a salient emergent feature supported both types of failures better than or at least as well as the other displays. This advantage was attributed to the fact that the display had a salient emergent feature rather than to the fact that it was an object display. This research shows that emergent features can be effectively exploited to support tasks involving both integration of information and attention to individual data sources. Author

A92-22100

USING THE SUBJECTIVE WORKLOAD DOMINANCE (SWORD) TECHNIQUE FOR PROJECTIVE WORKLOAD ASSESSMENT

MICHAEL A. VIDULICH (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), G. F. WARD (USAF, Crew Station Evaluation Facility, Wright-Patterson AFB, OH), and JAMES SCHUEREN (USAF, F-16 System Program Office, Wright-Patterson AFB, OH) Human Factors (ISSN 0018-7208), vol. 33, Dec. 1991, p. 677-691. Research supported by USAF. refs

Copyright

The present study examined the utility of the Subjective Workload Dominance (SWORD) technique as a projective workload tool. Two groups predicted the workload associated with using six possible head-up display (HUD) formats. One group contained college students inexperienced with HUDs, and the second group contained operational F-16 pilots who commonly used HUD displays but were familiar with only one format. The projective ratings from these groups were correlated with retrospective ratings from a group of operational F-16 pilots that had experienced all six formats in a simulator study. The correlation between the projective and retrospective groups of pilots was highly positive, and both groups' ratings correlated positively with the simulator study performance. In contrast, the student ratings were not significantly correlated with the ratings from either of the other groups, nor was performance. The results support the utility of the SWORD technique as a projective tool, provided a group of subject matter experts is available to make the required judgments. Author

A92-23325* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

WASTE STREAMS IN A CREWED SPACE HABITAT

T. WYDEVEN and M. A. GOLUB (NASA, Ames Research Center, Moffett Field, CA) Waste Management and Research (ISSN 0734-242X), vol. 9, 1991, p. 91-101. Previously announced in STAR as N90-28333. refs

Copyright

A judicious compilation of generation rates and chemical compositions of potential waste feed streams in a typical crewed space habitat was made in connection with the waste-management aspect of NASA's Physical/Chemical Closed-Loop Life Support Program. Waste composition definitions are needed for the design

of waste-processing technologies involved in closing major life support functions in future long-duration human space missions. Tables of data for the constituents and chemical formulas of the following waste streams are presented and discussed: human urine, feces, hygiene (laundry and shower) water, cleansing agents, trash, humidity condensate, dried sweat, and trace contaminants. Tables of data on dust generation and pH values of the different waste streams are also presented and discussed. Author

A92-23657

DESIGN AND DEVELOPMENT STATUS OF THE JEMRMS

K. KURAOKA (NASDA, Tokyo, Japan), K. GOMA, T. SUMI, and R. OKAMURA (Toshiba Corp., Space Programs Div., Kawasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 23-26. refs

The JEM Remote Manipulator System (RMS) under development for the Space Station Freedom is described in terms of the status and salient characteristics of the design. Two manipulators are delineated which include a 10-m primary arm and a 2-m small fine arm intended for, respectively, transfer operations and dexterous tasks. The automatic control mode of the larger main arm is discussed although, manual input is also possible with a six-DOF hand controller. The small arm is manually operated, and the system is described in terms of the bilateral and master-slave modes that are available. Feedback force for both arms can be detected by a force-moment sensor, and several tests are described to examine the specific components. A 2D functional model is illustrated that has verified some of the primary precepts of the JEMRMS project designs. C.C.S.

A92-23660* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

FTS - NASA'S FIRST DEXTEROUS TELEROBOT

HARRY G. MCCAIN (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 37-40.

NASA development and use of the Space Station Flight Telerobotic Servicer (SSFTS) is described. The SSFTS is a robotic device that combines the capability to be teleoperated (operates under the constant command of a human operator) and to be autonomous (performs mostly by itself but under the supervision of a human operator). Plans call for the SSFTS to assist the astronauts in the assembly, maintenance, servicing, and inspection of Space Station Freedom. The project forms the basis for combining teleoperational and robotics technologies and for rapidly applying the evolving technologies to government and commercial ventures in space and on earth. Author

A92-23662* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

HIGHLIGHTS OF NASA RESEARCH IN TELEROBOTICS

C. R. WEISBIN and J. F. STOCKY (JPL, Pasadena, CA) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 45-48. refs

This paper provides a brief overview of the NASA program of research in telerobotics. It describes ongoing effort in a number of participating laboratories investigating topics in human-machine interaction, intelligent task planning and execution, dual-arm control of manipulators with redundant degrees-of-freedom, sensing and perception. A brief list of illustrative references is provided. Author

A92-23665* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ANTHROPOMORPHIC DUAL-ARM SPACE TELEMANIPULATION SYSTEM

BRUNO M. JAU (JPL, Pasadena, CA) IN: i-SAIRAS '90;

Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 61-64. refs

Dexterous dual-arm manipulations are feasible with the system described and illustrated in the paper. The structure is based on an extensible host arm that carries the dual-arm robot which comprises two 7-DOF arms each of which includes a hand with a thumb and three fingers with 4 DOF each. Joint compliance can be stiffened to any level, and the operator uses arm harnesses and gloves to utilize the robotics in an anthropomorphic fashion. The configuration eliminates coordinate-transformation computations, and the system is found to achieve a control-frequency rate of 1000 Hz for its direct man/machine interfaces based on fiber-optic cables. The electronics control for the system utilizes a sensory system consisting of force, position, and compliance sensors. The robotics system is expected to be a user-friendly device that permits assembly, repair, tethering, and other complex mechanical operations. C.C.S.

A92-23666

DEVELOPMENT OF DUAL ARM TELEOPERATED SYSTEM FOR SEMIAUTONOMOUS ORBITAL OPERATIONS

HIROSHI KOYAMA, HIROYUKI TAMURA, KYOUSUKE KAWABATA, and NORIMASA YOSHIDA (Mitsubishi Electric Corp., Kamakura Works, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 65-68. refs

This paper deals with several concepts to facilitate the development of a practical teleoperated system for semiautonomous dual-arm space robots. The concept of local arm-control functions and problems related to the handling object's design and object-handling sequences are presented and discussed. A dual-arm teleoperated system is described to confirm the present approach to the problem. Truss-structure assembly experiments are performed for this purpose. Author

A92-23667* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

EVOLUTION OF THE FLIGHT TELEROBOTIC SERVICER

RONALD LUMIA (NIST, Gaithersburg, MD) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 69-72. refs (Contract NASA ORDER S-28187-D)

The Flight Telerobotic Servicer (FTS) is a two-armed manipulator which will be used to build and maintain Space Station Freedom. One of the goals of the project is to be able to upgrade the capabilities of the FTS by incorporating new technology. To achieve this goal, the FTS is using the NASA/NIST Standard Reference Model for Telerobot Control System Architecture (NASREM) for its functional architecture. While using NASREM helps integrate new technology into the system, the decisions concerning the precise technology needing development must be addressed. In this paper, an approach to the technological evolution of the FTS will be explored. The approach begins with detailed scripts of representative FTS activities. These scripts are analyzed to determine the generic or common actions performed by the FTS. Then, technological alternatives are described in terms of a decision tree format. Author

A92-23668

RESEARCH AND EXPERIMENT OF ACTIVE COMPLIANCE END EFFECTOR (ACE)

YOSHITUGU TODA, TOSHIKI IWATA, KAZUO MACHIDA (Electrotechnical Laboratory, Tsukuba, Japan), TADASHI KOMATSU, CHIAKI HONDA, and KAZUHITO KASUGA (Toshiba Corp., Kawasaki, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 73-76.

The development of a smart end effector is expected to perform precise on-orbit activity by space robots instead of EVA by

astronauts. The Active Compliance End effector (ACE) is developed as a step of the research of the future space robotics technologies. The ACE mainly consists of an effector mechanism, controller, gripper, proximity sensor and force/torque sensor. The experimental demonstrations of on-orbit high functional tasks using ACE, such as 'pin insertion', 'flying-target capture' and others are performed on the 2D air-bearing table at ETL. The experimental tests regarding position/velocity feedback control, velocity feedforward compensation, and force/torque feedback control are performed and confirm the feasibility and applicability of space robot system in the future. Author

A92-23669

AUTONOMOUS CAPTURE EXPERIMENT OF FREE-FLYING TARGET ON THE ZERO GRAVITY SIMULATOR

HARUHIKO SHIMOJI, MASAO INOUE, KAZUO TSUCHIYA (Mitsubishi Electric Corp., Amagasaki, Japan), KEIKEN NINOMIYA, ICHIRO NAKATANI, and JUN'ICHIRO KAWAGUCHI (Institute of Space and Astronautical Science, Sagami-hara, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 77-80. refs

This paper presents a developed experimental robot system that can recognize target position and control a manipulator accordingly. The algorithm for recognizing the position and the orientation of the target from visual information using extended Kalman filter is proposed. The algorithm to control the manipulator according to these information is proposed. Finally, automatic capture experiments of the free-flying target on the 6-DOF zero-gravity simulator where the relative motion between the robot and the target exists are presented. The validity of the proposed algorithms is confirmed in the experiments. Author

A92-23700* National Aeronautics and Space Administration, Washington, DC.

EXPERIMENTS IN TELEOPERATOR AND AUTONOMOUS CONTROL OF SPACE ROBOTIC VEHICLES

HAROLD L. ALEXANDER (MIT, Cambridge, MA) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 217-220. Research supported by MIT. refs (Contract NAGW-21)

A research program and strategy are described which include fundamental teleoperation issues and autonomous-control issues of sensing and navigation for satellite robots. The program consists of developing interfaces for visual operation and studying the consequences of interface designs as well as developing navigation and control technologies based on visual interaction. A space-robot-vehicle simulator is under development for use in virtual-environment teleoperation experiments and neutral-buoyancy investigations. These technologies can be utilized in a study of visual interfaces to address tradeoffs between head-tracking and manual remote cameras, panel-mounted and helmet-mounted displays, and stereoscopic and monoscopic display systems. The present program can provide significant data for the development of control experiments for autonomously controlled satellite robots. C.C.S.

A92-23717

APPLICATIONS OF HYPER-REDUNDANT MANIPULATORS FOR SPACE ROBOTICS AND AUTOMATION

GREGORY S. CHIRIKJIAN and JOEL W. BURDICK (California Institute of Technology, Pasadena) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 291-294. refs

The development of hyperredundant (snake-like) manipulators is examined and considered in terms of applying these complex kinematics to space-based robotics. Attention is given to the need for suitable actuator technologies for the hyperredundant approach, and developments are described in such areas as obstacle

avoidance, locomotion, grasping, and end-effector placement. The hyperredundant manipulator are considered good potential tools for obstacle avoidance because of their high number of degrees of freedom. Locomotion and grasping are illustrated to demonstrate the use of the manipulators' potential for wavelike motion. Methods are presented for addressing the complex kinematics required for the manipulators, and it is concluded that the practical application of this class of robotics is presently feasible. C.C.S.

A92-23718

FORCE-REFLECTING BILATERAL MASTER-SLAVE

TELEOPERATION SYSTEM IN VIRTUAL ENVIRONMENT

TETSUO KOTOKU, KAZUO TANIE, and AKIO FUJIKAWA (Mechanical Engineering Laboratory, Tsukuba, Japan) IN: i-SAIRAS '90; Proceedings of the International Symposium on Artificial Intelligence, Robotics and Automation in Space, Kobe, Japan, Nov. 18-20, 1990. Tokyo, REN Associates, Inc., 1990, p. 295-298. refs

The construction of a bilateral manipulation system in a virtual environment is examined in terms of critical technological issues required for this development. A method is developed for representing the constraint forces applied to the robot via the virtual environment based on a force-generation algorithm. A direct-drive master arm is presented which can produce constraint forces from a virtual environment using the proposed technique. An experimental scenario is developed based on the technique and master arm in which an operator attempts to locate an object in a virtual environment which includes a force-reflecting master manipulator system. Preliminary results indicate that a force-reflecting master-slave system is useful because the force information is helpful for environment recognition. The development of a bilateral teleoperation system is of interest to the teleoperation of robotics in aerospace applications while avoiding the detrimental effects of the communication time delay. C.C.S.

N92-16557# Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan).

RADIATION PRESERVATION OF DRY FRUITS AND NUTS

M. JAN, A. SATTAR, W. A. AHMAD, and I. KHAN Jun. 1990 11 p

(DE91-642163; INIS-MF-12955) Avail: NTIS HC/MF A03

Present studies were conducted to investigate insect infestation and oxidative changes of packaging materials. Dry fruits and nuts such as apricots, dates raisins, almonds, pinenuts, and walnuts were used for these experiments. Insect infestation and other physico-chemical parameters were used for quality evaluation of the stored dry fruits and nuts. The effects of irradiation and polyethylene (PE) thickness on the overall acceptability of dry fruits (based on their color, texture, taste, and flavor) were evaluated. Radiation treatment and low temperature independently inhibited insect infestation during storage. DOE

N92-16558 Department of the Navy, Washington, DC.

CARBON MONOXIDE CONVERSION DEVICE Patent

MILES J. MCGOFF, inventor (to Navy) and SHERIDAN J. RODGERS, inventor (to Navy) 13 Aug. 1991 5 p Filed 2 Oct. 1989

(AD-D015097; US-PATENT-5,038,768;

US-PATENT-APPL-SN-415519; US-PATENT-CLASS-128-202.26)

Avail: US Patent and Trademark Office CSCL 07/4

Means for removing contaminants from an air stream are disclosed that at the same time provides a cost effective apparatus for training firefighters. HOPCALITE is used to remove carbon monoxide while other compositions remove particulates, water and organic vapors, and carbon dioxide. The present invention is an apparatus comprising layers of filter and chemical parts through which air containing carbon monoxide with or without carbon dioxide, hydrocarbons and nitrogen oxides passes and is scrubbed for inhalation by a user. The apparatus further comprises an adaptation to, or replication of, the canister of an operational oxygen breathing apparatus, wherein the canister now is provided with an actuatable aperture to permit the canister to be used as a

flow-through device in an adapted or replicated operational breathing apparatus wherein the bag(s) are inflated with the exhaled breath of the user in lieu of air available for inhalation. GRA

N92-16559* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

END EFFECTOR WITH ASTRONAUT FOOT RESTRAINT Patent

LEO G. MONFORD, JR., inventor (to NASA) 10 Dec. 1991 9 p Filed 4 Mar. 1991

(NASA-CASE-MS-C-21721-1; US-PATENT-5,070,964; US-PATENT-APPL-SN-664008; US-PATENT-CLASS-182-63; US-PATENT-CLASS-182-2; US-PATENT-CLASS-182-129; US-PATENT-CLASS-182-134; US-PATENT-CLASS-182-141; INT-PATENT-CLASS-B66F-11/04) Avail: US Patent and Trademark Office CSCL 06/11

The combination of a foot restraint platform designed primarily for use by an astronaut being rigidly and permanently attached to an end effector which is suitable for attachment to the manipulator arm of a remote manipulating system is described. The foot restraint platform is attached by a brace to the end effector at a location away from the grappling interface of the end effector. The platform comprises a support plate provided with a pair of stirrups for receiving the toe portion of an astronaut's boots when standing on the platform and a pair of heel retainers in the form of raised members which are fixed to the surface of the platform and located to provide abutment surfaces for abutting engagement with the heels of the astronaut's boots when his toes are in the stirrups. The heel retainers preclude a backward sliding movement of the feet on the platform and instead require a lifting of the heels in order to extract the feet. The brace for attaching the foot restraint platform to the end effector may include a pivot or swivel joint to permit various orientations of the platform with respect to the end effector.

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

N92-16560# Army Natick Labs., MA.

ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: PILOT SUMMARY STATISTICS, 1988 Final Report, 1 Apr. 1989 - 7 Feb. 1990

SARAH M. DONELSON (Geo-Centers, Inc., Newton, MA.) and CLAIRE C. GORDON Jul. 1991 614 p (AD-A241952; NATICK/TR-91/040) Avail: NTIS HC/MF A99 CSCL 05/9

This report presents results of the 1988 anthropometric survey of U.S. Army pilots in the form of summary statistics and percentile data. These anthropometric data are presented for all male pilots measured during the survey and for a subset of the female data pool who were demographically matched for age and race to the June 1989 U.S. Army female pilot population. A total of 132 standard measurements, 60 derived dimensions, and 48 head and face dimensions are summarized in this report. Each dimension is fully described and visual indices are provided to facilitate practical application of the data. GRA

N92-16561# Naval Health Research Center, San Diego, CA. **HEAT STRAIN DURING AT-SEA HELICOPTER OPERATIONS IN A HIGH HEAT ENVIRONMENT AND THE EFFECT OF PASSIVE MICROCLIMATE COOLING Interim Report, 1988 - 1989**

GUY R. BANTA and DANIEL E. BRAUN 1990 19 p (AD-A242152; NHRC-90-30) Avail: NTIS HC/MF A03 CSCL 06/5

High heat loads due to engine exhaust intake and high ambient temperatures within a helicopter fuselage during flight, specifically hover, have resulted in reported episodes of symptomatic heat strain among aircrew. An in-flight study was conducted to assess: (1) fuselage ambient temperature during Navy H-3 helicopter at-sea operations in a high heat environment (Persian Gulf); (2) presence or absence of any cardiac strain or excessive physiological heat load; and (3) effectiveness of reducing these responses by wearing a protective cooling (ice) vest. Twelve helicopter aircrew were monitored (heart rate (HR) and skin (SK) and rectal (RT)

temperature) in both IV and non-IV conditions during flight while wearing standard flight equipment. Aircrew performing at-sea helicopter operations in an area of high ambient heat are subject to heat loads that may produce heat stress conditions that can result in marked cardiac and thermal regulatory strain. Wearing of a protective cooling vest appears to reduce this threat. GRA

N92-16562*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

RELIABILITY OF A SHUTTLE REACTION TIMER

RUSSELL D. HAYS, AUGUSTUS D. MAZZOCCA (Krug Life Sciences, Inc., Houston, TX.), MICHAEL RASHID, and STEVEN F. SICONOLFI Washington Jan. 1992 9 p (NASA-TP-3176; S-659; NAS 1.60:3176) Avail: NTIS HC/MF A02 CSCL 05/8

Reaction, movement, and task times refer to the times needed to initially respond to a stimulus, make the specific movement, and complete the entire task. This study evaluated the reliability of a simple reaction timer designed to mimic a Space Shuttle task (turning on an overhead switch). Author

N92-16982# Wright Lab., Wright-Patterson AFB, OH.

DUAL COLOR AND SHAPE CODING IN THE VISUAL PERIPHERY: A STUDY OF JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS) SYMBOLOGY Final Report, Mar. - Jul. 1991

EILEEN ANCMAN Aug. 1991 26 p (AD-A243253; WL-TM-91-315-FIGK) Avail: NTIS HC/MF A03 CSCL 06/4

This research looked at four different dual color and shape coded Joint Tactical Information Distribution System (JTIDS) symbols on a color CRT located in the subject's periphery. Nighttime cockpit conditions were simulated. No subject could detect the 0.5 degs. symbols in their periphery beyond 15 degs. Approximately 1/3 of the potential subject pool could not correctly identify symbol shape even at the lower end of the range under study: 5 degs. Subjects used only color to key in on the symbol's meaning; the symbol's shape did not matter at all during this recognition task, for symbol shape was harder to perceive than color in the periphery. Color and the symbol's meaning could both be perceived at approximately 12 degs. off of the fovea, while shape had to be at 8 degs before subjects could perceive it. It is recommended that additional research in this area be accomplished. If findings are confirmed, it is suggested that a careful examination of the JTIDS dual coding be undertaken. GRA

N92-17014# Navy Experimental Diving Unit, Panama City, FL. **EVALUATION OF BAUER HIGH PRESSURE BREATHING AIR P-2 PURIFICATION SYSTEM Final Report**

DAVID SULLIVAN Aug. 1991 19 p (AD-A243535; NEDU-10-91) Avail: NTIS HC/MF A03 CSCL 23/5

The Navy Experimental Diving Unit (NEDU) tested the BAUER P-2 High Pressure, Breathing Air Purification System from 16 July 1991 to 19 July 1991. The purpose of this test was to determine if the P-2 Air Purification System functioned as specified and was suitable for use by the U.S. Navy. Additionally, if the system passed the test criteria a recommendation would be made to add it to the Approved for Navy Use (ANU) list. The BAUER P-2 Purification System met the manufacturer's specifications for quantity of air processed with a quality which met U.S. Navy purity standards. The design and engineering were determined to be adequate. The BAUER P-2 Air purification System is considered suitable for use with U.S. Navy divers high pressure breathing air compressors. GRA

N92-17132*# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.

ACQUISITION AND PRODUCTION OF SKILLED BEHAVIOR IN DYNAMIC DECISION-MAKING TASKS Semiannual Status Report

ALEX KIRLIK 31 Jan. 1992 75 p

(Contract NAG2-656)

(NASA-CR-189846; NAS 1.26:189846) Avail: NTIS HC/MF A04 CSCL 05/8

Currently, two main approaches exist for improving the human-machine interface component of a system in order to improve overall system performance - display enhancement and intelligent decision making. Discussed here are the characteristic issues of these two decision-making strategies. Differences in expert and novice decision making are described in order to help determine whether a particular strategy may be better for a particular type of user. Research is outlined to compare and contrast the two technologies, as well as to examine the interaction effects introduced by the different skill levels and the different methods for training operators. Author

N92-17143# Army Natick Research and Development Command, MA.

USER EVALUATION OF LASER BALLISTIC SUN, WIND AND DUST GOGGLE LENSES (DYE TECHNOLOGY) Final Report, Sep. 1990 - Sep. 1991

B. JEZIOR, C. L. BLACKWELL, L. L. LESHNER, V. SHEARER, and L. PLANTE Nov. 1991 93 p Prepared in cooperation with Geo-Centers, Inc., Newton, MA (AD-A243245; NATICK/TR-92/007) Avail: NTIS HC/MF A05 CSCL 05/8

Prompted by a Product Improvement Program aimed at providing soldiers eye protection equal to that of the Ballistic Laser Protective Spectacles (BLPS), Natick Research, Development and Engineering Center recently field tested four experimental laser ballistic lenses in the Sun, Wind, and Dust Goggle. All lenses used dye absorber technology. Field testing with Armor and Infantry military personnel resulted in data collected from more than 300 soldiers on over 80 variables. The tests included typical military operational tasks. The soldiers also wore the lenses during field training exercises and were surveyed about the lenses' effects on mission performance. The Farnsworth-Munsell 100-Hue Test, a laboratory test which examines the effects of the lenses on color perception, was also conducted in both simulated daylight and reduced visibility conditions. Farnsworth-Munsell test results showed that performance was not seriously degraded by any lens in daylight illumination levels. In reduced visibility conditions there was impairment, and the degree of impairment was relatively consistent with what was expected from the respective lenses' transmittance levels and specific lines of protection. There were also some negative mission performance issues raised that were more a function of goggle wear than lens performance. GRA

N92-17278# Defence Research Establishment, Ottawa (Ontario).

HEAT STRESS CAUSED BY WEARING DIFFERENT TYPES OF CW PROTECTIVE GARMENT

S. D. LIVINGSTONE and R. W. NOLAN Aug. 1991 13 p (AD-A243043; DREO-TN-91-14) Avail: NTIS HC/MF A03 CSCL 05/8

One means of reducing the heat stress caused by wearing protective clothing is to eliminate the air layers between the skin and layers of the ensemble. In order to evaluate the effectiveness of this concept, four unacclimated males wearing either the current Canadian Forces (CF) chemical protective overgarment, and individually tailored skintight protective garment or CF combat uniform participated in a series of experiments conducted at 40 C and low relative humidity. Each was instrumented with a rectal thermistor, donned the clothing and walked on a treadmill at 5 km hr and 2 pct. grade for 90 min, until his rectal temperature reached 39 C or he requested to withdraw from the experiment. The results of this preliminary investigation indicate that there appears to be some advantage to wearing the skintight clothing under these conditions. GRA

N92-17331# Navy Experimental Diving Unit, Panama City, FL. **UNMANNED EVALUATION OF BAUER HIGH PRESSURE BREATHING AIR P-5 PURIFICATION SYSTEM Final Report**

DAVID SULLIVAN Aug. 1991 25 p

(AD-A243486; NEDU-12-91) Avail: NTIS HC/MF A03 CSCL 23/5

The BAUER P-5 high pressure, breathing air purification system was tested from 24 July 1991 to 12 August 1991. The purpose of this test was to determine if the P-5 air purification system functioned as specified and was suitable for use by the U.S. Navy. The BAUER P-5 air purification system met the manufacturer's specifications for quantity of air processed with a quality which met the U.S. Navy purity standards. The design and engineering were determined to be adequate. The BAUER P-5 purification system is considered suitable for use with U.S. Navy divers high pressure breathing air compressors. GRA

N92-17355*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.

ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM EVOLUTION ANALYSIS

PAUL WIELAND and SANDY MONTGOMERY In NASA, Washington, Beyond the Baseline 1991: Proceedings of the Space Station Evolution Symposium. Volume 2: Space Station Freedom, Part 2 p 1237-1270 Sep. 1991

Avail: NTIS HC/MF A20 CSCL 06/11

The Space Station Freedom Environmental Control and Life Support System (ECLSS) will have to accommodate the changes made to Freedom as it evolves over 30 years or more. Requirements will change as pressurized modules are added, crew numbers increase, and as the tasks to be performed change. This evolution will result in different demands on the ECLSS which will have to adapt to these changes. Technologies other than the baselined ones may be better able to perform the various ECLSS functions and technological advances will result in improved life support hardware better able to meet the new requirements. Author

N92-17356*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.

THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM ADVANCED AUTOMATION PROJECT

BRANDON S. DEWBERRY In NASA, Washington, Beyond the Baseline 1991: Proceedings of the Space Station Evolution Symposium. Volume 2: Space Station Freedom, Part 2 p 1271-1309 Sep. 1991

Avail: NTIS HC/MF A20 CSCL 06/11

The objective of the ECLSS Advanced Automation project includes reduction of the risk associated with the integration of new, beneficial software techniques. Demonstrations of this software to baseline engineering and test personnel will show the benefits of these techniques. The advanced software will be integrated into ground testing and ground support facilities, familiarizing its usage by key personnel. Author

N92-17357*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Artificial Intelligence Group.

ECLSS PREDICTIVE MONITORING

RICHARD J. DOYLE and STEVE A. CHIEN In NASA, Washington, Beyond the Baseline 1991: Proceedings of the Space Station Evolution Symposium. Volume 2: Space Station Freedom, Part 2 p 1311-1351 Sep. 1991

Avail: NTIS HC/MF A20 CSCL 06/11

On Space Station Freedom (SSF), design iterations have made clear the need to keep the sensor complement small. Along with the unprecedented duration of the mission, it is imperative that decisions regarding placement of sensors be carefully examined and justified during the design phase. In the ECLSS Predictive Monitoring task, we are developing AI-based software to enable design engineers to evaluate alternate sensor configurations. Based on techniques from model-based reasoning and information theory, the software tool makes explicit the quantitative tradeoffs among competing sensor placements, and helps designers explore and justify placement decisions. This work is being applied to the Environmental Control and Life Support System (ECLSS) testbed at MSFC to assist design personnel in placing sensors for test

purposes to evaluate baseline configurations and ultimately to select advanced life support system technologies for evolutionary SSF. Author

N92-17432# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

AIRCREW CRITIQUE OF HIGH-G CENTRIFUGE TRAINING: PART 3: WHAT CAN WE CHANGE TO BETTER SERVE YOU?

Final Report, Oct. 1988 - May 1991

JAMES E. WHINNERY and RICHARD J. HAMILTON 11 Jun. 1991 27 p

(AD-A243496; NADC-91071-90) Avail: NTIS HC/MF A03 CSCL 01/2

We have successfully initiated high-G centrifuge training for fighter attack aviators at the Naval Air Development Center. The response of aircrew to a post-training critique question, asking how the program could be modified to better meet operational needs, was evaluated so aircrew might have the ability to improve their training program. The recommendations could be grouped into 5 major categories: (1) no change, (2) addition of a closed loop aerial combat maneuvering (ACM) profile with bogey on a tracking task, (3) centrifuge gondola modifications, (4) training profile modifications, and (5) modifications concerning when the training is given. A number of suggestions for improvement are worth pursuing and implementing immediately. Although caution should be exercised when altering the content and goals of the proven program, we strongly concur with several of the changes. This includes providing a closed loop ACM profile with at least a moderately high-fidelity tracking task (bogey) and at least optional G-LOC training. GRA

N92-17569# David Taylor Research Center, Bethesda, MD. Ship Hydromechanics Dept.

A FREQUENCY-DOMAIN METHOD FOR ESTIMATING THE INCIDENCE AND SEVERITY OF SLIDING Final Report, 1 Jan. - 30 Aug. 1991

ROSS GRAHAM, A. E. BAITIS, and WILLIAM G. MEYRES 30 Aug. 1991 46 p

(AD-A243077; DTRC/SHD-1361-01) Avail: NTIS HC/MF A03 CSCL 13/10

A frequency-domain method of predicting the incidence of personnel or equipment sliding is presented which includes the (linearized) forces due to roll, pitch, longitudinal, lateral and vertical accelerations, and also the effects of non-zero mean heel. The predictions of the method are compared with the results of observations of at-sea sliding incidents, and good correspondence is obtained. A simple approximation for the duration of threshold exceedance probability density is described, and used to develop a method for predicting the incidence of slides greater than a certain severity. The method applies for arbitrary lateral and vertical acceleration, but only to the case in which the longitudinal acceleration is negligible. An example of the application of the method is presented. It is argued that ship motions such as roll, pitch, lateral and longitudinal accelerations are the wrong physical parameters for expressing seakeeping criteria. These criteria become simpler when expressed in terms of the incidence of degrading events such as helicopters sliding, and are equally applicable to all vessel types. GRA

N92-17617# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

VISUAL DETERMINATION OF INDUSTRIAL COLOR-DIFFERENCE TOLERANCES USING PROBIT ANALYSIS M.S. Thesis

GREGORY D. SNYDER Jun. 1991 112 p

(AD-A243545; AFIT/CI/CIA-91-083) Avail: NTIS HC/MF A06 CSCL 06/4

A perceptibility study was conducted to visually determine the median tolerance values of 45 color-difference vectors in CIELAB color space using surface model viewing of paint samples. Nine different color centers, each comprising five color vectors, were employed to collect a superthreshold dataset. Fifty color normal observers made quantal judgements under simulated D65 illuminant

regarding the magnitude of color difference pairs based on comparisons to a near neutral color difference anchor pair. Probit analysis was applied to the response frequencies for each vector to estimate the parameters of the distribution and the median tolerance values. Results indicated the probit adequately models the response distributions of the human observer population. GRA

N92-17656# Marine Biological Lab., Woods Hole, MA. **THE 7TH ANNUAL WORKSHOP ON COMPUTATIONAL NEUROSCIENCE Final Report**

30 Aug. 1991 7 p Workshop held in Woods Hole, MA, 24-30 Aug. 1991 Sponsored by Navy

(AD-A243462) Avail: NTIS HC/MF A02 CSCL 05/8

The Computational Neuroscience Workshop was held in Woods Hole at the Marine Biological Laboratory on August 24 to August 30, 1991, concurrently with the last week of the Computational Neuroscience Summer Course. The primary purpose of the workshop was to bring together the leading investigators interested in applying computational modeling techniques to problems in brain function. This was the seventh year in which this workshop was held at Woods Hole. There was a general feeling that the field of computational neuroscience had over this time started to live up to its early promise, and the workshop has contributed significantly to this development. The impact of the workshop was apparent in the research papers that the participants circulated, many of which grew out of discussions between participants at earlier workshops. The existence of the summer course was an encouraging indication of the hopes for the future of the field. One of the central themes of this year's workshop was learning and memory in populations of neurons. This topic was introduced in talks by Terry Sejnowski on adaption of the vestibulo-ocular reflex, by Eric Knudsen on neural and behavioral plasticity during the development of sound localization in the barn owl, by Bob Desimone on habituation of neurons in the inferior temporal cortex to complex stimuli, and by Dana Ballard on reinforcement learning in the setting of planning. GRA

N92-17673# Mitre Corp., Bedford, MA.

USI RAPID PROTOTYPING TOOL EVALUATIONS SURVEY

MARIAN J. MURPHY Sep. 1991 102 p

(AD-A243168; MTR-11259) Avail: NTIS HC/MF A06 CSCL 12/5

The Human Factors Engineering for User System Interface (HFE/USI) Specialty Group has conducted several evaluations of rapid prototyping tools to support the design and development of user interfaces for command and control systems. To standardize the evaluation methodology, we compiled a list of command and control criteria and rated tools against them. These ratings can be used to select a tool that will closely match the needs of a MITRE/ESD program. This paper describes the evaluation methodology and applies it to the review tools: VAPS, LUIS/SMS, SL-GMS, Data Views, TAE Plus, and SET. GRA

N92-17866*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTOMATIC LOCKING ORTHOTIC KNEE DEVICE Patent Application

BRUCE WEDDENDORF, inventor (to NASA) 26 Dec. 1991 15 p

(NASA-CASE-MFS-28633-1; NAS 1.71:MFS-28633-1;

US-PATENT-APPL-SN-813629) Avail: NTIS HC/MF A03 CSCL 05/8

An articulated tang in clevis joint for incorporation in newly manufactured conventional strap-on orthotic knee devices or for replacing such joints in conventional strap-on orthotic knee devices is discussed. The instant tang in clevis joint allows the user the freedom to extend and bend the knee normally when no load (weight) is applied to the knee and to automatically lock the knee when the user transfers weight to the knee, thus preventing a damaged knee from bending uncontrollably when weight is applied to the knee. The tang in clevis joint of the present invention includes first and second clevis plates, a tang assembly and a

spacer plate secured between the clevis plates. Each clevis plate includes a bevelled serrated upper section. A bevelled shoe is secured to the tank in close proximity to the bevelled serrated upper section of the clevis plates. A coiled spring mounted within an oblong bore of the tang normally urges the shoes secured to the tang out of engagement with the serrated upper section of each clevis plate to allow rotation of the tang relative to the clevis plate. When weight is applied to the joint, the load compresses the coiled spring, the serrations on each clevis plate dig into the bevelled shoes secured to the tang to prevent relative movement between the tang and clevis plates. A shoulder is provided on the tang and the spacer plate to prevent overextension of the joint.

NASA

N92-17910* # National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

TREADMILL FOR SPACE FLIGHT Patent Application

WILLIAM E. THORNTON, inventor (to NASA) 15 Oct. 1991 35 p
(NASA-CASE-MS-C-21752-1; NAS 1.71:MSC-21752-1; US-PATENT-APPL-SN-775404) Avail: NTIS HC/MF A03 CSCI 05/8

Method and apparatus for accurately simulating locomotion in a weightless environment, especially to prevent atrophy of a subject's musculoskeletal and cardiorespiratory systems during space travel, are disclosed. Forces, including the vertical, horizontal, and lateral force generated by an individual during locomotion on a treadmill using a rigid belt with rigid transfer elements supported by low friction bogies, are measured by strain gauges sensitive in their respective direction. The vertical forces produced by securing the subject to the treadmill via bungee cords, in conjunction with the measured velocity of the treadmill and the mode of locomotion, are used to determine the subject's equivalent weight. The other horizontal and lateral forces are used to determine the external work produced by the subject when locomotion is performed on a nonlevel surface with an effective grade angle. The measured forces are related in such a way that the grade angle is easily determined. A motor and additional circuitry can be added to the apparatus to measure and force a subject to maintain a predetermined work rate associated with a preselected grade angle and tread velocity.

NASA

N92-18001* # Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

SYSTEMATIC METHODS FOR KNOWLEDGE ACQUISITION AND EXPERT SYSTEM DEVELOPMENT

BRENDA L. BELKIN and ROBERT F. STENGEL *In* NASA. Langley Research Center, Joint University Program for Air Transportation Research, 1990-1991 p 173-179 Dec. 1991 Previously announced in IAA as A91-43926 Sponsored in part by Natural Sciences and Research Council of Canada (Contract NGL-31-001-252; DAAG29-84-K-0048) Avail: NTIS HC/MF A09 CSCI 05/8

Nine cooperating rule-based systems, collectively called AUTOCREW, were designed to automate functions and decisions associated with a combat aircraft's subsystem. The organization of tasks within each system is described; performance metrics were developed to evaluate the workload of each rule base, and to assess the cooperation between the rule-bases. Each AUTOCREW subsystem is composed of several expert systems that perform specific tasks. AUTOCREW's NAVIGATOR was analyzed in detail to understand the difficulties involved in designing the system and to identify tools and methodologies that ease development. The NAVIGATOR determines optimal navigation strategies from a set of available sensors. A Navigation Sensor Management (NSM) expert system was systematically designed from Kalman filter covariance data; four ground-based, a satellite-based, and two on-board INS-aiding sensors were modeled and simulated to aid an INS. The NSM Expert was developed using the Analysis of Variance (ANOVA) and the ID3 algorithm. Navigation strategy selection is based on an RSS position error decision metric, which is computed from the covariance data. Results show that the NSM Expert predicts position error correctly

between 45 and 100 percent of the time for a specified navaid configuration and aircraft trajectory. The NSM Expert adapts to new situations, and provides reasonable estimates of hybrid performance. The systematic nature of the ANOVA/ID3 method makes it broadly applicable to expert system design when experimental or simulation data is available.

Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A92-20933

LIFE SCIENCES AND SPACE RESEARCH XXIV(3) - PLANETARY BIOLOGY AND ORIGINS OF LIFE; PROCEEDINGS OF THE TOPICAL MEETING OF THE INTERDISCIPLINARY SCIENTIFIC COMMISSION F (MEETINGS F7, F1, F8 AND F9) AND EVENING SESSION 1 OF THE COSPAR 28TH PLENARY MEETING, THE HAGUE, NETHERLANDS, JUNE 25-JULY 6, 1990

J. ORO, ED. (Houston, University, TX), G. HORNECK, ED. (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), J. M. GREENBERG, ED. (Leiden, State University, Netherlands), F. RAULIN, ED. (Paris XII, Universite, Creteil, France), A. W. SCHWARTZ, ED. (Nijmegen, Catholic University, Netherlands), K. DOSE, ED. (Mainz, Universitaet, Federal Republic of Germany), and E. I. FRIEDMANN, ED. (Florida State University, Tallahassee) Meeting sponsored by COSPAR and IAGA. *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, 296 p. For individual items see A92-20934 to A92-20968.

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The present conference on planetary biology and the origins of life encompasses the structure and organic chemistry of comets, the impact of human expeditions to Mars, the chemical, physical, and astronomical perspectives on life in the universe, the evolution of primitive biochemical functions, and issues regarding life in extreme environments. Specific issues addressed include the cometary origin of C and H₂O on the terrestrial planets, cometary contributions to prebiotic chemistry, cometary/meteor coupling and the structure of young streams, scientific strategies for the human exploration of Mars, the search for extrasolar planetary systems, and a quantitative analysis of mutation and selection in self-replicating RNA. Also addressed are the seeding of life by comets, extracting clues on early life on Mars from stable carbon isotopes, the effects of vacuum-UV radiation on microorganisms and DNA, extreme dryness and DNA-protein crosslinks, a biological perspective of the history of water on Mars, cometary habitats for primitive life, and the long-term preservation of microbial ecosystems in permafrost.

C.C.S.

A92-20934* Toledo Univ., OH.

COMETARY ORIGIN OF CARBON AND WATER ON THE TERRESTRIAL PLANETS

A. H. DELSEMME (Toledo, University, OH) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 5-12. Research supported by NASA. refs

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An early high-temperature phase of the protosolar accretion disk is implied by at least three different telltales in chondrites and confirmed by peculiarities in the dust grains of Comet Halley. The existence of this high-temperature phase implies a large accretion rate hence a massive early disk. This clarifies the origin of the Kuiper Belt and of the Oort cloud, those two cometary populations of different symmetry that subsist today. Later, when

the dust sedimented and was removed from the thermal equilibrium with the gas phase, a somewhat lower temperature of the disk explains the future planets' densities as well as the location beyond 2.6 AU of the carbonaceous chondrite chemistry. This lower temperature remains however large enough to require an exogenous origin for all carbon and all water now present in the earth. The later orbital diffusion of planetesimals, which is required by protoplanetary growth, is needed to explain the origin of the terrestrial biosphere (atmosphere, oceans, carbonates and organic compounds) by a veneer mostly made of comets. Author

A92-20936**HYDROGEN CYANIDE POLYMERS ON COMETS**

C. N. MATTHEWS (Illinois, University, Chicago) and R. LUDICKY (Morton International, Inc., Specialty Chemicals Group, Woodstock, IL) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 21-32. refs

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The existence of hydrogen-cyanide polymers is proposed for the nonvolatile black crust of the Comet P/Halley based on direct images of the nucleic surface area. The synthesis and structure of HCN polymers is described, and their relationships with cometary data and the origin of life on earth are illustrated. The proposed structure is theorized to lead to HCN, CN, and H, C, and N in the coma and tail dusts, and this is substantiated with observational data. The polymers are found to be either ladder structures with conjugated -C=N- bonds or polyamides converted to polypeptides with H₂O. The macromolecules are discussed in the context of planetary dark matter, and cometary bombardment and other scenarios are examined in terms of the relationship between HCN polymers and the composition of the primitive earth. The polymers and the resulting proteinaceous matrix are theorized to have generated the chemical reactions that led to the creation of living organisms. C.C.S.

A92-20937* Houston Univ., TX.**THE COMETARY CONTRIBUTION TO PREBIOTIC CHEMISTRY**

J. ORO, T. MILLS (Houston, University, TX), and A. LAZCANO (Universidad Nacional Autonoma de Mexico, Coyoacan, Mexico) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 33-41. refs

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The chemical composition of cometary nuclei is examined to estimate the potential contribution of volatiles to the prebiotic earth from cometary collisions. Observations of cometary nuclei are reviewed to describe the chemical evolution of the objects and their theoretical potential for affecting the terrestrial environment. Specific attention is given to the plausibility of the single-impact formation of the earth-moon system, and experiments are proposed for testing the present theories. It is proposed that significant contributions of biogenic elements such as C, H, N, O, P, and S resulted from these nuclei colliding with the earth. Observations of the solar atmosphere and of the circumstellar shells of C-rich stars indicate that compounds such as CO, C₂, and H₂O were not pyrolyzed as a result of collision events. The compounds are theorized to have established the foundation for the abiotic synthesis of key biochemical molecules. C.C.S.

A92-20942**RADIATION-INDUCED SYNTHESIS IN COMETARY SIMULATED MODELS**

ALICIA NEGRON-MENDOZA, ELIZABETH CHACON, RAFAEL

NAVARRO-GONZALEZ (Universidad Nacional Autonoma de Mexico, Coyoacan, Mexico), ZORICA D. DRAGANIC, and IVAN G. DRAGANIC (Institute of Nuclear Sciences, Vinca, Yugoslavia) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 63-66. Research supported by Universidad Nacional Autonoma de Mexico. refs

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The behavior of an aqueous-dominant multicomponent cometary model is examined at high doses of ionizing radiation. The system is composed of a water mixture of HCN (0.2 mol/cu dm), CH₃CN (0.04 mol/cu dm), C₂H₅CN (0.02 mol/cu dm), CH₃OH (0.12 mol/cu dm) and HCO₂H (0.01 mol/cu dm). It was exposed to gamma rays at doses of up to 18.5 MGy. The chemical kinetic database used in the computer treatment of experimental data consists of 79 reactions. A complex mixture of products has been synthesized: gases, amino acids, carboxylic acids, and polymeric material. The results suggest that the pristine material in cometary nuclei may have been chemically altered by the action of cosmic rays and embedded radionuclides. Author

A92-20947**STABLE CARBON ISOTOPES - POSSIBLE CLUES TO EARLY LIFE ON MARS**

MANFRED SCHIDLowski (Max-Planck-Institut fuer Chemie, Mainz, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 101-110. refs

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It is argued that the kinetic fractionation effects on earth are also significant mechanisms on Mars and that Martian sediment with fractionations can yield data regarding previous life on Mars. The changes in the C-13/C-12 ratios on earth over the last 4 billion years are discussed with particular attention given to the inherent bias toward C-12 that is noted in biogenic matter. The conditions that lead to the terrestrial bias towards C-12 are examined in the light of universality and therefore in terms of possible life on Mars. C₃ photosynthesis is considered to have counterparts in extraterrestrial life; the discovery of C-13/C-12 fractionations between carbonate and reduced carbon is discussed on the Martian surface. It is concluded that such a discovery would be a strong indication of life processes in the carbon-isotope geochemistry of Mars. C.C.S.

A92-20948* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALYSES OF EXOBIOLOGICAL AND POTENTIAL RESOURCE MATERIALS IN THE MARTIAN SOIL

ROCCO L. MANCINELLI, JOHN R. MARSHALL, and MELISA R. WHITE (NASA, Ames Research Center, Moffett Field, CA) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 111-116. refs

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Potential Martian soil components relevant to exobiology include water, organic matter, evaporites, clays, and oxides. These materials are also resources for human expeditions to Mars. When found in particular combinations, some of these materials constitute diagnostic paleobiomarker suites, allowing insight to be gained into the probability of life originating on Mars. Critically important

to exobiology is the method of data analysis and data interpretation. To that end, methods of analysis of potential biomarker and paleobiomarker compounds and resource materials in soils and rocks pertinent to Martian geology are investigated. Differential thermal analysis coupled with gas chromatography is shown to be a highly useful analytical technique for detecting this wide and complex variety of materials. Author

A92-20949* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE USE OF MINERAL CRYSTALS AS BIO-MARKERS IN THE SEARCH FOR LIFE ON MARS

D. E. SCHWARTZ, R. L. MANCINELLI (NASA, Ames Research Center, Moffett Field, CA), and E. S. KANESHIRO (Cincinnati, University, OH) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 117-119. refs

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It is proposed that minerals resulting from biologically controlled mineralization processes be utilized as biomarkers because of their favorable qualities. Universal signatures of life (biomarkers) are discussed in terms of their terrestrial forms and hypothetical Martian counterparts including organics, suites of specific inorganic and organic compounds, and isotopic ratios. It is emphasized that minerals produced under biologic control have morphological and isotopic compositions that are not found in their abiotic counterparts. Other biomarkers are not necessarily indicative of biological origin and are therefore unreliable resources for scientific study. Mineral crystals are also stable over long geological periods, and the minerals from Martian fluvial features can therefore be employed to search for fossils and biomarkers of early biological activity. C.C.S.

A92-20950 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PLANETARY PROTECTION ISSUES AND THE FUTURE EXPLORATION OF MARS

D. L. DE VINCENZI (NASA, Ames Research Center, Moffett Field, CA) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 121-128. Research supported by NASA. refs

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The results of a workshop are presented in which the issues of planetary protection and biological cross-contamination between the earth and Mars were addressed. A detailed proposal is given regarding strategies for the implementation of the conclusions of the workshop. The significant findings include: (1) the need for evaluating protection issues via unmanned precursor missions; (2) the consideration of all Martian samples as hazardous; and (3) the strategy to avoid Martian landings until it is shown that Martian materials are safe for human contact. The resulting strategy is based on preventing the forward contamination of orbiters and landers by following Mars Observer and Viking planetary-protection procedures. The strategy also allows for back-contamination prevention by means of sample sealing, containment, and quarantine analysis. C.C.S.

A92-20951* National Aeronautics and Space Administration, Washington, DC.

PLANETARY PROTECTION POLICY (U.S.A.)

JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting,

The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 129-131. refs

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Through existing treaty obligations of the United States, NASA is committed to exploring space while avoiding biological contamination of the planets, and to the protection of the earth against harm from materials returned from space. Because of the similarities between Mars and earth, plans for the exploration of Mars evoke discussions of these Planetary Protection issues. U.S. Planetary Protection Policy will be focused on the preservation of these goals in an arena that will change with the growth of scientific knowledge about the Martian environment. Early opportunities to gain the appropriate data will be used to guide later policy implementation. Because human presence on Mars will result in the end of earth's separation from the Martian environment, it is expected that precursor robotic missions will address critical planetary protection concerns before humans arrive. Author

A92-20952* York Univ., Toronto (Ontario).

THE IMPLANTATION OF LIFE ON MARS - FEASIBILITY AND MOTIVATION

ROBERT H. HAYNES (York University, Toronto, Canada) and CHRISTOPHER P. MCKAY (NASA, Ames Research Center, Moffett Field, CA) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 133-140. refs

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Scientific concepts are reviewed regarding the potential formation and development of a life-bearing environment on Mars, and a potential ecopoiesis scenario is given. The development of the earth's biosphere is defined, and the major assumptions related to the formation of Martian life are listed. Three basic phases are described for the life-implantation concept which include determining whether sufficient quantities of volatiles are available, engineering the warming of the planet, and implanting microbial communities if necessary. Warming the planet theoretically releases liquid H₂O and produces a thick CO₂ atmosphere, and the implantation of biological communities is only necessary if no indigenous microbes emerge. It is concluded that a feasibility study is required to assess the possibilities of implanting life on Mars more concretely. C.C.S.

A92-20955* Leiden Univ. (Netherlands).

THE SEEDING OF LIFE BY COMETS

J. M. GREENBERG and CELIA X. MENDOZA-GOMEZ (Leiden, State University, Netherlands) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 169-180. Research supported by Universidad Nacional Autonoma de Mexico. refs

(Contract NGR-33-018-148)

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The chemical and morphological structures of comets and interstellar dust are reviewed to demonstrate the feasibility of comets providing the necessary prebiotic molecules for the formation of life on the early earth. The chemical evolution of interstellar dust is shown to be the source of organics in comets, and the molecules observed in the grains are listed as are the products resulting from grain photolysis. It is emphasized that comets could only transfer prebiotic molecules to the earth if they are fluffy aggregates that break up into fine fragments. The contributions to the early earth are considered in terms of the competition between the evolution of the living organisms and the destructive effects of impacts. It is considered that life began as

the bombardment during the first 5 x 10 exp 8 years began to tail off. C.C.S.

A92-20956* California Univ., Davis.

POLYCYCLIC AROMATIC HYDROCARBONS - PRIMITIVE PIGMENT SYSTEMS IN THE PREBIOTIC ENVIRONMENT

D. W. DEAMER (California, University, Davis) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 183-189. refs

(Contract NAGW-1119)

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The chemical evolution of meteoritic organics in the primitive earth is examined experimentally with attention given to the photochemical effects of hydrocarbon/water mixtures. Also addressed are the generation of amphiphilic products by photochemical reactions and the transduction of light energy into potentially useful forms. Polycyclic aromatic hydrocarbons (PAHs) absorb light and exist in carbonaceous chondrites; PAHs are therefore examined as primitive pigments by means of salt solutions with pyrene, fluoranthene, and pyrene derivatives with hexadecane. The hexadecane undergoes photochemical oxidation and yields long-chain amphiphiles with oxygen supplied by water, and acid pH shifts also occur. PAHs are also tested in lipid bilayer membranes to examine light-energy transduction. Protons are found to accumulate within the membrane-bounded volume to form proton gradients, and this reaction is theorized to be a good model of primitive photochemical reactions that related to the transduction of light energy into useable forms. C.C.S.

A92-20957

QUANTITATIVE ANALYSIS OF MUTATION AND SELECTION IN SELF-REPLICATING RNA

CHRISTOF K. BIEBRICHER (Max-Planck-Institut fuer Biophysikalische Chemie, Goettingen, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 191-197. refs

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Evolutionary parameters can be examined analytically by means of a model system introduced in the paper that is based on a short-chained RNA species with self-replication catalyzed by Q-beta replicase. A series of equations are employed to study the competing RNA species by describing the efficiency with which the genotype directs its own synthesis. The equations lead to phenotypic expressions based on the efficiency of synthesis, and the selection behavior can account for different concentrations, specific types of ecosystems, and the introduction of mutants. A quasi-species distribution is established by the processes of mutation and selection as well as by the replication of RNA clones. The techniques presented in the model system based on self-replicating RNA molecules are concluded to permit the study of the complex Darwinian evolution of living organisms. C.C.S.

A92-20961* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

HISTORY OF WATER ON MARS - A BIOLOGICAL PERSPECTIVE

CHRISTOPHER P. MCKAY (NASA, Ames Research Center, Moffett Field, CA), E. I. FRIEDMAN (Florida State University, Tallahassee), ROBERT A. WHARTON (Nevada, University, Reno), and WANDA L. DAVIES (SETI Institute, Mountain View, CA) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening

Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 231-238. refs

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A general scenario is developed for the history of liquid water on the surface of Mars, according to which the history of water on Mars can be divided into four epochs based on the fundamental temperature and pressure characteristics. In Epoch I, the mean annual temperature is assumed to have been above freezing and the pressure to have been above 1 atm; liquid water was widespread and life could have arisen and become abundant. In Epoch II, the mean annual temperature fell below freezing, but peak temperatures were above freezing; In Epoch II ice-covered lakes could have provided a habitat for life. In Epoch III, both the mean and the peak temperatures were below freezing, and only transient liquid water would be possible; under these conditions, microbial ecosystems living in endolithic rock 'greenhouses' could have continued to survive. Finally, in Epoch IV, the pressure dropped to near the triple point pressure of water; at this stage, life on the surface of Mars would have become extinct. I.S.

A92-20964

LONG-TERM PRESERVATION OF MICROBIAL ECOSYSTEMS IN PERMAFROST

D. A. GILICHINSKII, L. G. EROKHINA, D. G. FEDOROV-DAVYDOV, N. R. CHAIKOVSKAIA (AN SSSR, Institut Pochvovedeniia i Fotosinteza, Pushchino, USSR), and E. A. VOROB'EVA (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 255-263. refs

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The paper summarizes the results of a long-term study in which about 1000 samples of sedimentary deposits of the late Pliocene-Holocene were taken aseptically from frozen cores from 100-m deep bores and were analyzed for the presence of viable microorganisms. It was found that the complexity of the microbial community preserved varied with the age of the permafrost, with the diversity of microorganisms decreasing with the increasing sediment age. Eukaryotes were found only in Holocene sediments, while prokaryotes were found in Pliocene and Pleistocene. Enzyme activity (catalase and hydrolytic enzymes) and photosynthetic pigments (chlorophyll and pheophytin) were also detected. Results are used to outline approaches to the search for traces of life in the permafrost of Martian sediments. I.S.

A92-20966

SURVIVAL RATES OF SOME TERRESTRIAL MICROORGANISMS UNDER SIMULATED SPACE CONDITIONS

J. KOIKE, T. OSHIMA (Tokyo Institute of Technology, Yokohama, Japan), K. A. KOIKE (Tsukuba University, Japan), H. TAGUCHI, R. TANAKA, K. NISHIMURA, and M. MIYAJI (Chiba University, Japan) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) Advances in Space Research (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 271-274. Research supported by MOESC. refs

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In connection with planetary quarantine, the survival rates of nine species of terrestrial microorganisms (viruses, bacteria, yeasts, fungi, etc.) are studied under simulated interstellar conditions. If common terrestrial microorganisms cannot survive in space even for short periods, expenditure can be reduced for sterilizing space probes. The interstellar environment in the solar system is simulated by low temperature, high vacuum, and proton irradiation from a Van de Graaff generator. After exposure to a barrage of protons

corresponding to about 250 years of irradiation in solar space, tobacco mosaic virus, *Bacillus subtilis* spores, *Aspergillus niger* spores, and *Clostridium manganoti* spores showed survival rates of 82, 45, 28, and 25 percent, respectively. Furthermore, pathogenic *Candida albicans* showed 7-percent survival after irradiation corresponding to about 60 years in space. Author

A92-20967

THYMINE PHOTOPRODUCT FORMATION AND INACTIVATION OF INTACT SPORES OF *BACILLUS SUBTILIS* IRRADIATED WITH SHORT WAVELENGTH UV (200-300 NM) AT ATMOSPHERIC PRESSURE AND IN VACUO

C. LINDBERG and G. HORNECK (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 275-279. refs

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The mechanism of the response of *B. subtilis* spores to the simultaneous exposures to solar UV radiation and vacuum (i.e., to the conditions of free space) was investigated by analyzing the thymine photoproducts formed in dry spores irradiated by UV light at 200-300 nm in a vacuum chamber at 2×10^{-6} Pa and in dry and wet spores irradiated at atmospheric pressure. It was found that, compared to irradiation at atmospheric pressure, where only 5-thyminyl 5,6-dihydrothymine was detected, two additional products, known as the c,s and t,s isomers of thymine dimer were produced in vacuo. It is suggested that vacuum-specific photoproducts may cause a synergistic response of spores to the simultaneous action of UV light and UHV. Three different mechanisms are suggested for this effect. I.S.

A92-20968

COMETARY HABITATS FOR PRIMITIVE LIFE

M. K. WALLIS, N. C. WICKRAMASINGHE, and F. HOYLE (University of Wales, Cardiff) (Life sciences and space research XXIV/3/ - Planetary biology and origins of life; Proceedings of the Topical Meeting of the Interdisciplinary Scientific Commission F /Meetings F7, F1, F8 and F9/ and Evening Session 1 of the COSPAR 28th Plenary Meeting, The Hague, Netherlands, June 25-July 6, 1990. A92-20933 07-55) *Advances in Space Research* (ISSN 0273-1177), vol. 12, no. 4, 1992, p. 281-285. refs

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Comet Halley studies indicate most of the nucleus is covered by an insulating crust, presumed of pyrolyzed organic material. The subcrust is warmed and percolated by gases within 2AU, so provides one habitat for primitive replicating organisms. Cracks and crevices within contaminated ice in the craters provides a habitat for photosynthesizing organisms. Subsurface lakes on the Europa model, though insulated by some meters of ice, would require a trigger (perhaps meteorite impact) and energy source (chemical or metabolic energy) to initiate and maintain a suitable habitat on short period comets. Constraints on transfer between comets and other planetary bodies implies that radiation-resistant species with lengthy hibernation potential would be expected. Author

A92-21015

AN ESTIMATE OF THE PREVALENCE OF BIOCOMPATIBLE AND HABITABLE PLANETS

MARTYN J. FOGG (Probability Research Group, London, England) *British Interplanetary Society, Journal* (ISSN 0007-094X), vol. 45, Jan. 1992, p. 3-12. refs

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Consideration is given to a Monte Carlo computer model of extrasolar planetary formation and evolution, which includes the planetary geochemical carbon cycle. Results of a run of one-million galactic disk stars are presented where the aim was to assess the possible abundance of both biocompatible and habitable

planets. The model provides an estimate of one biocompatible planet per 39 stars, with the subset of habitable planets being much rarer at one such planet per 413 stars. It is suggested that the nearest biocompatible planet may lie about 14 LY distant and the nearest habitable planet about 31 LY away. If planets form in multiple star systems then the above planet/star ratio may be more than doubled. It is concluded that, by applying the results to stars in the solar neighborhood, it is possible to identify 28 stars at distances of less than 22 LY with a nonzero probability of possessing a biocompatible planet. O.G.

A92-21016

AN APPROACH TO THE DETECTION OF MICROBE LIFE IN PLANETARY ENVIRONMENTS THROUGH CHARGE-COUPLED DEVICES

S. V. LYSENKO, M. I. KOZLOVSKII, I. S. POGODIN (AN SSSR, Institut Mikrobiologii, Moscow, USSR), and M. D. NUSSINOV (British Interplanetary Society, *Journal* (ISSN 0007-094X), vol. 45, Jan. 1992, p. 13, 14. refs

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Charge-coupled devices are proposed for detecting the growth of microorganism colonies. The accuracy of the method is characterized by a channel width, and its sensitivity is characterized by the signal-to-noise ratio. The method was tested on a dense nutrient medium, which is considered to be more suitable for microorganisms of the dry Martian soil than the water solution of nutrients employed in the Viking's strategy. O.G.

A92-21017

POLYCONDENSATION REACTIONS OF CERTAIN BIOLOGICALLY ESSENTIAL MOLECULES ON MINERAL SURFACES

V. A. OTROSHCHENKO, L. N. MOISEEVA, N. V. VASIL'EVA, T. F. STRIGUNKOVA, and R. KH. EGOFAKOVA (AN SSSR, Institut Biokhimii, Moscow, USSR) *British Interplanetary Society, Journal* (ISSN 0007-094X), vol. 45, Jan. 1992, p. 15-21. refs

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Processes occurring on mineral and clay mineral surfaces are illustrated, and the possible role of clays in prebiological evolution is discussed. It is concluded that the interaction between organic molecules and mineral surfaces may be responsible not only for the accumulation and stabilization of precursor molecules but also for the selection and catalysis of oligonucleotides and oligopeptides. It is suggested that the mineral surface acts as a substrate for more complicated interactions, enabling specific matrix synthesis of nucleotides to proceed due to fixation of matrix molecules. O.G.

A92-21019

HYDROGEN CYANIDE POLYMERIZATION - A PREFERRED COSMOCHEMICAL PATHWAY

CLIFFORD N. MATTHEWS (Illinois, University, Chicago) *British Interplanetary Society, Journal* (ISSN 0007-094X), vol. 45, Jan. 1992, p. 43-48. refs

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HCN polymerization and its significance for prebiotic and extraterrestrial chemistry are discussed. Results of laboratory and extraterrestrial investigations suggest that hydrogen cyanide polymers plus water yield heteropolypeptides. This process accounts not only for the past synthesis of protein ancestors on earth but also for reactions proceeding elsewhere today within the solar system, on planetary bodies and satellites around other stars and in the dusty molecular clouds of spiral galaxies. It is concluded that the existence of this preferred pathway, hydrogen cyanide polymerization, increases greatly the probability that carbon-based life is widespread in the universe. O.G.

A92-21498

Scripps Institution of Oceanography, La Jolla, CA. OXYGEN SUPERSATURATION IN ICE-COVERED ANTARCTIC LAKES - BIOLOGICAL VERSUS PHYSICAL CONTRIBUTIONS

H. CRAIG (Scripps Institution of Oceanography, La Jolla, CA), R. A. WHARTON, JR. (Nevada, University, Reno), and C. P. MCKAY (NASA, Ames Research Center, Moffett Field, CA) *Science* (ISSN

0036-8075), vol. 255, Jan. 17, 1992, p. 318-321. refs
(Contract NSF DPP-87-22718; NAGW-972; NSF DPP-84-16340;
NCA2-182)
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Lake Hoare is one of a number of ice-covered polar lakes in the Dry Valley Region of southern Victoria Land, Antarctica. Analysis of N₂, O₂, and Ar in bubbles from this lake's ice indicates that while O₂ is about 2.4 times supersaturated in the water below the ice, only 11 percent of the O₂ input to this lake is due to biological activity and the balance is derived from meltwater inflow. In Lake Hoare, as much as 70 percent of total gas loss may occur by advection through the ice cover; the remaining gas fractions are removed by respiration at the lower boundary in the case of O₂, and by molecular exchange with the atmosphere in the peripheral summer moat around the ice. O.C.

A92-22103

DIKETOPIPERAZINE-MEDIATED PEPTIDE FORMATION IN AQUEOUS SOLUTION. II - CATALYTIC EFFECT OF PHOSPHATE

O. TAKAOKA, Y. YAMAGATA, and K. INOMATA (Kanazawa University, Japan) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 113-118. refs
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Results are presented from experiments illustrating the catalytic effect of orthophosphate on the condensation reaction between diketopiperazine (DKP) and glycine (Gly) or with oligoglycines (Gly_{n+2}) producing longer oligoglycines. In the experiments, synthesis of Gly₄ and Gly₂ was carried out in orthophosphate solutions of various molarity (between 0.06 and 0.24 M), at a neutral pH at 41 °C. The yields of Gly₄ increased almost linearly with increasing concentrations, up to a yield that was about 100 times higher than in the absence of the orthophosphate. In the case of Gly₃, formed from Gly and DKP (glycine anhydride), the yield was only 10 times higher than the absence of orthophosphate. I.S.

A92-22104

GROWTH OF PEPTIDE CHAINS ON SILICA IN ABSENCE OF AMINO ACID ACCESS FROM WITHOUT

TARAS I.U. GROMOVOI, VLADIMIR A. BASIUK, and ALEKSEI A. CHUIKO (AN USSR, Institut Khimii Poverkhnosti, Kiev, Ukrainian SSR) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 119-128. refs
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Results are presented from a study of peptide production during thermal treatment of chemisorbed (on partially dehydrated silica) glycine and valine vapors, by following changes in IR spectra. The results demonstrated growth of peptide products from these chemisorbed species. It was found that the presence of an alpha substituent in valine results in a lower reactivity in the processes of intermolecular condensation as compared to glycine. A scheme is suggested for the peptide chain growth on the silica surface in absence of amino acids, based on the concept of the ester-type activated intermediates. I.S.

A92-22105

CHEMICAL TRANSFORMATIONS OF PROTEINOGENIC AMINO ACIDS DURING THEIR SUBLIMATION IN THE PRESENCE OF SILICA

VLADIMIR A. BASIUK, TARAS I.U. GROMOVOI, ALEKSANDR M. GLUKHOI, and VITALII G. GOLOVATYI (AN USSR, Institut Khimii Poverkhnosti, Kiev, Ukrainian SSR) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 129-144. refs
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The reactions taking place when gram quantities of proteinogenic amino acids are sublimed in the presence of silica were investigated using results of high-performance liquid chromatography and fast-atom-bombardment mass spectrometry in experiments conducted with 11 amino acids, including several D-amino acids. Results showed that, in the case of aliphatic bifunctional amino acids (i.e., not containing heteroatoms in the

alpha substituent), diketopiperazines were the main products of the silica-catalyzed thermal transformations. In the case of trifunctional amino acids and phenylalanine, the reaction products included those of decarboxylation and deamination. The possible mechanisms of these reactions are discussed. I.S.

A92-22107* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

HYDROGEN PEROXIDE AND THE EVOLUTION OF OXYGENIC PHOTOSYNTHESIS

C. P. MCKAY (NASA, Ames Research Center, Moffett Field, CA) and H. HARTMAN (California, University, Berkeley) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 157-163. refs
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Possible pathways for the evolution of oxygenic photosynthesis in the early reducing atmosphere of the earth are discussed. It is suggested that the abiotic production of atmospheric oxidants could have provided a mechanism by which locally oxidizing conditions were sustained within spatially confined habitats thus removing the available reductants and forcing photosynthetic organisms to utilize water (rather than ferrous or sulfide ions) as the electron donor. It is argued that atmospheric H₂O₂ played the key role in inducing oxygenic photosynthesis, because, as peroxide concentrations local environments increased, primitive organisms would not only be faced with a loss of a reductant, but would be also forced to develop a biochemical apparatus (such as catalase) that would protect them against the products of oxygenic photosynthesis. This scenario allows for the early evolution of oxygenic photosynthesis at the time when global conditions were still anaerobic. I.S.

A92-22109

DNA-STRAND BREAKS LIMIT SURVIVAL IN EXTREME DRYNESS

KLAUS DOSE, ANGELIKA BIEGER-DOSE, OLIVER KERZ, and MARKUS GILL (Mainz, Universitaet, Federal Republic of Germany) (International Symposium on the Biological Exploration of Mars, Tallahassee, FL, Oct. 26, 27, 1990) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 177-187. refs
(Contract BMFT-01-QV-174; BMFT-01-QV-8942)
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Results are presented from an experimental study in which the quantity of DNA double-strand breaks occurring in spores of *B. subtilis* during exposure to vacuum is correlated with the length of the exposure. It is shown that, during exposures of up to 12 weeks, there was a steady increase in DNA strand breaks. The same results may be expected if the same organisms would be exposed to a simulated Martian atmosphere at room temperature. On Mars, chemical processes may be slowed down by about one order of magnitude due to the lower (by about 60 K) mean temperature on Mars, but the cyclic temperature changes from 200 K to 290 K according to Martian conditions are expected to pose an additional stress factor. The results suggest that the continuous increase of DNA lesions during the long-time storage of microorganisms under vacuum may be a general phenomenon and will finally limit survival during exposures for geological periods of time. I.S.

A92-22110* Geological Survey, Flagstaff, AZ.

MARTIAN PALEOLAKES AND WATERWAYS - EXOBIOLOGICAL IMPLICATIONS

DAVID H. SCOTT, JAMES W. RICE, JR., and JAMES M. DOHM (USGS, Flagstaff, AZ) (International Symposium on the Biological Exploration of Mars, Tallahassee, FL, Oct. 26, 27, 1990) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 3, 1991, p. 189-198. refs
(Contract NASA ORDER W-15814)
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Mars may have had an early environment similar to earth's that was conducive to the emergence of life. In addition, increasing geologic evidence indicates that water, upon which terrestrial life

depends, has been present on Mars throughout its history. This evidence suggests that life could have developed not only on early Mars but also over longer periods of time in longer lasting, more element local environments. It is suggested that paleolakes may have provided such environments. Unlike the case on earth, this record of the origin and evolution of life has probably not been erased by extensive deformation of the Martian surface. The work reported in this paper has identified eleven prospective areas where large lacustrine basins may once have existed.

Author

A92-22481

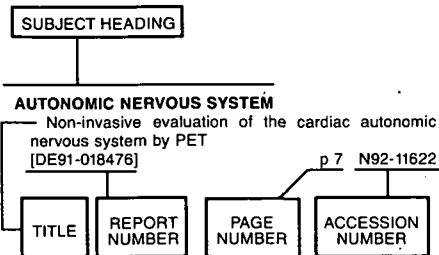
PANSPERMIA REVISITED - ASTROPHYSICAL AND BIOLOGICAL CONDITIONS FOR THE EXCHANGE OF ORGANISMS BETWEEN STARS

PAUL S. WESSON, JEFF SECKER, and JAMES R. LEPOCK (Waterloo, University, Canada) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 8 p. Research supported by NSERC and WATSPA. refs (IAF PAPER 91-616) Copyright

A series of calculations has been carried out involving bacteria and viruses attached to dust grains that are ejected from the solar system by radiation pressure and travel through space to other star systems. Under many conditions, this kind of panspermia is impractical, mainly because the ultraviolet radiation of the present sun kills the microorganisms. However, if the organisms are shielded by an absorbing material like carbon, and if the ejection takes place in the late-sun (red giant) phase, they can reach another system alive. In addition to panspermia with living microorganisms, it is noted that it is possible to seed the Galaxy with dead ones, whose DNA might provide the initial information necessary to start biological evolution in favorable environments.

Author

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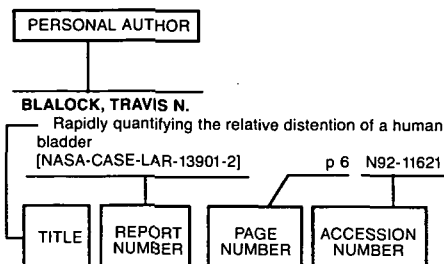
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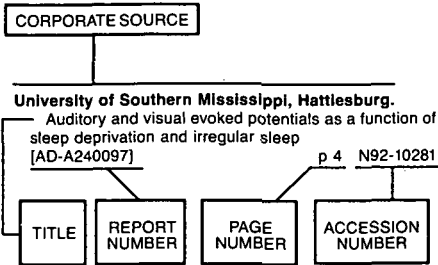
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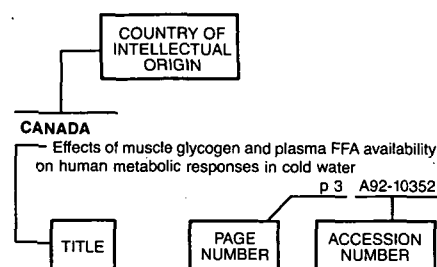
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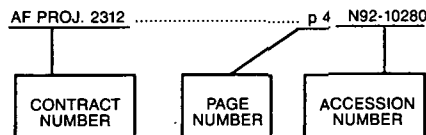
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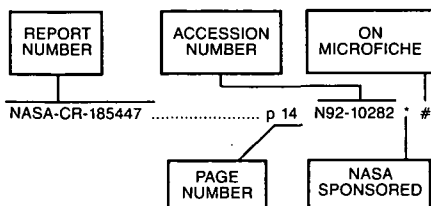
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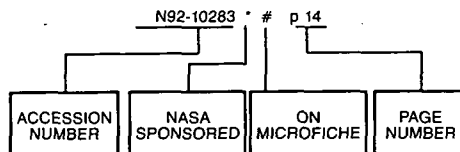
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1. Report No. NASA SP-7011(362)		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Aerospace Medicine and Biology A Continuing Bibliography (Supplement 362)				5. Report Date May 1992	
				6. Performing Organization Code JTT	
7. Author(s)				8. Performing Organization Report No.	
9. Performing Organization Name and Address NASA Scientific and Technical Information Program				10. Work Unit No.	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546				13. Type of Report and Period Covered Special Publication	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract This bibliography lists 357 reports, articles and other documents introduced into the NASA scientific and technical information system in April 1992.					
17. Key Words (Suggested by Author(s)) Aerospace Medicine Bibliographies Biological Effects			18. Distribution Statement Unclassified - Unlimited Subject Category - 52		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		22. Price * A06/HC	
		21. No. of Pages 122			

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