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October 1995

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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INTRODUCTION

This electronic issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 346 reports, articles, and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

<i>Scientific and Technical Aerospace Reports (STAR)</i> (N-10000 Series)	N95-28678 — N95-30357
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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 NASA STI Database.

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TABLE OF CONTENTS

Category 51	Life Sciences (General)	407
Category 52	Aerospace Medicine Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.	432
Category 53	Behavioral Sciences Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.	454
Category 54	Man/System Technology and Life Support Includes human engineering; biotechnology; and space suits and protective clothing.	457
Category 55	Space Biology Includes exobiology; planetary biology; and extraterrestrial life.	472
Appendix	APP-1



TYPICAL REPORT CITATION AND ABSTRACT

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ACCESSION NUMBER → **N95-10863**** National Aeronautics and Space Administration. ← **CORPORATE SOURCE**
 Ames Research Center, Moffett Field, CA.

TITLE → **BIOTELEMETRY IMPLANT VOLUME AND WEIGHT IN RATS:
 A PILOT STUDY REPORT**

AUTHOR → CHRIS J. SOMPS May 1994 19 p ← **PUBLICATION DATE**

CONTRACT NUMBER → (Contract RTOP 545-20-01)

REPORT NUMBERS → (NASA-TM-108812; A-94059; NAS 1.15:108812) Avail: CASI HC ← **AVAILABILITY AND PRICE CODE**
 A03/MF A01

This paper reports the results of a pilot study in which a 240-gram rat was implanted for 41 days with biotelemetry devices weighing a total of 36 gm (18 cc). The implanted animal showed no differences in weight gain, food and water consumption, and postnecropsy organ weights when compared to both an unoperated control animal and an animal that underwent surgery but did not receive an implant. The implanted animal also had temperature and activity rhythms similar to those reported using much smaller implants. Thus, this pilot study showed that a 240-gm rat could be implanted with biotelemetry devices weighing nearly 15 percent of body weight without significant changes in health or behavior. A larger study involving more animals and similar implant sizes is recommended.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

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ACCESSION NUMBER → **A95-63745*** National Aeronautics and Space Administration. John F. ← **CORPORATE SOURCE**
 Kennedy Space Center, Cocoa Beach, FL.

TITLE → **THE ORIGIN AND EARLY EVOLUTION OF ISSOL**

AUTHOR → RICHARD S. YOUNG NASA. Kennedy Space Center, Cocoa Beach, ← **AUTHORS' AFFILIATION**
 FL, US ISSOL Meeting, 7th, Barcelona, Spain, July 4-9, 1993.

PRIMARY DOCUMENT → A95-63744 Origins of Life and Evolution of the Biosphere (ISSN 0169- ← **JOURNAL TITLE**
 6149) vol. 24, no. 2-4. June 1994 p. 83 ← **PUBLICATION DATE**
 Copyright

This is a discussion of the beginnings of the International Society for the Study of the Origin of Life (ISSOL)—how it came to be and the people responsible for it. It will include the early meetings on the subject of the Origin of Life which led to the formation of the Society. It will discuss the genesis of the interest of NASA in such a program and how the Exobiology Program got started, leading up to the Viking Program and the early exploration of Mars. Photographs of early meetings and the scientists involved will be included.

Author (Herner)

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 406)

October 1995

51

LIFE SCIENCES (GENERAL)

A95-87297

BEHAVIOURAL CHANGES IN PARAMECIUM AND DIDINIUM EXPOSED TO SHORT-TERM MICROGRAVITY AND HYPERGRAVITY

R. BRAEUCKER Ruhr-Univ., Bochum, Germany Microgravity sciences: Results and analysis of recent spaceflights; Symposium G1 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87258 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 7 1995 p. (7)231-(7)234 Research sponsored by the Deutsche Agentur fuer Raumfahrtangelegenheiten (DARA), and the Minister fuer Wissenschaft und Forschung Copyright

The swimming behavior of two ciliate species, *Paramecium caudatum* and *Didinium nasutum* was analyzed under microgravity and hypergravity. In *Paramecium* the differences between former upward and downward swimming rates disappeared under weightlessness. At microgravity the swimming rates equalled those of horizontally swimming cells at 1g. In contrast, the swimming rates of *Didinium* increased under microgravity conditions, being larger than horizontal swimming rates at 1g. These findings are in accordance with a hypothesis of gravireception in ciliates based on electrophysiological data, which considers the different topology of mechanoreceptor channels in these species. The hypothesis received further support by data recorded under hypergravity conditions. Author (Herner)

A95-87298

GRAVITY EFFECTS ON CONNECTIVE TISSUE BIOSYNTHESIS BY CULTURED MESENCHYMAL CELLS

U. SEITZER Medizinische Univ. zu Luebeck, Luebeck, Germany, M. BODO Medizinische Univ. zu Luebeck, Luebeck, Germany, and P. K. MUELLER Medizinische Univ. zu Luebeck, Luebeck, Germany Microgravity sciences: Results and analysis of recent spaceflights; Symposium G1 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87258 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 7 1995 p. (7)235-(7)238 Research sponsored by Dara GmbH Bonn Copyright

Quantitative and qualitative aspects of collagen synthesis under microgravity, normal gravity and hypergravity conditions were investigated during the spacelab D-2 mission by incubating human fibroblast cultures with (H-3)-proline for 0, 4, 7, 10 and 20 hours. Quantitative analysis revealed an increase of collagen synthesis under microgravity conditions, being 40% higher than 1g controls. Hypergravity samples at 1.44g, 6.6g and 10g showed a decrease in collagen synthesis with increasing g, being down to about 15% at 10g. The relative proportion of collagen from total protein synthesized, the secretion of collagen by the cells, proline hydroxylation of individual collagen alpha-chains and the relative proportions of collagens I, III and V synthesized were not affected at any of the applied conditions. Author (Herner)

A95-87299

ANALYSIS OF AGGREGATION MECHANISM OF

ERYTHROCYTES UNDER NORMAL- AND MICROGRAVITY CONDITIONS

M. SINGH Indian Inst. of Tech., Madras, India and H. J. RATH ZARM - Univ. of Bremen, Bremen, Germany Microgravity sciences: Results and analysis of recent spaceflights; Symposium G1 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87258 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 7 1995 p. (7)239-(7)242 Copyright

Aggregation mechanism of erythrocytes under normal and microgravity conditions is analyzed from their recorded images. The video data is analyzed by PC/AT based image processing system. The results show that the shape of individual erythrocytes and their formed aggregates changes significantly which may affect the formation process of aggregates under microgravity conditions. Author (Herner)

A95-87485

LIFE AND GRAVITY: PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES; MEETING F1.1 OF THE COSPAR SCIENTIFIC ASSEMBLY, 30TH, HAMBURG, GERMANY, JULY 11-21, 1994

P. TODD, editor Univ. of Colorado, Boulder, CO, US, H. J. ANTON, editor Univ. zu Koeln, Koeln, Germany, P. W. BARLOW, editor Univ. of Bristol, Bristol, UK, R. GERZER, editor DLR Inst. of Aerospace Medicine, Koeln, Germany, J.-M. HEIM, editor Med. Klinikum Innenstadt der LMU Muenchen, Muenchen, Germany, R. HEMMERSBACH-KRAUSE, editor DLR Inst. of Aerospace Medicine, Koeln, Germany, K. SLENZKA, editor Univ. of Stuttgart-Hohenheim, Stuttgart, Germany, E. KORDYUM, editor National Academy of Sciences of Ukraine, Kiev, Ukraine, P. J. DUKE, editor Univ. of Texas Health Science Center at Houston, Houston, TX, US, and A. M. DUPRAT, editor Univ. Paul-Sabatier, Toulouse, France Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 300 p. (ISBN 0-08-042649-2; HTN-95-51847) Copyright

Cellular responses to altered gravity and acceleration forces are reported from in vivo and vitro research. Mechanical cellular phenomena, gravitropism and gravisensing, and the effects of inertial unloading and high loads are examined. Gravitational effects have been divided into direct and indirect in an attempt to develop a taxonomy of biological responses. Both directly gravisensing and other cells are affected by changes in gravitational forces. These effects are studies in cell culture and simple organisms. Models for simulated weightlessness include clinostat rotation with studies of various animal species and cellular processes. High gravity environments are simulated with centrifuging. Plants and plant cells are also experimental models in studies of spaceborne and earth-based simulated altered gravitational. Signal systems and membrane transport functions are affected by changed inertial forces. Embryological studies of fish and amphibia show early development affects without genetic change or abnormalities in offspring. Nerve and muscle growth and regeneration in amphibia and rodents appear accelerated by high gravity and slowed in low gravity. Enzyme and immune systems responses are also sensitive to altered gravity. For individual titles, see A95-87486 through A95-87529. Herner

51 LIFE SCIENCES (GENERAL)

A95-87486* National Aeronautics and Space Administration, Washington, DC.

THEORIES AND MODELS ON THE BIOLOGICAL OF CELLS IN SPACE

P. TODD Univ. of Colorado, Boulder, CO, US and D. M. KLAUS Univ. of Colorado, Boulder, CO, US Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 *Advances in Space Research* (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 3-10 Research sponsored by NASA and the Colorado Inst. for Research in Biotechnology

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A wide variety of observations on cells in space, admittedly made under constraining and unnatural conditions in many cases, have led to experimental results that were surprising or unexpected. Reproducibility, freedom from artifacts, and plausibility must be considered in all cases, even when results are not surprising. The papers in the symposium on 'Theories and Models on the Biology of Cells in Space' are dedicated to the subject of the plausibility of cellular responses to gravity — inertial accelerations between 0 and 9.8 m/s² and higher. The mechanical phenomena inside the cell, the gravitactic locomotion of single eukaryotic and prokaryotic cells, and the effects of inertial unloading on cellular physiology are addressed in theoretical and experimental studies.

Author (Herner)

A95-87487

A THEORY OF GRAVIKINESIS IN PARAMECIUM

H. MACHEMER Ruhr-Univ., Bochum, Germany Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 *Advances in Space Research* (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 11-20 Research sponsored by DARA and the Minister fuer Wissenschaft und Forschung of the state of Northrhine-Westfalia

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The archaic eukaryote unicellular microorganism, Paramecium, is propelled by thousands of cilia, which are regulated by modulation of the membrane potential. Ciliates can successfully cope with gravity, which is the phylogenetically oldest stimulus for living things. One mechanism for overcoming sedimentation is negative gravitaxis, an orientational response antiparallel to the gravity vector. We have postulated the existence of a negative gravikinesis in Paramecium, i.e. a modulation of swimming speed as a function of cellular orientation in space. With negative gravikinesis, an upward oriented cell actively augments the rate of forward swimming and depresses active locomotion during downward orientation. A brief outline of the gravikinesis hypothesis is given on a quantitative basis and experimental data are presented which have confirmed the major assumptions.

Author (Herner)

A95-87489* National Aeronautics and Space Administration, Washington, DC.

CELLULAR RESPONSES TO ENDOGENOUS ELECTROCHEMICAL GRADIENTS IN MORPHOLOGICAL DEVELOPMENT

M. F. DESROSIERS DFD Enterprises, East Lansing, MI, US Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 *Advances in Space Research* (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 27-33 Research sponsored by NASA

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Endogenous electric fields give vectorial direction to morphological development in Zea mays (sweet corn) in response to gravity. Endogenous electrical fields are important because of their ability to influence: (1) intercellular organization and development through their effects on the membrane potential, (2) direct effects such as electrophoresis of membrane components, and (3) both intracellular and extracellular transport of charged compounds. Their primary influence is in providing a vectorial dimension to the progression of one physiological state to another. Gravity perception and transduc-

tion in the mesocotyl of vascular plants is a complex interplay of electrical and chemical gradients which ultimately provide the driving force for the resulting growth curvature called gravitropism. Among the earliest events in gravitropism are changes in impedance, voltage, and conductance between the vascular stele and the growth tissues, the cortex, in the mesocotyl of corn shoots. In response to gravistimulation: (1) a potential develops which is vectorial and of sufficient magnitude to be a driving force for transport between the vascular stele and cortex, (2) the ionic conductance changes within seconds showing altered transport between the tissues, and (3) the impedance shows a transient biphasic response which indicates that the mobility of charges is altered following gravistimulation and is possibly the triggering event for the cascade of actions which leads to growth curvature.

Author (Herner)

A95-87490

POSSIBLE MECHANISMS OF PLANT CELL WALL CHANGES AT MICROGRAVITY

E. M. NEDUKHA National Academy of Sciences of Ukraine, Kiev, Ukraine Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 *Advances in Space Research* (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 37-45

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Space and clinostatic experiments revealed that changes of plant cell wall structure and its function depend on type of tissue and duration of influence. It was shown that clinostat conditions reproduce the part of weightlessness biological effects. It is established that various responses of wall structural-metabolic organization occur at microgravity: changes of cell walls ultrastructure and organelles structure; decrease of synthesis of primary plant cell wall; rearrangements of polysaccharides content. It is shown that mechanisms of plant cell wall changes at microgravity are connected with decrease of cellulose crystallization, activation of pectolytic enzymes and rearrangement of calcium balance of apoplast and cytoplasm.

Author (Herner)

A95-87491

POSSIBLE USE OF A 3-D CLINOSTAT TO ANALYZE PLANT GROWTH PROCESSES UNDER MICROGRAVITY CONDITIONS

T. HOSON Osaka City Univ., Osaka, Japan, S. KAMISAKA Osaka City Univ., Osaka, Japan, B. BUCHEN Univ. Bonn, Bonn, Germany, A. SIEVERS Univ. Bonn, Bonn, Germany, M. YAMASHITA Inst. of Space and Astronautical Science, Sagami-hara, Japan, and Y. MASUDA Tezukayama College, Nara, Japan Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 *Advances in Space Research* (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 47-53

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A three-dimensional (3-D) clinostat equipped with two rotation axes placed at right angles was constructed, and various growth processes of higher plants grown on this clinostat were compared with ground controls, with plants grown on the conventional horizontal clinostat, and with those under real microgravity in space. On the 3-D clinostat, cress roots developed a normal root cap and the statocytes showed the typical polar organization except a random distribution of statoliths. The structural features of clinostatted statocytes were fundamentally similar to those observed under real microgravity. The graviresponse of cress roots grown on the 3-D clinostat was the same as the control roots. On the 3-D clinostat, shoots and roots exhibited a spontaneous curvature as well as an altered growth direction. Such an automorphogenesis was sometimes exaggerated when plants were subjected to the horizontal rotation, whereas the curvature was suppressed on the vertical rotation. These discrepancies in curvature between the 3-D clinostat and the conventional ones appear to be brought about by the centrifugal force produced. Thus, the 3-D clinostat was proven as a useful device to simulate microgravity.

Author (Herner)

A95-87492
INFLUENCE OF LONGITUDINAL WHOLE ANIMAL
CLINOROTATION OF LENS, TAIL, AND LIMB
REGENERATION IN URODELES

H. J. ANTON Univ. of Cologne, Cologne, Germany, E. N. GRIGORYAN Russian Academy Science, Moscow, Russia, and V. I. MITASHOV Russian Academy Science, Moscow, Russia Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 55-65
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Two species of newts (Urodela) and two types of clinostats for fast clinorotation (60 rpm) were used to investigate the influence of simulated weightlessness on regeneration and to compare results obtained with data from spaceflight experiments. Seven or fourteen days of weightlessness in Russian biosatellites caused acceleration of lens and limb regeneration by an increase in cell proliferation, differentiation, and rate of morphogenesis in comparison with ground controls. After a comparable time of clinorotation the results obtained with *Triturus vulgaris* using a horizontal clinostat were similar to those found in spaceflight. In contrast, in *Pleurodeles waltl* using both horizontal and radial clinostats the results were contradictory compared to *Triturus*. We speculate that different levels of gravity or/and species specific thresholds for gravitational sensitivity could be responsible for these contradictory results. Author (Herner)

A95-87493
AN INTRODUCTION TO GRAVITY PERCEPTION IN PLANTS
AND FUNGI — A MULTIPLICITY OF MECHANISMS

P. W. BARLOW Univ. of Bristol, Bristol, UK Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 69-72
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The origin and subsequent evolution of life on Earth has taken place within an environment of which a 1g gravitational force is a part. Thus, all living organisms accommodate this variable in their structure and function. Evolution has also selected mechanisms to sense gravity which, in consequence, give particular orientations to living process. It is anticipated that the higher the evolutionary status of an organism, the greater the chance that it will possess multiple mechanisms of gravisensing because evolution discards nothing that assists fitness, but only adds to existing processes. A multiplicity of mechanisms permits gravity to participate in a wide range of developmental program, such as taxes, morphisms and tropisms, through the action of different sensor and distinct transduction/response pathways. Author (Herner)

A95-87494
GRAVIRESPONSES IN FUNGI

D. MOORE Univ. of Manchester, Manchester, UK Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 73-82
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Although the orientation of mycelial hyphal growth is usually independent of the gravity vector, individual specialized hyphae can show response to gravity. This is exemplified by the sporangiophore of *Phycomyces*, but the most striking gravitropic reactions occur in mushroom fruit bodies. During the course of development of a mushroom different tropisms predominate at different times; the young fruit body primordium is positively phototropic, but negative gravitropism later predominates. The switch between tropisms has been associated with meiosis. The spore-bearing tissue is positively gravitropic and responds independently of the stem. Bracket polypores do not show tropisms but exhibit gravimorphogenetic responses: disturbance leads to renewal of growth producing an entirely new fruiting structure. Indications from both clinostat and

space flown experiments are that the basic form of the mushroom (overall tissue arrangement of stem, cap, gills, hymenium, veil) is established independently of the gravity vector although maturation, and especially commitment to the meiosis-sporulation pathway, requires the normal gravity vector. The gravity perception mechanism is difficult to identify. The latest results suggest that disturbance of cytoskeletal microfilaments is involved in perception (with nuclei possibly being used as statoliths), and Ca₂(+) -mediated signal transduction may be involved in directing growth differentials. Author (Herner)

A95-87495
MORPHOMETRIC ANALYSIS OF CELL SIZE PATTERNING
INVOLVED IN GRAVITROPIC CURVATURE OF THE STIPE
OF COPRINUS CINEREUS

J. P. GREENING Univ. of Manchester, Manchester, UK and D. MOORE Univ. of Manchester, Manchester, UK Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 83-86
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During gravitropic bending of the stipe of *Coprinus cinereus* the majority of elongation occurred in the apical region of the lower surface of the stipe, although some elongation was seen throughout the stipe. The final rate of elongation was similar at both the upper and lower stipe surfaces but the lower surface achieved this rate first, whilst the upper surface of the stipe only attained its final elongation rate after a period of acceleration of 150 min. Detailed morphometric analysis of cell size patterning in transverse sections revealed no significant differences in cross sectional area, spatial or proportional distribution of different cell types between the upper and lower regions of the gravitropic bend. Measurements of longitudinal cell size revealed significant differences in compartment size between the lower and upper region. Hyphal compartments of lower regions of the bend were on average four to five times longer than those of the upper region. Author (Herner)

A95-87496
THE ROLE OF CALCIUM ACCUMULATION AND THE
CYTOSKELETON IN THE PERCEPTION AND RESPONSE
OF COPRINUS CINEREUS TO GRAVITY

L. NOVAK FRAZER Univ. of Manchester, Manchester, UK and D. MOORE Univ. of Manchester, Manchester, UK Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 87-90
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The role of Ca₂(+) in the gravitropic perception and/or response mechanism of *Coprinus cinereus* was examined by treating stipes with inhibitors of Ca₂(+) transport and calmodulin. Inhibitors had no effect on gravity perception but significantly diminished gravitropism. It is concluded that, under the conditions tested, Ca₂(+) is not involved in gravity perception by *Coprinus* stipes, but does contribute to transduction of the gravitropic impulse. The results would be consistent with regulation of the gravitropic bending process requiring accumulation of Ca₂(+) within a membrane-bound compartment. Treatment of stipes with an actin inhibitor caused a significantly delayed response, a result not observed with the Ca₂(+) inhibitors. This suggests that cytoskeletal elements may be involved directly in perception of gravity by *Coprinus* stipes while Ca₂(+) -mediated signal transduction may be involved in directing growth differentials. Author (Herner)

A95-87497
STRUCTURE OF CRESS ROOT STATOCYTES IN
MICROGRAVITY (BION-10 MISSION)

R. LAURINAVICIUS Inst. of Botany, Vilnius, Lithuania, A. STOCKUS Inst. of Botany, Vilnius, Lithuania, B. BUCHEN Univ. Bonn, Bonn, Germany, and A. SIEVERS Univ. Bonn, Bonn, Germany Life and gravity: Physiological and morphological responses; Meeting F1.1

51 LIFE SCIENCES (GENERAL)

of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 91-94 Research sponsored by DARA

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Experiments on primary roots of *Lepidium sativum* L. have been performed on board the Bion-10 satellite. The experimental set-up was extremely miniaturized and completely automatic. The results demonstrate the effectiveness of the instrumentation. The spatial orientation, growth, root cap differentiation and statocyte structure of roots grown under microgravity (MG) have been compared with control roots grown on the ground (GC) and in a 1G-reference centrifuge in space (RC). Root length and cap shape did not differ between MG and control samples. Under MG, the mean distance of the statoliths from the distal cell wall of the statocytes increased significantly, the mean distance of the mitochondria decreased and the nucleus did not change its position in comparison to both controls. The number and the shape of the amyloplasts (statoliths) were not influenced by the space flight factors, but their size as well as their relative area in the cell decreased. The number of starch grains per statolith as well as their size and shape changed under MG. In MG and RC samples the number of lipid bodies in the statocytes was higher and the relative area larger than in GC samples. The relative area occupied by vacuoles was greater in RC statocytes than in GC and MG statocytes. These results partly confirm and, in addition, extend the data from earlier experiments in space. Author (Herner)

A95-87498

ACTION OF GRAVIRECEPTORS: LABILITY HYPOTHESIS AND MODEL

A. STOCKUS Inst. of Botany, Vilnius, Lithuania Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 95-98

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The plagiogravitropic growth stage usually occurring after gravitropic stimulation can be explained if (1) the liminal angle is interpreted as the angle to which the gravitropic response system tends to react after displacement and (2) the liminal angle is assumed to be labile, tending to equalize itself with the actual apex angle from the gravity vector. The process of equalization may be interpreted as adaptation of gravity-receptors to exposure angle. Based on these assumptions, an adaptational model of the gravitropic response was proposed. It is in agreement with experimental data and described adequately the plagiogravitropic growth stage occurring after gravitropic stimulation. It is supposed that such a mechanism acts in cooperation with others for initiation and maintenance of plagiogravitropic growth. Author (Herner)

A95-87499

PECULIARITIES OF ULTRASTRUCTURE OF CHLORELLA CELLS GROWING ABOARD THE BION-10 DURING 12 DAYS

A. F. POPOVA National Academy Sciences of Ukraine, Kiev, Ukraine and K. M. SYTNIK National Academy Sciences of Ukraine, Kiev, Ukraine Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 99-102

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The ultrastructure of chlorella cells grown in darkness on a solid agar medium with organic additions aboard the Bion-10 biosatellite was studied. Certain differences in submicroscopic organization of organelles in the experimental cells were revealed compared to the Earth control. The changes are registered mainly in ultrastructure of energetic organelles - mitochondria and plastids of the experimental cells, in particular, an increase of mitochondria and their cristae size, as well as an increase of the total volume of mitochondrion per cell were established. The decrease of the starch amount in the plastid

stroma and the electron density of the latter was also observed. In many experimental cells, the increase of condensed chromatin in the nuclei has been noted. Ultrastructural rearrangements in cells after laboratory experiment realized according to the thermogram registered aboard the Bion-10 were insignificant compared to the flight experiment. Data obtained are compared to results of space flight experiments carried out aboard the Bion-9 (polycapillary aquatic system) and the orbital station Mir (solid agar medium).

Author (Herner)

A95-87500

ENERGETIC METABOLISM RESPONSE IN ALGAE AND HIGHER PLANT SPECIES FROM SIMULATION EXPERIMENTS WITH THE CLINOSTAT

A. VASILENKO National Academy Sciences of Ukraine, Kiev, Ukraine and A. F. POPOVA National Academy Sciences of Ukraine, Kiev, Ukraine Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 103-106

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Adenylate state is acknowledge to be among the most convenient approaches in the study of physiological changes in plant cells under simulation of altered gravity condition with the clinostat. Adenylate levels and the ATP/ADP ratio in cytoplasmic and mitochondrial extracts of cultivated cells of *Haplopappus gracilis* and algae cells of *Chlorella vulgaris* under initial stages of the fast-rotating and slow-rotating clinorotation, as well as the long-term clinorotation, have been investigated. For analysis of ATP and ADP levels in the plant cells under the clinorotation, we applied a high-sensitive bioluminescence method using the luciferase and pyruvate kinase enzyme systems. It has been shown that the adenylate ratio is already increase during at the start of clinorotation with the different speed of rotation in the biological material tested. The considerable changes in mitochondrial ultrastructure of *Chlorella* cells, as well as the rising ATP level and dropping of the ATP/ADP ratio appear after long-duration clinorotation if compared to control material. It is probably connected with the distinctions in ATP-synthetase functioning in mitochondria of the cells under the clinorotation conditions. Author (Herner)

A95-87501

EFFECT OF SIMULATED MICROGRAVITATION ON PHYTOHORMONES AND CELL STRUCTURE OF TROPICAL ORCHIDS

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When studying the effect of two months clinostating on the phytohormonal system of orchids with different types of shoot system branching and different shoot morphology, it was determined that, as a result of simulated microgravitation, endogenous growth regulators changed less in the species with sympodial branching than in species with monopodial branching and without pseudobulbs. Stimulators prevail in the balance of growth regulators in species of the first type and inhibitors in species of the second type. Besides this, comparative analysis of structural organization of juvenile leaf surface tissue of tested orchids was carried out. Variability of size number and structure of stomatal organization were found according to species belonging to each branching type after clinostating. Electronic microscope studies show some structural peculiarities of epidermal and mesophyllous cells.

Author (Herner)

A95-87502
THE ROLE OF SIGNAL SYSTEMS IN CELL GRAVISENSITIVITY

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 Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 113-119
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Reception of physical environmental signals caused by alteration of the gravitation field leads to the shift of morpho-physiological cell characteristics. The gravity influence on a cell may be direct or non direct, its extent varying in dependence of the cell model applied. Direct influences are more pronounced in vitro, while non direct influences are usually expressed in the community of unicellular organisms (in vivo). Gravity affects morphogenesis processes, such as locomotion, adhesion, intercellular contacts, etc. At the same time, all the processes named are under control of cell integral systems of the signal transduction. Minor disturbances in this system coming from the environment, due to amplification, may provide significant modulations of the signals. So, studies of this system at the level of molecular cell reception is of great interest. Results of flight and model experiments are discussed in the present manuscript.
 Author (Herner)

A95-87503
INFLUENCE OF LONG-TERM ALTERED GRAVITY ON THE SWIMMING PERFORMANCE OF DEVELOPING CICHLID FISH: INCLUDING RESULTS FROM THE 2ND GERMAN SPACELAB MISSION D-2

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 Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 121-124
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This study presents qualitative and quantitative data concerning gravity-dependent changes in the swimming behavior of developing cichlid fish larvae (*Oreochromis mossambicus*) after a 9 resp. 10 days exposure to increased acceleration (centrifuge experiments), to reduced gravity (fast-rotating clinostat), changed accelerations (parabolic air craft flights) and to near weightlessness (2nd German Spacelab Mission D-2). Changes of gravity initially cause disturbances of the swimming performance of the fish larvae. With prolonged stay in orbit a step by step normalisation of the swimming behavior took place in the fish. After return to 1g earth conditions no somersaulting or looping could be detected concerning the fish, but still slow and disorientated movements as compared to controls occurred. The fish larvae adapted to earth gravity within 3-5 days. Fish seem to be in a distinct early developmental stages extremely sensitive and adaptable to altered gravity. However, elder fish either do not react or show compensatory behavior e.g. escape reactions.
 Author (Herner)

A95-87504
INFLUENCE OF ALTERED GRAVITY ON BRAIN CELLULAR ENERGY AND PLASMA MEMBRANE METABOLISM OF DEVELOPING LOWER AQUATIC VERTEBRATES

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 Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 125-128
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Biochemical analyses of the brain of cichlid fish larvae, exposed for 7 days to increased acceleration of 3 g (hyper-g), revealed an increase in energy availability (succinate dehydrogenase activity, SDH), and in mitochondrial energy transformation (creatine kinase, Mi(sub a) -CK), but no changes in an energy consumptive process (high-affinity Ca²⁺ -ATPase). Brain glucose-6-phosphate dehydrogenase (G6PPDH) of developing fish was previously found to be increased after hyper-g exposure. Three respectively 5 hours thereafter dramatic fluctuations in enzyme activity were registered. Analyzing the cytosolic or plasma membrane-located brain creatine kinase (BB-CK) of clawed toad larvae after long-term hyper-g exposure a significant increase in enzyme activity was demonstrated, whereas the activity of a high affinity Ca²⁺ -ATPase remained unaffected.
 Author (Herner)

A95-87505
REGENERATION OF GUINEA PIG FACIAL NERVE: THE EFFECT OF HYPERGRAVITY

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 Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 129-137
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Exposure to moderate hypergravity improves the regenerative capacity of sectioned guinea-pig facial nerve. The improvement in regeneration is tri-directional as follows: (2) an average 1.7 fold increase in rate of regeneration in guinea pigs subjected to hypergravity; (b) a 25% enhancement of facial muscle activity following the exposure to hypergravity; and (c) improvement in the quality of regeneration from an esthetic standpoint. A good correlation was recorded between the histological structure of the served nerve at the end of the regeneration and the clinical results.
 Author (Herner)

A95-87506
STUDIES OF THE INTERACTION OF GRAVITY WITH BIOLOGICAL MEMBRANES USING ALAMETHICIN DOPED PLANAR LIPID BILAYERS AS A MODEL SYSTEM

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 Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 143-150
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Gravity interacts with biological systems on different levels of complexity. For the understanding of the action of gravity on such systems at higher degrees of organization, the investigation of interactions on the membrane and even on the molecular level is crucial. To do such studies, planar lipid bilayers with incorporated transport mediating molecules, i.e. membranes of defined biochemical composition, are close to perfect model systems. In our experiments we have used painted planar lipid bilayers doped with alamethicin. Alamethicin is especially suitable for such studies because of its high sensitivity to applied external forces, which is a result of its special pore forming mechanism. Additional, different to most other transport mediating molecules, a big amount of data from the literature is available about the dependency of alamethicin pores on physical and chemical membrane parameters. We found that the conductance of alamethicin doped bilayers is dependent on the angle of the bilayer with the gravitational vector and that it furthermore can be reduced significantly under hyper gravity conditions in a centrifuge. The effect of gravity here is not an effect on the pore conductance or the membrane-aqueous solution interface, but it is due to an interaction of gravity with the pore forming mechanism, as can be shown by investigating the dependency of the alamethicin pore kinetics on the applied forces.
 Author (Herner)

51 LIFE SCIENCES (GENERAL)

A95-87507

LIPOSOME FORMATION IN MICROGRAVITY

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Liposomes are artificial vesicles with a phospholipid bilayer membrane. The formation of liposomes is a self-assembly process that is driven by the amphipathic nature of phospholipid molecules and can be observed during the removal of detergent from phospholipids dissolved in detergent micelles. As detergent concentration in the mixed micelles decreases, the non-polar tail regions of phospholipids produce a hydrophobic effect that drives the micelles to fuse and form planar bilayers in which phospholipids orient with tail regions to the center of the bilayer and polar head regions to the external surface. Remaining detergent molecules shield exposed edges of the bilayer sheet from the aqueous environment. Further removal of detergent leads to intramembrane folding and membrane vesiculation, forming liposomes. We have observed that the formation of liposomes is altered in microgravity. Liposomes that were formed at 1-g did not exceed 150 nm in diameter, whereas liposomes that were formed during spaceflight exhibited diameters up to 2000 nm. Using detergent-stabilized planar bilayers, we determined that the stage of liposome formation most influenced by gravity is membrane vesiculation. In addition, we found that small, equipment-induced fluid disturbances increased vesiculation and negated the size-enhancing effects of microgravity. However, these small disturbances had no effect on liposome size at 1-g, likely due to the presence of gravity-induced buoyancy-driven fluid flows (e.g. convection currents). Our results indicate that fluid disturbances, induced by gravity, influence the vesiculation of membranes and limit the diameter of forming liposomes. Author (Herner)

A95-87508

PHYSICO-CHEMICAL CHARACTERISTICS OF BIOMEMBRANES AND CELL GRAVISENSITIVITY

M. G. TAIRBEKOV Inst. of Biomedical Problems, Moscow, Russia Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 161-164
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The resistance of living systems to the action of environmental factors is known to be largely determined by molecular organization of biomembranes constituting the basis of the cell per se and of all intracellular organelles. Gravity as one of the environmental factors, plays a definite role in the vital activity of organisms. Therefore, the problem of altered gravity impact on biological objects should be considered in close relation to the functional state of membranes and contractible elements of cytoskeleton. Moreover, the involvement of membrane structures and cytoskeleton in the processes of reception and realization of gravitational stimulus allows us to evaluate the extent of the direct or indirect influence of gravity on cell functioning in the gravitational field. The results of experimental studies having been conducted up to this time on a variety of cells and cell organelles under altered gravity conditions demonstrated noticeable alterations in the molecular organization of the membranes. Author (Herner)

A95-87509

THE THEORETICAL CONSIDERATION OF MICROGRAVITY EFFECTS ON A CELL

A. V. KONDRACHUK National Academy of Sciences, Kiev, Ukraine and S. P. SIRENKO National Academy of Sciences, Kiev, Ukraine Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 165-168

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Mechanical processes and factors involved in gravireception of a plant cell are qualitatively considered and their changes caused by microgravity and clinostat modeling conditions are discussed. It is supposed that the most of the cell microgravity effects as well as clinostat modeling effects on a cell may be attributed to the generalized unspecific reaction of a cell to external influence.

Author (Herner)

A95-87510

FREE AND MEMBRANE-BOUND CALCIUM IN MICROGRAVITY AND MICROGRAVITY EFFECTS AT THE MEMBRANE LEVEL

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The changes of (Ca^{2+}) sub i controlled is known to play a key regulatory role in numerous cellular processes especially associated with membranes. Previous studies from our laboratory have demonstrated an increase in calcium level in root cells of pea seedlings grown aboard orbital station 'Salyut 6'. These results: (1) indicate that observed Ca^{2+} -binding sites of membranes also consist in proteins and phospholipids; (2) suggest that such effects of space flight in membrane Ca-binding might be due to the enhancement of Ca^{2+} influx through membranes. In model presented, I propose that Ca^{2+} -activated channels in plasma membrane in response to microgravity allow the movement of Ca^{2+} into the root cells, causing a rise in cytoplasmic free Ca^{2+} levels. The latter, in its turn, may induce the inhibition of a Ca^{2+} efflux by Ca^{2+} -activated ATPases and through a Ca^{2+}/H antiport. It is possible that increased cytosolic levels of Ca^{2+} ions have stimulated hydrolysis and turnover of phosphatidylinositols, with a consequent elevation of cytosolic (Ca^{2+}) sub i. Plant cell can response to such a Ca^{2+} rise by an enhancement of membranous Ca^{2+} -binding activities to rescue thus a cell from an abundance of a cytotoxin. A Ca^{2+} -induced phase separation of membranous lipids assists to appear the structure nonstable zones with high energy level at the boundary of microdomains which are rich by some phospholipid components; there is mixing of molecules of the membranes contacted in these zones, the first stage of membranous fusion, which was found in plants exposed to microgravity. These results support the hypothesis that a target for microgravity effect is the flux mechanism of Ca^{2+} to plant cell. Author (Herner)

A95-87512

GRAVIMORPHOGENESIS AND ULTRASTRUCTURE OF THE FUNGUS FLAMMULINA VELUTIPES GROWN IN SPACE, ON CLINOSTATS AND UNDER HYPER-G CONDITIONS

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The D-2 mission provided the facilities to cultivate the higher basidiomycete *Flammulina velutipes* (Agaricales) in space for about 8 days. Gravimorphogenesis of developing fruiting body primordia in weightlessness was documented in comparison to cultures incubated on a 1 x g reference centrifuge in space. Chemical fixation of fruiting bodies took place for later ultrastructural analysis. The micro-g grown fruiting bodies exhibited random orientation compared to the 1 x g-cultures where fruiting bodies showed exactly negative gravitropic orientation. Weightlessness did not impair fruiting body morphogenesis and growth although flat and helically twisted stipes were observed. Ultrastructural analyses of micro-g, 1 x g- and 20 x g-

samples did not reveal sedimentable cell components. Gravitropic bending involves growth inhibition at the upper side of a horizontally oriented transition zone, the graviperceptive region of the stipe. The fastest ultrastructural response to the altered direction of the acceleration force is the accumulation of cytosolic vesicles at the lower part of this region. They contribute to the expansion of the central vacuole and therefore to the differential enlargement of the lower side of the stipe. Author (Herner)

A95-87513
EFFECT OF CLINOSTAT ROTATION ON DIFFERENTIATION OF EMBRYONIC BONE IN VITRO

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We have investigated the effect of changes in the gravity vector on osteoblast behavior, using the clinostat set at 8 rpm. Two sources of osteoblasts were used: secondary cultures of fetal rat bone cells, and the rat osteosarcoma line 17/2.8 (ROS). Cell number was determined by incubation with 3-(4, dimethyl-2yl)-2,3 diphenyl tetrazolium bromide (MTT) and measurement of optical density at 570 nm (OD). Alkaline phosphatase activity was detected by standard cytochemical methods. Dividing cells were localized by labeling dividing nuclei with Bromodeoxyuridine (BrdU), detected by immunofluorescence. Cell culture was initiated at densities between 1-4 x 10(exp 4) cells/ml. Growth rates in all cultures during the first 48 hours exposure to clinostat rotation were less than in stationary controls. After 3 days, ROS cell numbers were 35% lower, and calvarial cells 39% lower than their respective controls. Alkaline phosphatase activity in calvarial control cultures was uniformly present in characteristically polygonal cells, but after culture in the clinostat the enzyme was present sporadically, and the cells were cuboid. These were also no BrdU uptake in nuclei, but it was present in cell cytoplasm. We conclude that the clinostat decreases cell numbers and cell division. Both cell shape and the distribution of alkaline phosphatase activity in calvarial cell cultures were also affected. This implies that changes in the gravity vector can affect osteoblasts directly, without interaction with other cell types. Author (Herner)

A95-87514
IN VIVO AND IN VITRO STUDIES OF CARTILAGE DIFFERENTIATION IN ALTERED GRAVITIES

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The in vivo model our laboratory uses for studies of cartilage differentiation in space is the rat growth plate. Differences between missions, and in rat age and recovery times, provided differing results from each mission. However, in all missions, proliferation and differentiation of chondrocytes in the epiphyseal plate of spaceflown rats was altered as was matrix organization. In vitro systems, necessary complements to in vivo work, provide some advantages over the in vivo situation. In vitro, centrifugation of embryonic limb buds suppressed morphogenesis due to precocious differentiation, and changes in the developmental pattern suggest the involvement of Hox genes. In space, embryonic mouse limb mesenchyme cells differentiating in vitro on IML-1 had smoother membranes and lacked matrix seen in controls. Unusual formations, possibly highly ruffled membranes, were found in flight cultures. These results, coupled with in vivo centrifugation studies, show that

in vivo or in vitro, the response of chondrocytes to gravitational changes follows Hert's curve as modified by Simon, i.e. decreased loading decreases differentiation, and increased loading speeds it up, but only to a point. After that, additional increases again slow down chondrogenesis. Author (Herner)

A95-87515* National Aeronautics and Space Administration, Washington, DC.

CRUSTACEANS AS A MODEL FOR MICROGRAVITY-INDUCED MUSCLE ATROPHY

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Atrophy of skeletal muscles is a serious problem in a microgravity environment. It is hypothesized that the unloading of postural muscles, which no longer must resist gravity force, causes an accelerated breakdown of contractile proteins, resulting in reduction in muscle mass and strength. A crustacean model using the land crab, *Gecarcinus lateralis*, to assess the effects of spaceflight on protein metabolism is presented. The model is compared to a developmentally-regulated atrophy in which a premolt reduction in muscle mass allows the withdrawal of the large claws at molt. The biochemical mechanisms underlying protein breakdown involves both Ca²⁺-dependent and multicatalytic proteolytic enzymes. Crustacean claw muscle can be used to determine the interactions between shortening and unloading at the molecular level. Author (Herner)

A95-87516* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

REGULATIVE DEVELOPMENT OF XENOPUS LAEVIS IN MICROGRAVITY

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To test whether gravity is required for normal amphibian development, *Xenopus laevis* females were induced to ovulate aboard the orbiting Space Shuttle. Eggs were fertilized in vitro, and although early embryonic stages showed some abnormalities, the embryos were able to regulate and produce nearly normal larvae. These results demonstrate for the first time that a vertebrate can ovulate in the virtual absence of gravity, and that the eggs can develop to a free-living stage. Author (Herner)

A95-87517
TRANSIENT EFFECTS OF MICROGRAVITY ON EARLY EMBRYOS OF XENOPUS LAEVIS

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In order to study the role of gravity on the early development of the clawed toad *Xenopus laevis*, we performed an experiment on the Maser-6 sounding rocket launched from Kiruna (Sweden) on 4 Nov 1993. The aim was to find out whether a short period of microgravity

51 LIFE SCIENCES (GENERAL)

(micro-g) during fertilization and the first few minutes of development does indeed result in abnormal axis formation as was suggested by pilot experiment on the Maser 3 in 1989. On the Maser 6 we used two new technical additions in the Fokker CIS unit, viz. a 1-g control centrifuge and a video recording unit which both worked successfully. The 1-g control centrifuge was used to discriminate between the influences of flight perturbations and micro-g. After fertilization shortly before launch, one of the first indications of successful egg activation, the cortical contraction, we registered in micro-g and on earth. Analysis of the video tapes revealed that the cortical contraction in micro-g starts earlier than at 1 g on earth. After recovery of the eggs fertilized in micro-g and culture of the embryos on earth, the morphology of the blastocoel has some consistent differences from blastulae from eggs fertilized in the 1-g centrifuge of the rocket. However from the gastrula stage onward, the micro-g embryos apparently recover and resume normal development: the X_{Bra} gene is normally expressed, and histological examination shows normal axis formation. Author (Herner)

A95-87518

GRAVITATIONAL EFFECTS ON THE REARRANGEMENT OF CYTOPLASMIC COMPONENTS DURING AXIAL FORMATION IN AMPHIBIAN DEVELOPMENT

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The spatial positioning of the dorsal-ventral axis in the amphibian, *Xenopus laevis*, can be experimentally manipulated either by tipping the embryo relative to Earth's gravitational force vector or by centrifugation. Experimental evidence suggests that certain cytoplasmic components are redistributed during the first cell cycle and that these components are, in part, responsible for the establishment of this axis. Further studies indicate that at least some of the cytoplasmic components responsible for establishing this axis may be RNA. Recombinant cDNA and PCR technology are utilized to isolate DNA clones for messenger RNA which becomes spatially localized to the dorsal side of the embryo. These clones are being used to study the mechanisms of spatial localization and the function of the localized RNA transcripts. Author (Herner)

A95-87519

AMPHIBIAN TAIL REGENERATION IN SPACE: EFFECT ON THE PIGMENTATION OF THE BLASTEMA

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In Urodele amphibians, the tail regenerates after section. This regeneration, including tissues as different as bone (vertebrae), muscle, epidermis and central nervous system (spinal cord), was studied in adult *Pleurodeles* sent aboard the Russian satellite Bion 10 and compared with tail regeneration in synchronous controls. Spinal cord, muscle and cartilage regeneration occurred in space animals as in synchronous controls. One of the most important differences between the two groups was the pigmentation of the blastemas; it was shown in laboratory, to be not due to a difference in light intensity. Author (Herner)

A95-87520

REGENERATION OF ORGANS AND TISSUES IN LOWER VERTEBRATES DURING AND AFTER SPACE FLIGHT

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In this paper most important data obtained in studies on the effect of space flight conditions on regeneration in the adult newt are summarized. We demonstrate a phenomenon of synchronization of limb and lens regeneration and increase in its rate during and after space flight. We also describe a peculiarities of cell proliferation in lens, limb and tail regenerates and of the process of minced muscle regeneration. Author (Herner)

A95-87521

ASTRONEWT: EARLY DEVELOPMENT OF NEWT IN SPACE

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AstroNewt experiment explores the effects of earth gravity on the early development of Japanese red-bellied newt, *Cynops pyrrhogaster*. Since female newts keep spermatophore in cloaca, fertilized eggs could be obtained without mating. Fertilization of newt's egg occurs just prior to spawning, so that gonadotrophic cues applies to females in orbit leads to laying eggs fertilized just in space. A property of newt being kept in hibernation at low temperature may be of great help for the space experiment carried out with much limited resources. A general outline of the AstroNewt project is shown here in addition to some technical advances for the development of the project. Experimental schemes of two space experiments (IML-2 in summer 1994 and unmanned SFU at the beginning of 1995) are also shown. Author (Herner)

A95-87522

THE PLEURODELE, AN ANIMAL MODEL FOR SPACE BIOLOGY STUDIES

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Pleurodeles waltl, an Urodele amphibian is proposed as a model for space biology studies. Our laboratory is developing three types of experiments in space using this animal: (1) in vivo fertilization and development ('FERTILE' project); (2) influence of microgravity and space radiation on the organization and preservation of specialized structures in the neurons and muscle cells (in vitro; 'CELIMENE' PROJECT); (3) influence of microgravity on tissue regeneration (muscle, bone, epidermis and spinal cord). Author (Herner)

A95-87523

FATE OF THE GRAFTED OVARIES FROM FEMALE SALAMANDER PLEURODELES WATL EMBARKED ON THE COSMOS 2229 FLIGHT

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The flight procedure of 'Experience Triton' on Cosmos 2229 made necessary to sacrifice the embarked females just after landing. In order to detect genetic abnormalities in the progeny of these adult females, we have performed a surgical procedure based on the transplantation of an ovarian piece on a recipient animal. One year later, as observed after laparotomy, the grafted ovaries exhibit oogonies and some growing oocytes. In present time, out of 10 castrates and grafted adult females only one is still alive bearing a large grafted ovary. Out of 5 castrated and grafted juvenile males, there are still alive, two of them exhibit a developing grafted ovary. The grafted animals will be ready for mating within a few months. Therefore, it will soon be possible to study the progeny of animals that have been submitted to space conditions. Author (Herner)

A95-87524

PEPTIDASE-1 EXPRESSION IN SOME ORGANS OF THE SALAMANDER PLEURODELES WATL SUBMITTED TO A 12-DAY SPACE FLIGHT

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In Pleurodeles, the peptidase-1 is a sex-linked enzyme encoded by two codominant genes (Pep-1A and Pep-1B) located on the Z and W sex chromosomes. The sexual genotype can be determined by the electrophoretic pattern of the peptidase from erythrocytes. Z(sub A) W(sub B) genotypic females characterized by 3 electrophoretic bands AA, AB and BB were embarked on Cosmos 2229. The pattern in ovary, muscles and gut issued from the embarked or synchrone females displayed the 3 characteristic bands. In heart and kidney, the bands AA and BB were revealed, while the band BB appeared very faintly. The specific enzymatic activity in the same organs was compared. Except for the kidney, no statistical significant difference was observed between flight and synchrone samples. This enzyme can be efficiently used as sexual genotypic marker of Pleurodeles experimentally submitted to the effects of space environment. Author (Herner)

A95-87525

EARLY DEVELOPMENT IN AQUATIC VERTEBRATES IN NEAR WEIGHTLESSNESS DURING THE D-2 MISSION STATEX PROJECT

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Aboard the German-Spacelab-Mission D-2 the project 'Gravity Perception and Neuronal Plasticity (STATEX II)' was performed. STATEX is for STATolith EXperiment. Objects were growing tadpoles of the South African Toad (*Xenopus laevis* D.) and a juvenile cichlid fish (*Oreochromis mossambicus*). The results give a broader base for the understanding of how environmental stimuli (e.g. linear accelerations) affect the development and function of the gravity perceiving systems in these two vertebrates. These systems are accepted as models for the human vestibulum. Results of experiments in hyper-g (up to 5 g), simulated weightlessness (Fast-rotating-clinostat) and parabolic flights are compared and discussed. Author (Herner)

A95-87526

HISTOCHEMICAL INVESTIGATIONS ON THE INFLUENCE OF LONG-TERM ALTERED GRAVITY ON THE CNS OF DEVELOPING CICHLID FISH: RESULTS FROM THE 2ND GERMAN SPACELAB MISSION D-2

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The effect of long-term (10 days) altered gravitational conditions upon succinate dehydrogenase (SDH) reactivity in total brains as well as in individual brain nuclei of developing cichlid fish larvae had been investigated by means of semiquantitative histochemical methods (densitometric grey value analysis). Increasing accelerations from near weightlessness (spaceflight) via 1g controls to 3g hyper gravity (centrifuge) resulted in slightly increasing 'all over the brain' (total brain) SDH reactivity. When focusing on distinct neuronal integration centers within the same brains in order to find the anatomical substratum of the gross histochemical data, significant effects of altered gravity only within vestibulum related brain parts were obtained. Author (Herner)

A95-87527

INFLUENCE OF ALTERED GRAVITY ON THE CYTOCHEMICAL LOCALIZATION OF CYTOCHROME OXIDASE ACTIVITY IN CENTRAL AND PERIPHERAL GRAISENSORY SYSTEMS IN DEVELOPING CICHLID FISH

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Cichlid fish larvae were reared from hatching to active free swimming under different gravity conditions: natural environment, increased acceleration in a centrifuge, simulated weightlessness in a clinostat and near weightlessness during space flight. Cytochrome oxidase activity was analyzed semiquantitatively on the ultrastructural level as a marker of regional neuronal activity in a primary, vestibular brainstem nucleus and in gravity receptive epithelia in the inner ear. Our results show, that gravity seems to be positively correlated with cytochrome oxidase activity in the magnocellular nucleus of developing fish brain. In the inner ear the energy metabolism is decreased under microgravity concerning utricle but not saccule. Hypergravity has no effect on cytochrome oxidase activity in sensory inner ear epithelia. Author (Herner)

51 LIFE SCIENCES (GENERAL)

A95-87528

CHONDROGENESIS IN AGGREGATES OF EMBRYONIC LIMB CELLS GROWN IN A ROTATING WALL VESSEL

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Previous studies in this lab have shown that chondrogenesis is affected in growth plates of rats exposed to microgravity, and in micromass cultures of embryonic limb mesenchyme differentiating in space. In order to provide a three dimensional aspect not seen in the micromass system, and a tissue homogeneity not possible with explants of limb or limb elements, and to alleviate certain difficulties regarding crew time and stowage, we began culturing embryonic limb cells in Rotating Wall Vessels (RWV). First, these cells were attached to beads, and grown for up to 65 days in a type of RWV known as STLV at the Johnson Space Center. During this time, the cells and beads aggregated and the aggregates continued to increase in size, and differentiated into Alcian blue staining chondrocytes. Because our intent was to use these aggregates for implanting into bony defects in addition to their use in studies of chondrogenic regulation at 1g and micro-g, aggregates of these cells without beads were grown in the commercially available version of the STLV, and their ability to ossify when subcutaneously implanted assessed. Author (Herner)

A95-87529

BLOOD AND CLONOGENIC HEMOPOIETIC CELLS OF NEWTS AFTER THE SPACE FLIGHT

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Ribbed newts were used for studying the effect of space flight on board of the biosatellite (Cosmos-2229) on blood and clonogenic hemopoietic cells. In blood of newts of the flight group, the relative proportion of neutrophils increased, whereas that of lymphocytes and eosinophils decreased. Space flight did not result in loss of the ability of newt blood cells to incorporate H(sup 3)-thymidine. Analysis of clonogenic hemopoietic cells was performed using the method of hemopoietic colony formation on cellulose acetate membranes implanted into the peritoneal cavity of irradiated newts. To analyze reconstitution of hemopoiesis after irradiation donor hemopoietic cells from flight or control newts were transplanted into irradiated newts whose hemopoietic organs were investigated. The newt can be considered an adequate model for studying hemopoiesis under the conditions of the space flight. Previous studies on rats subjected to 5- to 19-day space flights revealed a decrease in the number of clonogenic cells in their hemopoietic organs accompanied by specific changes in the precursor cell compartment and in blood. Hence, it was interesting to analyze blood and hemopoietic tissue of lower vertebrates after a space flight and to compare the response to it of animals belonging to different taxonomic groups. We analyzed blood and clonogenic hemopoietic cells of ribbed newts, *Pleurodeles waltl* (age one year, weight 20-28 g) subjected to a 12-day space flight on board of a Cosmos-2229 biosatellite. The same animals were used in studies on limb and lens regeneration. The results were compared with those obtained with control groups of

newts: (1) basic control, operated newts sacrificed on the day of biosatellite launching (BC); (2) synchronous control, operated newt kept in the laboratory under simulated space flight conditions (SC) and (3) intact newts (IC). Author (Herner)

A95-88567

FISH PHYSIOLOGY FOR A MODEL OF BEHAVIORAL CHANGES IN WEIGHTLESSNESS

SATORU WATANABE Nagoya University, Nagoya, Japan, AKIRA TAKABAYASHI Fujita Gakuen Health University, Toyoake, Japan, and DAI YANAGIHARA Osaka University, Toyonaka, Japan In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 105-115
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Most fish swim around freely in the 3 dimensional space. Therefore, the vestibular organ of the fish is well developed and plays a more important role for the body equilibrium than in other vertebrates. The fish vestibular organ functions similarly to that of humans in all essential respects. Many investigators studied these vestibular organs as a model for human's ones. In this paper, at first we focused on the postural control of the fish. For this purpose, we used the dorsal light response, which was described by von Holst 1935, as a simple model for the visuo-vestibular interaction in body equilibrium. Next, in order to investigate the nervous center of the dorsal light response and to investigate the artificially made asymmetry we employed the lesion methods. Otherwise, of course, the lesion method allows us to observe the loss of function in the altered brain. Author (Herner)

A95-88570

CONVERGENCE OF VESTIBULAR AND CALLOSAL AFFERENTS ON CAT CORTICAL NEURONS IN VESTIBULAR AREA 2V

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Convergence of vestibular and callosal afferents on neurons in the cortical vestibular area in the cat was investigated. Electrical vestibular stimulation was delivered by two ways; stimulation at the round window in the inner ear and at the ampulla of the horizontal canal. A great care was taken to suppress current spread into the near-by nerves. The corpus callosum (CC) was stimulated at the vestibular projection site. Among 674 neurons tested, 6 responded to ampulla stimulation and one of the 6 responded to CC stimulation. Sixty neurons responded to round window stimulation and 8 of the 60 responded to CC stimulation. The rest of 608 neurons were not responsive to vestibular stimulation and 80 of them responded to CC stimulation. Therefore, it is concluded that the callosal afferents impinged on 2v neurons equally irrespective of a manner of vestibular inputs. Also cutaneous receptive fields were determined for 95 neurons. Among these, 27 had receptive fields in the left forelimb, 17 in the left hand, 11 in the hind limb, 7 in the left pes, 2 in the right forelimb, 1 in the right hind limb, another one in the hindlimb on both sides, 17 on the face and the rest of 12 in the trunk. Of the 95 units, 5 units responded to vestibular (window) stimulation. Author (Herner)

A95-88575

EFFECTS OF ANTI-EMETICS ON MOTION SICKNESS OF RATS

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The incidence of space motion sickness is increasing; 35% of the astronauts in Apollo, 60% in Skylab and 70% in Space Shuttle programs experienced it during their space flight. Space motion sickness is a persistent operational problem and is the most clinically significant medical phenomenon seen during the first several days of space flight. Anti-motion sickness drugs have been used to prevent space motion sickness, but their effects are limited. For developing new anti-space motion sickness drugs, it is essential to understand the pharmacological mechanism of the emetic reflex. In this report, we describe our hypothesis on the pharmacological mechanisms of the emetic reflex, based on our findings in studies with the animal model using rats. Author (Herner)

A95-88579

CHANGES IN CARDIAC OUTPUT AND BLOOD FLOW DISTRIBUTION IN THE INITIAL STAGE OF EXPOSURE TO THE MICROGRAVITATIONAL ENVIRONMENT UNDER EXPERIMENTALLY SIMULATED CONDITIONS IN THE RABBIT

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Cardiovascular deconditioning is one of the serious problems to be solved in space medicine and physiology. To understand the mechanism of this unpleasant condition and to find countermeasures for preventing or minimizing the deconditioning symptoms, many results of experimentally simulated studies and data collected in the space have been reported. However these studies have not answered to all questions and we are still on the way to the goal to get the answer. An obvious effect of weightlessness on the cardiovascular system is that body fluids shift cephalad and this physical phenomenon may be one of the principal causes related to cardiovascular deconditioning. Up to the present time, details of the hemodynamic changes due to the cephalad shifted blood, for example, changes in cardiac output or distribution of the ejected blood to each organ have not been fully understood. Therefore we have tried to infer these effects by applying head-down tilt (HDT) method which has been recognized to simulate the headward shift of body fluids and by observing changes in circulatory parameters during the initial period of head-down tilt in detail in anesthetized rabbits. In this paper we describe some results of these experiments. Author (revised by Herner)

A95-88580

EFFECTS OF HEAD DOWN TILT ON VENOUS PRESSURE GRADIENTS ALONG THE VENA CAVA IN ANESTHETIZED MONKEYS

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Several studies have been reported a role of venous responses on cardiovascular adjustments to postural change. Head down tilt at a low angle below 30 deg has been used as an experimental model

to study neural and humoral regulatory adjustment on the cardiovascular system under the microgravitational environments. However, head down tilt at a low angle did not produce any change in renal function and in heart rate, which was reflexly mediated by activation of systemic baroreceptors. In other previous studies also, it has been reported that head down tilt did not cause any significant change in cardiac output, stroke volume or heart rate. These results suggest that head down tilt may not cause an increase in venous return. Thus, it has been unclear whether head down tilt at a low angle causes a shift of blood volume into the intra-thoracic region from the lower body. Therefore, the purpose of this experiment was designed to determine venous pressure gradients between the superior vena cava and terminal iliac vein during postural changes at a tilt angles of 6 deg, 15 deg or 30 deg of both head down and head up postures in anesthetized monkeys. Author (revised by Herner)

A95-88588

EFFECTS OF TENSION PRODUCTION AND/OR NEURAL ACTIVITY ON THE REGULATION OF MUSCLE MASS DURING HINDLIMB SUSPENSION IN RATS

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It is well known that gravitational unloading during space flight or simulation model such as hindlimb suspension of rats induces an atrophy mainly in antigravity muscles. Such atrophy may be directly influenced by reduced muscular activity. However, Alford et al. reported that muscle atrophy induced by hindlimb suspension of rats is not closely related to changes in the muscle activity detected by the daily activity of electromyogram (EMG). The EMG activity disappeared in response to acute suspension of hindlimbs, although the silent EMG was not sustained when suspension was continued. Even though the total EMG activity of soleus decreased by 91% on the day of suspension compared with the pre-suspension level, it was gradually recovered and reached to 81% of normal by the 7th day. However, a significant atrophy was still observed in these muscles. Ankle joints of rats are generally kept extended when the hindlimbs are suspended. Further, the ankle extensors are shortened passively when the ankle joints are extended. Therefore, the tension may not be produced by the shortened muscles, even if they are active electrically. In the current study, the influences of EMG activity and tension production on the muscle mass in suspended rat hindlimbs were studied. Author (Herner)

A95-88589

METABOLIC AND NUTRITIONAL PROBLEMS IN SIMULATED MICROGRAVITY — INFLUENCE OF SUSPENSION HYPOKINESIA ON MUSCLE ATROPHY

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Muscle atrophy is characteristic of the prolonged hypokinesia resulting from restricted movement, prolonged bed rest, limited muscular function and immobilization. The causes may be disuse, inadequate functional loading, insufficient food intake and lack of

51 LIFE SCIENCES (GENERAL)

exercise. Space flight may be associated with more than one of these conditions, because the absence of gravity favors the diminished use of the lower limbs for postural support and locomotion, reduced loading on weight-bearing tissues, and interference with proprioceptive reflexes, which can influence muscle metabolism and function. With reduced load-bearing of the musculoskeletal system under conditions of weightlessness (both astronauts and cosmonauts), a loss of nitrogen has been demonstrated. Prolonged immobilization also leads to a negative nitrogen balance. However, according to Skylab data, a negative nitrogen balance developed in flight and then persisted for 3 weeks, but after about a month, the nitrogen balance varies from negative to slightly positive. In this study, we examined short-term hypokinesia with an animal model in relation to the effect of concentrations of dietary proteins on body weight, organ weight, nitrogen balance and muscle protein turnover.

Author (revised by Herner)

A95-88590

EFFECT OF ADRENALECTOMY AND ORCHIECTOMY ON MUSCLE ATROPHY OF RAT HINDLIMBS INDUCED BY TAIL SUSPENSION

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It is well known that space flight brings various disadvantages to our body. Among them, atrophy of anti-gravity muscles caused by a weightlessness environment is a major problem for astronauts. However, underlying mechanisms of the atrophy are not fully understood. There have been few studies on the role of hormones such as glucocorticoids and testosterone in the atrophic response while they have been shown to affect muscles in a catabolic and anabolic manner, respectively. Recently, various suspension models using rats have been developed to study muscle response to reduced load-bearing in weightlessness. We have investigated involvement of hormones in the atrophy, using a tail suspension model of rats as a simulated weightlessness.

Author (Herner)

A95-88591

ULTRASTRUCTURE OF ENDOCRINE GLANDS UNDER HYPERGRAVITY ENVIRONMENT: PARATHYROID GLAND AND ADRENAL MEDULLA

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The ultrastructure of the parathyroid gland and adrenal medulla of adult golden hamsters subjected to 5 g environment after an injection of 2% isoproterenol was studied to examine morphologically the effects of a hypergravity environment and beta-adrenergic stimulator, isoproterenol, on the parathyroid gland and the adrenal medulla.

Author (Herner)

A95-88592

LUMBAR BONE IS NOT THE TARGET BONE IN RAT OSTEOPOROSIS MODELS INDUCED BY THYROID HORMONE EXCESS

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Osteoporosis is the term used for diseases of diverse etiology that cause a reduction of bone mass per unit volume. The reduction of bone mass is not accompanied by a significant reduction in the ratio of the mineral to the organic phase, nor by any abnormality in bone mineral content or organic matrix. Evidences for marked changes in calcium metabolism are hypercalciuria, have been noted in animal subjects sent into outer space. In these non-gravitational fields, the body fluid balance and the upper body especially the cranial portion are affected, therefore, it is important to understand the heterogeneity of bone changes at different levels of exposure for outer space. As a unique model of secondary osteoporosis, we have used hyperthyroid rats and have analyzed the BMD on the different types of bones. The superfamily receptor genes; vitamin D(sub 3) and vitamin A receptors, have been demonstrated to interact each other on the specific target gene. In order to further elucidate the hormonal imbalance on the different types of bones in these rats, the hormonal effects of thyroid hormone and vitamin D(sub 3) on BMD were also investigated.

Author (revised by Herner)

A95-88593

CHANGES IN HEPATIC METABOLISM THROUGH SIMULATED WEIGHTLESSNESS: ACCUMULATION OF LIPIDS AND VITAMIN A FOLLOWING PROLONGED IMMOBILIZATION IN THE RAT

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Many studies on physiological responses during and following spaceflight reported that various hormonal changes occur in the crews. Space flight is assumed to associate with environmental stress which may cause various changes in hormone secretions, followed by alterations of diverse metabolisms in the body. Indeed, significantly increased serum concentrations of thyroxine, thyroid stimulating hormone and elevated cortisol have been reported following spaceflight. In the present study, we investigated the effects of a simulated weightlessness on the hepatic lipid and a fat-soluble vitamin (vitamin A) metabolisms under conditions of controlled food consumption. To partially simulate the state to which orbiter crews might be exposed, we have utilized a procedure of prolonged immobilization/suspension in the rats.

Author (revised by Herner)

A95-88594

PARASYMPATHETIC CONTROL OF BLOOD CALCIUM IN ACUTE IMMOBILIZATION IS MEDIATED BY THE STOMACH IN RATS

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Culture, and Uehara Memorial Foundation
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The involvement of the parasympathetic nervous system in the etiology of immobilization (IMB)-induced hypocalcemia was investigated in female Wistar and Wistar King A rats. A muscarinic antagonist, atropine sulphate and atropine methyl bromide applied 20 min before the IMB suppressed hypocalcemia induced by the IMB. The bilateral vagotomy of the cervical trunks also abolished the IMB-induced hypocalcemia. Either vagotomy of the thyroid/parathyroid branches or the celiac branches had no effect on the hypocalcemia, however, the vagotomy of the gastric branches completely suppressed calcium reducing effect of IMB. Pretreatment of an inhibitor of gastrin release, secretin, or a histamine H2 blocker, ranitidine, diminished calcium lowering effect of IMB. It is concluded that IMB-induced hypocalcemia is due to the activation of the vagus innervating the stomach. Gastrin and histamine are involved as the consequent hypocalcemic factors through the activation of the gastric vagus in IMB. Author (Herner)

A95-88598

MODIFICATION OF RADIORESPONSES OF THE DEVELOPING MOUSE BRAIN BY PRE- AND POSTIRRADIATION EXPOSURE TO 2.45 GHZ MICROWAVES

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Pregnant Slc:ICR mice were exposed to microwave and gamma-radiations, either singly or in combination, on day 13 of pregnancy: (1) 2.45 GHz microwaves at 46.0 mW/cm² for 3 minutes; (2) 0.24 Gy gamma rays; (3) gamma-rays initially followed by microwaves within 20 minutes, or 2 or 3 hours later, (4) microwaves 1-15 hours before gamma-rays. The fetal brains were then histologically examined for cell death (apoptosis) in the ventricular zone of telencephalon. Levels of cell death following exposure to sham, microwaves alone, and gamma-rays alone were 0.12, 0.5 and 8.3%, respectively. Exposure to microwaves 1 hour before or 2 hours after gamma rays caused 8.8 and 8.9% cell mortality, respectively, much the same as the sum of the levels for microwaves alone and gamma-rays alone. Microwave exposure within 20 minutes after gamma-rays caused 10.4% mortality, which was more than the sum of their respective levels. Microwave pretreatment 12 or 15 hours before gamma-irradiation, on the other hand, resulted in slightly, but significantly, lower mortality than by exposure to gamma-rays alone. Author (Herner)

A95-88600

CIRCADIAN RHYTHMS IN THE SENSITIVITY TO RADIATION AND DIFFERENT DRUGS IN MOUSE INTESTINAL EPITHELIUM

K. IJIRI University of Tokyo, Tokyo, Japan *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 403-410
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The circadian rhythms in the cellular responses to different cytotoxic agents were studied for mouse intestinal epithelium. The incidence of cell death (apoptosis) was investigated in the intestinal crypts after radiation (gamma rays), two colon carcinogens, and six other cytotoxic drugs. A clear circadian rhythm was displayed in the incidence of radiation-induced cell death. The peak time of day for inducing cell death was 06.00-09.00 h, and the trough occurred at 18.00-21.00 h. When mice were transferred to a room with the light-cycle reversed, the transition from the normal-light pattern to the

reversed-light pattern of the circadian rhythm in radiation-induced cell death occurred 7 days after the transfer and the rhythm was completely reversed by 14 days. Cell death induced by the carcinogens and other cytotoxic drugs also exhibited similar patterns of rhythm to that by radiation. Author (Herner)

A95-88726* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ISSOL MEETING, BARCELONA, SPAIN, 1993

JAMES P. FERRIS, editor Rensselaer Polytechnic Institute, East Windsor Hill, CT, US *Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 293 p. (HTN-95-92680) Copyright

Topics in a conference on the origins of life and the evolution of the biosphere include the origin of chirality, prebiotic chemistry of small biomolecules, primitive polymer formation, RNA regulation and control. Early origins of life and the ecology of hydrothermal systems such as ocean floor vents and their simple organisms are examined. The process of mineral catalysis in Montmorillonite as a model for early metabolism is used. The origin of the genetic code and the development of branching in molecular structures of amino acids is described. Studies are reported of the effects of meteorite impact on early Earth life. For individual titles, see A95-88727 through A95-88748. Herner

A95-88727* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PROBING THE STRUCTURE OF COMETARY ICE

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Computer simulations of bulk and vapor deposited amorphous ices are presented. The structure of the bulk low density amorphous ice is in good agreement with experiments on pressure disordered amorphous ice. Both the low density bulk ice and the vapor deposited ices exhibit strong ordering. Vapor deposition of hot (300 K) water molecules onto a cold (77 K) substrate yields less porous ices than deposition of cold (77 K) water molecules onto a cold substrate. Both vapor deposited ices are more porous than the bulk amorphous ice. The structure of bulk high density amorphous ice is only in fair agreement with experimental results. Attempts to simulate high density amorphous ice via vapor deposition were not successful. Electron diffraction results on vapor deposited amorphous ice indicate that the temperature of the nucleation of the cubic phase depends upon the amount of time between the deposition and the onset of crystallization, suggesting that freshly deposited ice layers reconstruct on time of the order of hours. The temperature dependence of the microporosity of the vapor deposited amorphous ices might affect laboratory experiments that are aimed at simulating astrophysical ices in the context of the origin of prebiotic organic material and its transport to the Earth. Author (Herner)

A95-88728* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MOLECULAR DYNAMICS STUDIES OF SIMPLE MEMBRANE-WATER INTERFACES: STRUCTURE AND FUNCTIONS IN THE BEGINNINGS OF CELLULAR LIFE

ANDREW POHORILLE NASA. Ames Research Center, Moffett Field, CA, US and MICHAEL A. WILSON NASA. Ames Research Center, Moffett Field, CA, US *ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere* (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 21-46
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Molecular dynamics computer simulations of the structure and functions of a simple membrane are performed in order to examine whether membranes provide an environment capable of promoting

51 LIFE SCIENCES (GENERAL)

protobiological evolution. Our model membrane is composed of glycerol 1-monooleate. It is found that the bilayer surface fluctuates in time and space, occasionally creating thinning defects in the membrane. These defects are essential for passive transport of simple ions across membranes because they reduce the Born barrier to this process by approximately 40%. Negative ions are transferred across the bilayer more readily than positive ions due to favorable interactions with the electric field at the membrane-water interface. Passive transport of neutral molecules is, in general, more complex than predicted by the solubility-diffusion model. In particular, molecules which exhibit sufficient hydrophilicity and lipophilicity concentrate near membrane surfaces and experience 'interfacial resistance' to transport. The membrane-water interface forms an environment suitable for heterogeneous catalysis. Several possible mechanisms leading to an increase of reaction rates at the interface are discussed. We conclude that vesicles have many properties that make them very good candidates for earliest protocells. Some potentially fruitful directions of experimental and theoretical research on this subject are proposed. Author (Herner)

A95-88729

SPECIFIC EFFECT OF MAGNESIUM ION ON 2', 3'-CYCLIC AMP SYNTHESIS FROM ADENOSINE AND TRIMETA PHOSPHATE IN AQUEOUS SOLUTION

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Phosphorylation of adenosine by trimetaphosphate was investigated using various catalysts in aqueous solution under mild conditions at pH approximately 7.0 and at 41 C. The product was primarily 2', 3'-cyclic AMP together with smaller amounts of ATP. Magnesium ion was found to have a remarkable catalytic effect of approximately one hundred times greater than the other chemicals tested. The mechanism for the specific effect of magnesium ion is discussed. Author (Herner)

A95-88730* National Aeronautics and Space Administration, Washington, DC.

PREBIOTIC POLYMERIZATION: OXIDATIVE POLYMERIZATION OF 2, 3-DIMERCAPTO-1-PROPANOL ON THE SURFACE OF IRON(III) HYDROXIDE OXIDE

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The oxidation of 2, 3-dimercapto-1-propanol by ferric ions on the surface of iron(III) hydroxide oxide (Fe(OH)O) yielded polydisulfide oligomers. This polymerization occurred readily at low dithiol concentration under mild aqueous conditions. Polydisulfide polymers up to the 15-mer were synthesized from 1 mM dithiol in 5 ml water reacted with iron(III) hydroxide oxide (20 mg, 160 micromole Fe) for 3 days under anaerobic conditions at 40 C and pH 4. About 91% of the dithiol was converted to short soluble oligomers and 9% to insoluble larger oligomers that were isolated with the Fe(OH)O phase. Reactions carried out at the same ratio of dithiol to Fe(OH)O but at higher dithiol concentrations gave higher yields of the larger insoluble oligomers. The relationship of these results to prebiotic polymer synthesis is discussed. Author (Herner)

A95-88731

BINDING OF ADENINE AND ADENINE-RELATED COMPOUNDS TO THE CLAY MONTMORILLONITE AND THE MINERAL HYDROXYLAPATITE

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The first living things may have consisted of no more than RNA or RNA-like molecules bound to the surfaces of mineral particles. A key aspect of this theory is that these mineral particles have binding sites for RNA and its prebiotic precursors. The object of this study is to explore the binding properties of two of the best studied minerals, montmorillonite and hydroxylapatite, for possible precursors of RNA. The list of compounds investigated includes purines, pyrimidines, nucleosides, nucleotides, nucleotide coenzymes, diaminomaleonitrile and aminoimidazole carboxamide. Affinities for hydroxylapatite are dominated by ionic interactions between negatively charged small molecules and positively charged sites in the mineral. Binding to montmorillonite presents a more complex picture. These clay particles have a high affinity for organic ring structures which is augmented if they are positively charged. This binding probably takes place on the negatively charged faces of these sheet-like clay particles. Additional binding sites on the edges of these sheets have a moderate affinity for negatively charged molecules. Small molecules that bind to these minerals sometimes bind independently to sites on the minerals and sometimes bind cooperatively with favorable interactions between the bound molecules. Author (Herner)

A95-88732

THE PREBIOTIC ROLE OF ADENINE: A CRITICAL ANALYSIS

ROBERT SHAPIRO New York University, New York, NY, US ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 83-98 Copyright

Adenine plays an essential role in replication in all known living systems today, and is prominent in many other aspects of biochemistry. It occurs among the products of oligomerization of HCN. These circumstances have stimulated the idea that adenine was a component in a replication system that was present at the start of life. Such replicators have included not only RNA, but also a number of simpler RNA-like alternatives which utilize a simpler backbone. Despite these encouraging indicators, a consideration of the chemical properties of adenine reveals reasons that disfavor its participation in such a role. The properties include the following: (1) Adenine synthesis requires HCN concentrations of at least 0.01 M. Such concentrations would be expected only in unique circumstances on the early Earth. Adenine yields are low in prebiotic simulations, and if a subsequent high-temperature hydrolysis step is omitted, the reported yield does not represent adenine itself, but 8-substituted adenines and other derivatives. (2) Adenine is susceptible to hydrolysis (the half life for deamination at 37 C, pH 7, is about 80 years), and to reaction with a variety of simple electrophiles, forming a multiplicity of products. Its accumulation would not be expected over a geological time scale, and its regioselective incorporation into a replicator appears implausible. (3) The adenine-uracil interaction, which involves two hydrogen bonds (rather than three, as in guanine-cytosine pairing) is weak and nonspecific. Pairing of adenine with many other partners has been observed with monomers, synthetic oligonucleotides and in RNA. The hydrogen-bonding properties of adenine appear inadequate for it to function in any specific recognition scheme under the chaotic conditions of a prebiotic soup. New and fundamental discoveries in the chemistry of adenine would be needed to reverse this perception. An alternative and attractive possibility is that some other replicator preceded RNA (or RNA-like substances) in the origin of life. Author (Herner)

A95-88733* National Aeronautics and Space Administration, Washington, DC.

EVOLUTION OF THE BIOSYNTHESIS OF THE BRANCHED-CHAIN AMINO ACIDS

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The origins of the biosynthetic pathways for the branched-chain amino acids cannot be understood in terms of the backwards development of the present acetolactate pathway because it contains unstable intermediates. We propose that the first biosynthesis of the branched-chain amino acids was by the reductive carboxylation of short branched chain fatty acids giving keto acids which were then transaminated. Similar reaction sequences mediated by non-specific enzymes would produce serine and threonine from the abundant prebiotic compounds glycolic and lactic acids. The aromatic amino acids may also have first been synthesized in this way, e.g. tryptophan from indole acetic acid. The next step would have been the biosynthesis of leucine from alpha-ketoisovaleric acid. The acetolactate pathway developed subsequently. The first version of the Krebs cycle, which was used for amino acid biosynthesis, would have been assembled by making use of the reductive carboxylation and leucine biosynthesis enzymes, and completed with the development of a single new enzyme, succinate dehydrogenase. This evolutionary scheme suggests that there may be limitations to inferring the origins of metabolism by a simple back extrapolation of current pathways.
Author (Herner)

A95-88734* National Aeronautics and Space Administration, Washington, DC.

THE STABILITY OF AMINO ACIDS AT SUBMARINE HYDROTHERMAL VENT TEMPERATURES

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It has been postulated that amino acid stability at hydrothermal vent temperatures is controlled by a metastable thermodynamic equilibrium rather than by kinetics. Experiments reported here demonstrate that the amino acids are irreversibly destroyed by heating at 240 C and that quasi-equilibrium calculations give misleading descriptions of the experimental observations. Equilibrium thermodynamic calculations are not applicable to organic compounds under high-temperature submarine vent conditions.
Author (Herner)

A95-88735* National Aeronautics and Space Administration, Washington, DC.

EVIDENCE FOR ORGANIC SYNTHESIS IN HIGH TEMPERATURE AQUEOUS MEDIA - FACTS AND PROGNOSIS

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ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 119-140
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Hydrothermal systems are common along the active tectonic areas of the earth. Potential sites being studied for organic matter alteration and possible organic synthesis are spreading ridges, off-axis systems, back-arc activity, hot spots, volcanism, and subduction. Organic matter alteration, primarily reductive and generally from immature organic detritus, occurs in these high temperature and rapid fluid flow hydrothermal regimes. Hot circulating water (temperature range - warm to greater than 400 C) is responsible for these molecular alterations, expulsion and migration. Compounds that are obviously synthesized are minor components because they are generally masked by the pyrolysis products formed from contemporary natural organic precursors. The reactivity of organic compounds in hot water (200-350 C) has been studied in autoclaves, and supercritical water as a medium for chemistry has also been evaluated. This high temperature aqueous organic chemistry and

the strong reducing conditions of the natural systems suggest this as an important route to produce organic compounds on the primitive earth. Thus a better understanding of the potential syntheses of organic compounds in hydrothermal systems will require investigations of the chemistry of condensation, autocatalysis, catalysis and hydrolysis reactions in aqueous mineral buffered systems over a range of temperatures from warm to greater than 400 C.

Author (revised by Herner)

A95-88736* National Aeronautics and Space Administration, Washington, DC.

GEOCHEMICAL CONSTRAINTS ON CHEMOLITHOAUTOTROPHIC REACTIONS IN HYDROTHERMAL SYSTEMS

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ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 141-159
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Thermodynamic calculations provide the means to quantify the chemical disequilibrium inherent in the mixing of reduced hydrothermal fluids with seawater. The chemical energy available for metabolic processes in these environments can be evaluated by taking into account the pressure and temperature dependence of the apparent standard Gibbs free energies of reactions in the S-H₂-H₂O system together with geochemical constraints on pH, activities of aqueous sulfur species and fugacities of H₂ and/or O₂. Using present-day mixing of hydrothermal fluids and seawater as a starting point, it is shown that each mole of H₂S entering seawater from hydrothermal fluids represents about 200,000 calories of chemical energy for metabolic systems able to catalyze H₂S oxidation. Extrapolating to the early Earth, which was likely to have had an atmosphere more reduced than at present, shows that this chemical energy may have been a factor of two or so less. Nevertheless, mixing of hydrothermal fluids with seawater would have been an abundant source of chemical energy, and an inevitable consequence of the presence of an ocean on an initially hot Earth. The amount of energy available was more than enough for organic synthesis from CO₂ or CO, and/or polymer formation, indicating that the vicinity of hydrothermal systems at the sea floor was an ideal location for the emergence of the first chemolithoautotrophic metabolic systems.
Author (Herner)

A95-88737* National Aeronautics and Space Administration, Washington, DC.

THERMODYNAMICS OF STRECKER SYNTHESIS IN HYDROTHERMAL SYSTEMS

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Submarine hydrothermal systems on the early Earth may have been the sites from which life emerged. The potential for Strecker synthesis to produce biomolecules (amino and hydroxy acids) from starting compounds (ketones, aldehydes, HCN and ammonia) in such environments is evaluated quantitatively using thermodynamic data and parameters for the revised Helgeson-Kirkham-Flowers (HKF) equation of state. Although there is an overwhelming thermodynamic drive to form biomolecules by the Strecker synthesis at hydrothermal conditions, the availability and concentration of starting compounds limit the efficiency and productivity of Strecker reactions. Mechanisms for concentrating reactant compounds could help overcome this problem, but other mechanisms for production of biomolecules may have been required to produce the required compounds on the early Earth. Geochemical constraints imposed by

51 LIFE SCIENCES (GENERAL)

hydrothermal systems provide important clues for determining the potential of these and other systems as sites for the emergence of life.

Author (Herner)

A95-88738

CHIRALITY AND LIFE

WILLIAM A. BONNER Stanford University, Stanford, CA, US ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 175-190

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The crucial role of homochirality and chiral homogeneity in the self-replication of contemporary biopolymers is emphasized, and the experimentally demonstrated advantages of these chirality attributes in simpler polymeric systems are summarized. The implausibility of life without chirality and hence of a biogenic scenario for the origin of chiral molecules is stressed, and chance and determinate abiotic mechanisms for the origin of chirality are reviewed briefly in the context of their potential viability on the primitive Earth. It is concluded that all such mechanisms would be nonviable, and that the turbulent prebiotic environment would require an ongoing extraterrestrial source for the accumulation of chiral molecules on the primitive Earth. A scenario is described wherein the circularly polarized ultraviolet synchrotron radiation from the neutron star remnants of supernovae engenders asymmetric photolysis of the racemic constituents in the organic mantles on interstellar dust grains, whereupon these chiral constituents are transported repetitively to the primitive Earth by direct accretion of the interstellar dust or through impacts of comets and asteroids.

Author (Herner)

A95-88739

ELECTROWEAK ENANTIOSELECTION AND THE ORIGIN OF LIFE

ALEXANDRA J. MACDERMOTT Oxford Brookes University, Oxford, UK ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 191-199

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All biomolecules are of one hand - but what determines which hand? Why is life based on L-amino acids and D-sugars rather than D-amino acids and L-sugars? We believe the symmetry-breaker could be the weak force, which causes enantiomers to differ very slightly in energy. In this paper we present our calculations of this parity-violating energy difference (PVED) for a range of important biomolecules, and in nearly all cases it is indeed the 'natural' enantiomer which is the more stable.

Author (Herner)

A95-88740

EFFECT OF A CHIRAL IMPULSE ON THE WEAK INTERACTION INDUCED HANDEDNESS IN A PREBIOTIC MEDIUM

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Previously we have carried out simulation of the Weak Neutral Current and symmetry breaking transition bifurcation process addressing some of the issues raised by critics of the approach. We now include the effects of a chiral impulse on the transition and show that under certain cases this could greatly alter transition time. Examples of a chiral impulse could be nearby Supernova and an impulse of beta-emitters. We briefly discuss the possibility of these processes in the early solar system.

Author (Herner)

A95-88741

CAN BIOLOGICAL HOMOCHIRALITY RESULT FROM A PHASE TRANSITION?

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BOUKENTER Universite Claude Bernard, Villeurbanne, France ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 211-217

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The problem of chiral purity in living organisms is still one of the prominent difficulties in the study of the origins of life. In particular the parity non-conservation known to occur in weak interactions could not be related to this lack of symmetry: these physical forces, though universal, are very weak and up to now no amplification process had been proposed. In 1991, A. Salam remarked that, due to the attractive character of the parity violating force in electro-weak interactions, a phase transition at low temperature should exist, leading eventually to enantiometric purity. We undertook then a series of experimental tests, looking for a sizeable change in the optical activity of cystine molecules. We found no evidence for the phase transition down to 0.01 K. The interpretation of these negative results will be discussed, and future experiments proposed.

Author (Herner)

A95-88742

THE ROLE OF ACCURACY FOR EARLY STAGES OF THE ORIGIN OF LIFE

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The role of accuracy in developing stages in the origin of life is investigated by mathematical models. Errors yield difficult stability problems in a description of a cooperative system with information-carriers (genes) and catalytic polymers (enzymes) that are related to each other. This problem is highly relevant for a proper understanding of the RNA world. The model that is treated takes two relevant error effects, which can be coupled, into account. One is the occurrence of parasites, inactive genes that are efficiently reproduced by the catalytic support of other polymers but which do not give rise to any catalytic activity. The other is an error propagation due to the fact that erroneous catalysts will provide an increased error level and thus more erroneous catalysts which may lead to still increasing error levels, eventually an error catastrophe.

Author (Herner)

A95-88743

HYPERCYCLES VERSUS PARASITES IN THE ORIGIN OF LIFE: MODEL DEPENDENCE IN SPATIAL HYPERCYCLE SYSTEMS

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Spatial hyperscale systems can be modeled by means of cellular automata or partial differential equations. In either model, two dimensional spirals or clusters can be formed. Different models give rise to slightly different spatial structures, but the response to parasites is fundamentally different: In cellular automata the hypercycle is resistant to parasites that are fatal in a partial differential equations model. In three dimensions scroll rings correspond to the two dimensional spirals. Numerical simulations on a partial differential equations model indicate that the scroll rings are unstable: The contract by a power law and disappear. Therefore, in three dimensions clusters seem to be the best candidate for the hypercycle resistant to parasites.

Author (Herner)

A95-88744

SPECULATIONS ON THE ORIGIN OF LIFE AND THERMOPHILY: REVIEW OF AVAILABLE INFORMATION ON REVERSE GYRASE SUGGESTS THAT HYPERTHERMOPHILIC PROCARYOTES ARE NOT SO PRIMITIVE

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FRANCK CHARBONNIER Universite Paris-Sud, Orsay, France, and MICHEL DUGUET Universite Paris-Sud, Orsay, France ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 235-249 Research sponsored by the Association de la Recherche sur le Cancer
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All present-day hyperthermophiles studied so far (either Bacteria or Archaea) contain a unique DNA topoisomerase, reverse gyrase, which probably helps to stabilize genomic DNA at high temperature. Herein the data relating this enzyme is reviewed and discussed from the perspective of the nature of the last detectable common ancestor and the origin of life. The sequence of the gene encoding reverse gyrase from an archaeon, *Sulfolobus acidocaldarius*, suggests that this enzyme contains both a helicase and a topoisomerase domains. Accordingly, it has been proposed that reverse gyrase originated by the fusion of DNA helicase and DNA topoisomerase genes. If reverse gyrase is essential for life at high temperature, its composite structure suggests that DNA helicases and topoisomerases appeared independently and first evolved in a mesophilic world. Such scenario contradicts the hypothesis that a direct link connects present day hyperthermophiles to a hot origin of life. We discuss different patterns for the early cellular evolution in which reverse gyrase appeared either before the emergence of the last common ancestor of Archaea, Bacteria and Eucarya, or in a lineage common to the two prokaryotic domains. The latter scenario could explain why all today hyperthermophiles are prokaryotes.
Author (Herner)

A95-88745
THE EFFECTS OF HEAVY METEORITE BOMBARDMENT ON THE EARLY EVOLUTION - THE EMERGENCE OF THE THREE DOMAINS OF LIFE

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In this paper we propose a large meteorite impact that wiped out almost all life forms present on the early Earth. Following this nearly complete frustration of life on Earth, two surviving extreme thermophilic species gave rise to the now existing major groups of living organisms, the Bacteria and Archaea. The analysis of molecular sequences suggests that the separation between the Eucarya and the two prokaryotic domains is less deep than the separation between Bacteria and Archaea. The fundamental cell biological differences between Archaea and Eucarya were obtained over a comparatively short evolutionary distance (as measured in number of substitution events in biological macromolecules). Our interpretation of the molecular record suggests that life emerged early in Earth's history even before the time of the heavy bombardment was over. Early life forms already had colonized extreme habitats which allowed at least two prokaryotic species to survive a late nearly ocean boiling impact. The distribution of ecotypes on the rooted universal tree of life should not be interpreted as evidence that life originated in extremely hot environments.
Author (revised by Herner)

A95-88746
SPECULATIONS ON THE EVOLUTION OF THE GENETIC CODE IV THE EVOLUTION OF THE AMINOACYL-TRNA SYNTHETASES

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An evolutionary scheme is postulated in which a primitive code,

involving only guanine and cytosine, would code for glycine(GG.), alanine(GC.), arginine(CG.) and proline(CC.). There evolves from this primitive code families of related amino acids as the code expands. The evolution of the aminacyl-tRNA synthetases are considered to be indicators for the evolution of the genetic code. The postulated model for the evolution of the genetic code is used to give an evolutionary interpretation to the recent work on the structure and sequences of the aminoacyl-tRNA synthetases. Author (Herner)

A95-88747
ON THE NATURE OF MUTATIONS IN MOLECULAR EVOLUTION

MARIA ANGELICA SOTO Universidad de Chile, Santiago, Chile and JOSE TOHA Universidad de Chile, Santiago, Chile ISSOL Meeting, Barcelona, Spain, 1993. A95-88726 Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 1-3 June 1995 p. 271-275
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In this work it is proposed that in evolution amino acid substitutions implying strong physico-chemical and structural differences are more relevant and more frequent than substitutions between similar amino acids. This analysis is made over a group of protein families representing about 10,000 substitutions and as examples the evolutionary trees of fibrinopeptides A and calcitonins were constructed and compared.
Author (Herner)

A95-88748
DNA STABILITY AND SURVIVAL OF BACILLUS SUBTILIS SPORES IN EXTREME DRYNESS

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The inactivation of *Bacillus subtilis* spores during long-term exposure (up to several months) to extreme dryness (especially vacuum) is strain-dependent, through only to a small degree. During a first phase (lasting about four days) monolayers of spores lose about 20% of their viability, regardless of the strain studied. During this phase loss in viability can be equally attributed both to damages of hydrophobic structures (membranes and proteins) and DNA. During a second phase lasting for the remaining time of experimental observation (weeks, months, and years) the loss in viability is slowed. A viability of 55% to 75% (depending on the strain) is attained after a total exposure of 36 days. The loss in viability during the second phase can be correlated with the occurrence of DNA double strand breaks. Also covalent DNA-protein cross-links are formed by vacuum exposure. If the protein moiety of these cross-links is degraded by proteinase K-treatment in vitro additional DNA double strand breaks result. The data are also discussed with respect to survival on Mars and in near Earth orbits.
Author (Herner)

A95-89093* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

P-MASS AND P-GBA: TWO NEW HARDWARE DEVELOPMENTS FOR GROWING PLANTS IN SPACE

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Plant growth, and especially plant performance experiments in microgravity are limited by the currently available plant growth facilities (low light levels, inadequate nutrient delivery and atmosphere

51 LIFE SCIENCES (GENERAL)

conditioning systems, insufficient science instrumentation, infrequent flight opportunities). In addition, mission durations of 10 to 14 days aboard the NSTS Space Shuttle allow for only brief periods of microgravity exposure with respect to the life cycle of a plant. Based on seed germination experiments, using the Generic BioProcessing Apparatus hardware (GBA), two new payloads have been designed specifically for plant growth. These payloads provide new opportunities for plant gravitational and space biology research and emphasize the investigation of plant performance (photosynthesis, biomass accumulations) in microgravity. The Plant-Module for Autonomous Space Support (P-MASS) was designed to utilize microgravity exposure times in excess of 30 days on the first flight of the recoverable COMET satellite (Commercial Experiment Transporter). The Plant-Generic Bioprocessing Apparatus (P-GBA), is designed for the National Space Transportation System (NSTS) Space Shuttle middeck and the SPACEHAB environment. The P-GBA is an evolution from the GBA hardware and P-MASS (plant chamber and instrumentation). The available light levels of both payloads more than double currently available capabilities.

Author (revised by Herner)

A95-89463

HUMAN HAIR RADIOACTIVITY IN THE CHERNOBYL AREA

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Studies of recent decades have shown that the elemental composition of human hair can be considered as an indicator of both internal and external human body status. However, there are only a few studies on human hair radioactivity. The Chernobyl accident necessitated the study of the hair of various groups of inhabitants of the contaminated area. Data on hair radioactivity and elemental composition allowed us to draw the following conclusions. (1) When account is taken of the simplicity of sampling and measurements of human hair activity in polluted areas can be used as a monitor for fast detection of the scale and area of pollution. (2) Measurement of hair alpha and beta activity is useful for preliminary body burden determination while the whole body counter is inapplicable. (3) Study of activity along the hair strand allows dating of contamination with an accuracy of about 10 days and gives information about the removal of radioactivity from the body. (4) Determination of uranium could give additional information about the distance of nuclear fuel transport from the damaged reactor. (5) Elemental composition of hair and profiles along the strand reflect the influence of medical treatment and can be used to study post-accident health status.

Author (Elsevier)

A95-89501

BIOCHEMISTRY OF THE ACTINIDES

DAVID R. WILLIAMS School of Chemistry and Applied Chemistry, University of Wales, Cardiff, P.O. Box 912, Cardiff CF1 3TB, UK *Journal of Alloys and Compounds* (ISSN 0925-8388) vol. 213, no. 1-2 October 10, 1994 p. 318-323 Copyright (c) 1995 Elsevier Science B.V., Amsterdam. All rights reserved. (GTN-95-09258388-4023; HTN-95-Z0317) Copyright

In this plenary paper the evolution of the trace element content of the human body to its present-day composition, the role that non-essential elements play in human biochemistry, the relatively recently researched roles of actinide complexes present in humans, and means of decontaminating wounds and other biological tissue are considered, and desirable researches and legislation required for the next century are referred to.

Author (Elsevier)

A95-90932

ULTRASHORT PULSE RESPONSE IN NONLINEAR DISPERSIVE MEDIA

RICHARD ALBANESE Brooks Air Force Base, San Antonio, TX, US, JOHN PENN Brooks Air Force Base, San Antonio, TX, US, and RICHARD MEDINA Brooks Air Force Base, San Antonio, TX, US *In Ultra-wideband, short-pulse electromagnetics; WRI International Conference, 2nd, Brooklyn, NY, October 8-10, 1992. A95-90904 New York, NY Plenum Press January 1993 p. 259-265 Copyright*

Development of fast electromagnetic switches, power sources and antennas is resulting in the generation of short, high-energy electromagnetic pulses. Understanding how such pulses propagate through living tissue is of interest to basic biology and of particular interest to the field of occupational medicine which is concerned to establish safe exposure levels for humans. In this paper we inquire into the influence on transient formation of weak nonlinearity in the dispersive medium. A perturbation analysis is presented. We have studied trapezoidal modulation of a sinusoidal field as the incident signal. This described in the following section. After fixing the incident field, the perturbation analysis is given, which is in turn followed by numerical results and discussion.

Author (revised by Herner)

A95-90934

DEEPER-PENETRATING WAVES IN LOSSY MEDIA

LIYOU L. LI Univ. of Maryland, College Park, MD, US, LEONARD S. TAYLOR Univ. of Maryland, College Park, MD, US, and HAINAN DONG Univ. of Maryland, College Park, MD, US *In Ultra-wideband, short-pulse electromagnetics; WRI International Conference, 2nd, Brooklyn, NY, October 8-10, 1992. A95-90904 New York, NY Plenum Press January 1993 p. 275-284 Copyright*

The 'electromagnetic missile' is an electromagnetic beam wave generated by short current pulses. In this mode of propagation, introduced by T. T. Wu, electromagnetic energy in the form of short impulses, rather than a modulated carrier, propagates in a directed beam, rather than a spherically spreading wave, and the power density in the beam is maintained over long distances with relatively small decay. The properties of the EM missile beam wave have been confirmed both theoretically and experimentally in air. We have been able to demonstrate theoretically that in lossy media, the rate of decay can be much less than that for ordinary wave types. If the theoretical promise of this technique can be realized, it may be possible to direct time-multiplexed beams to selectively heat deep-lying tumors, in much the same way that ionizing radiation beams are now employed. In our analysis an in the numerical computation the effects of both absorption and dispersion on the EM missile beam wave taken into account. Because the numerical computation requires a specific model and because our interest was centered on medical applications, the computation was carried out using a medium whose dielectric and conductive properties were based on the published measurements of the properties of high water content biological materials (muscle and organ tissue) which is highly absorbing for electromagnetic radiation at high frequencies. Thus in these cases, the wave field of the radiator is ordinarily significantly attenuated even within the near field, and it is not possible to use Fresnel diffraction theory. In our study, a specific magnetic current source was used as the radiator and four different excitation pulse forms were considered. The numerical results show that this type of wave applicator will greatly enhance the penetration of electromagnetic energy into lossy biological materials. A preliminary experiment undertaken to verify the possibility of deeper-penetrating waves also provided preliminary verification that through a suitable choice of pulse shape a deeper penetrating wave can be generated.

Author (Herner)

A95-91326

REVEALING THE BLUEPRINT OF PHOTOSYNTHESIS

J. BARBER Imperial Coll of Science, Technology and Medicine, London, United Kingdom and B. ANDERSSON *Nature* (ISSN 0028-

0836) vol. 370, no. 6484 July 7 1994 p. 31-34 refs
(BTN-95-EIX95302430624) Copyright

Plants and photosynthetic bacteria capture and efficiently use sunlight by employing molecular machinery embedded in their membrane systems. Today, photosynthesis captures more than a hundred times the food requirement of mankind and is the origin of fossil fuels. The initial photosynthetic conversion of light energy to chemical energy takes place in pigment protein complexes known as type-I and type-II reaction centers. The two types of reaction centers use a special pair of chlorophyll molecules as the primary electron donor and a chlorophyll or pheophytin as the primary electron acceptor. When excited by light, an electron transfer occurs and a radical pair is formed. The pigments are arranged in the reaction-center proteins in such a way that primary charge separation occurs across a lipid membrane with a low dielectric constant. This paper describes the primary electron transfer events of both type-I and type-II reaction centers and gives some details concerning the structure of a light-harvesting chlorophyll *a/b*-protein complex. EI

A95-91441
PHYSICAL PERFORMANCE AND HEAT TOLERANCE
AFTER CHRONIC WATER LOADING AND HEAT
ACCLIMATION

ESTELA KRISTAL-BONEH Occupational Health and Rehabilitation Institute, Raanana, Israel, JOSE G. GLUSMAN Ben Gurion University, Beer-Sheva, Israel, RONIT SHITRIT Ben Gurion University, Beer-Sheva, Israel, CIDIO CHAEMOVITZ Ben Gurion University, Beer-Sheva, Israel, and YAIR CASSUTO Ben Gurion University, Beer-Sheva, Israel Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 733-738 (HTN-95-01209) Copyright

Heat acclimation (HA) and forced water intake (FWI) have both been found to improve the endurance of human subjects working in hot environments. Therefore, we studied the interaction between HA and FWI. Prior to any treatment (control, AI and BI) the subjects ($n = 9$) underwent a heat tolerance (HT) test. Thereafter, they were divided into two groups. The first ($n = 5$) were heat-acclimated (AII), underwent a second HT test, doubled their normal daily water intake for 1 week (AIII), and underwent a third HT test; the second group ($n = 4$) were subjected to the same protocol, except that the FWI came before and during HA (BII). It was found that both regimes (phases AII and BII) significantly increased work duration. Although the results of the two methods were similar, their combination somewhat lengthened work tolerance time (phases AIII, BIII). Maximal oxygen uptake did not change after HA (BII) or FWI(AII), but the maximal values were attained at significantly lower heart rates, both after BII alone or combined with HA (BIII). In an additional experiment, the time needed to 'ride' 15 km on a bicycle ergo-meter was reduced by 10% after FWI as compared to control time. Author (Herner)

A95-91443
CONTINUOUS AND INTERMITTENT PERSONAL
MICROCLIMATE COOLING STRATEGIES

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A comparison was made between two personal auxiliary cooling approaches for the relief of thermal stress while wearing the standard USAF Chemical Defense Ensemble (CDE). Subjects exercised at approximately 40% $\dot{V}O_2$ (sub max) in either warm (28/24/34 C) or hot (38/26/43 C) environmental conditions. During each of three trials, four hours of intermittent work (four work/rest cycles) were attempted. Microclimate air cooling was applied in two different fashions and compared with a control trial during which no cooling was received (NC). In one trial, conditioned air cooling was delivered during rest periods only (intermittent cooling, IC), while during the second trial, ambient air cooling was also applied during the work period in addition to the conditioned air delivered during rest periods

(continuous cooling, CC). During the warm condition, exposure cycle time was 45 min work and 15 min rest, while under the hot conditions, exposure cycle time was 30 min work and 30 min rest. Both CC and IC trials resulted in significantly extended work times, lower final rectal temperatures, heart rates, and sweat production (SP) than in the NC trial. Additionally, CC resulted in significantly lower SP, higher % sweat evaporation, and lower ratings of perceived exertion (RPE) and thermal comfort (TC) than IC at both warm and hot temperatures. Moreover, subjects were better able to maintain thermal equilibrium (i.e., cumulative heat balance) over time using CC compared to IC in the warm environment. The physiological significance of these findings, in some cases, was secondary to the improvement in subjective measures of TC and RPE. In conclusion, the addition of ambient air, microclimate cooling during work in these environments is effective in lowering thermal strain for subjects exercising in the heat while wearing the CDE.

Author (Herner)

A95-91444
EFFECTS OF INSPIRED O₂ AND CO₂ ON VENTILATORY
RESPONSES TO LBNP-RELEASE AND ACUTE HEAD-
DOWN TILT

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Increases in blood flow and CO₂ return to the heart and lungs at the onset of exercise have been proposed to initiate reflexive feedback which increases ventilation (dot-VE), via mechano-receptors in the heart and/or intrapulmonary CO₂ flow receptors. Both lower body negative pressure (-40 mm Hg) release (LBNP-release) and acute head-down tilt (TILT) provide physiological models to focus upon the effects of increased venous return and CO₂ flow on dot-VE, without the confounding influence of limb afferents or the descending efferents associated with central command. We examined the ventilatory responses to LBNP-release and TILT while inhaling one of four gas mixtures: (a) room air (R); (b) 95% O₂ (O); 95% O₂, 1.25% CO₂ (LC); and (d) 95% O₂, 2.25% CO₂ (HC). Breath-by-breath measurements for dot-VE end-tidal CO₂ (PETCO₂), tidal volume (VT), and breathing frequency (fB) were taken. Dot-VE and VT for HC were significantly higher than those for R, O, and LC throughout the test session, while fB and PETCO₂ were not significantly different among the gas treatments. Dot-VE increased above resting baseline with LBNP-release and TILT for R, O, LC, and HC primarily through an elevation of fB. Further, the maximal change in dot-VE following LBNP-release or TILT were not different among inhaled gas mixtures. However, area under the dot-VE curve following LBNP-release and TILT was higher for HC compared to the other gas mixtures. We conclude that these results are inconsistent with the theory that carotid bodies are essential in driving dot-VE with these models. We postulate that mechano-receptors in the right heart and/or pulmonary artery contribute to the elevation in dot-VE which immediately follows LBNP-release and TILT. Author (Herner)

A95-91445
PRECONDITIONING WITH SODIUM DEFICITS TO IMPROVE
ORTHOSTATIC TOLERANCE IN RATS

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We hypothesized that prior deficits in total body sodium would improve the subsequent ability of non-hypovolemic rats to maintain arterial pressure when subjected to an orthostatic challenge. This hypothesis was based on similarities in the response of neurohumoral cardiovascular control systems to lower-body negative pressure

51 LIFE SCIENCES (GENERAL)

and negative sodium balance. Sodium deficits were induced in male Sprague-Dawley rats for 7-8 d by feeding sodium restricted diets, or by administering furosemide daily. After this, rats were allowed to regain a positive sodium balance for 1 d by increasing dietary intake or withholding furosemide, and receiving additional normal saline intraperitoneally. Rats subjected to these protocols had equal plasma volumes at the time they were anesthetized and evaluated for orthostatic tolerance. Furosemide-treated rats maintained a higher mean arterial pressure (MAP) than controls when rotated to a 90 deg head-up position for 20 s. Rats receiving the lowest dietary sodium maintained the highest MAP when placed at 60 deg head-up for 5 min. Both before and during the orthostatic challenges, prior furosemide treatment was associated with a higher peripheral resistance, while prior dietary restriction of sodium was associated with a higher cardiac output. We conclude that preconditioning consisting of chronic sodium deficits can improve orthostatic tolerance in this animal model. The hemodynamic data indicate the different modes of preconditioning may have their primary effect on different determinants of orthostatic tolerance. Author (Herner)

A95-91446

EFFECTS OF SHORT-TERM SPACEFLIGHT AND RECOMBINANT HUMAN GROWTH HORMONE (RHGH) ON BONE GROWTH IN YOUNG RATS

RUSSELL T. TURNER Mayo Graduate School of Medicine, Rochester, MN, US Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 763-769 Research supported by the Pennsylvania State University and the Mayo Foundation

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The purpose of this study was to characterize the effects of short-term spaceflight and recombinant human growth hormone (rhGH) on bone growth in rapidly growing male rats. Bone growth was determined by dynamic bone histomorphometry and rhGH was administered using implanted ALZET osmotic pumps. Treatment with rhGH for 5 d has no effect on body weight but a 4-d spaceflight resulted in a small reduction in the rate of weight gain. Neither spaceflight nor rhGH altered bone length or the rate of bone elongation. In contrast, rhGH and spaceflight each resulted in site- and bone-specific increases (periosteal) and decreases (endocortical) in formation of cortical bone. The results demonstrate that: (1) inhibition of periosteal bone formation observed during longer spaceflight is not apparent during a 4-d spaceflight; and (2) influence of rhGH stimulates cortical bone formation in weightless as well as in weight bearing animals. Author (Herner)

A95-91447

SPACEFLIGHT RESULTS IN DEPRESSED CANCELLOUS BONE FORMATION IN RAT HUMERI

RUSSELL T. TURNER Mayo Graduate School of Medicine, Rochester, MN, US, GLENDA L. EVANS Mayo Graduate School of Medicine, Rochester, MN, US, and GLENN K. WAKLEY Mayo Graduate School of Medicine, Rochester, MN, US Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 770-774 Research supported by the Pennsylvania State University and the Mayo Foundation

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Two experiments investigating the effects of short-term spaceflight on cancellous bone turnover were carried out: Physiological Systems Experiment-1 (PSE-1) (a 4-d orbital spaceflight) and PSE-2 (a 10-d flight). Cancellous bone area was not significantly altered by spaceflight in the humerus during either flight. The calculated bone formation rate was unchanged during the 4-d flight but decreased during the 10-d flight. The decrease in calculated bone formation during the longer flight was due to a combination of a statistically significant decrease in mineral apposition rate and a nonsignificant decrease in double label perimeter. The dynamic measurements suggest that spaceflight results in decreases in osteoblast number and activity. Further, the decreases in osteoblast perimeter and osteoid perimeter

indicate that a 2-d reloading period was insufficient to restore bone formation to normal. Resorption of the preflight fluorochrome label was not influenced by spaceflight, suggesting that there was no net change in bone resorption. This conclusion is supported by the unremarkable effects of spaceflight on osteoclast number and osteoclast perimeter. Our findings indicate that short-term spaceflight results in depressed osteoblast number and/or activity. Continued decreases in bone formation with normal bone resorption could ultimately lead to cancellous osteopenia and reduced bone strength. Author (Herner)

A95-91448

FACTORS AFFECTING DIFFERENCES IN SUPINE, SITTING, AND STANDING HEART RATE: THE ISRAELI CORDIS STUDY

ESTELA KRISTAL-BONEH Occupational Health & Rehabilitation Institute, Raanana, Israel, GIL HARARI Occupational Health & Rehabilitation Institute, Raanana, Israel, YITZHAK WEINSTEIN Wingate Institute, Israel, and MANFRED S. GREEN Occupational Health & Rehabilitation Institute, Raanana, Israel Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 775-779 (HTN-95-01216) Copyright

Measuring postural changes is among the simplest methods to elicit cardiovascular responses from patients who should not be subjected to treadmill stress testing. We attempted to clarify the individual factors that may affect these changes in resting heart rate (HR). In a cross-sectional study, 6016 employees in Israeli industries were screened during 1985-87 for cardiovascular disease risk factors (The CORDIS Study). Measures of resting HR (supine, sitting, and standing) were obtained from 5428 subjects. The association between the HR differences for different postures and age, sex, height, body mass index, blood pressure level, health related habits, environmental temperature, and time of the day was analyzed. The difference in HR between supine and standing position was found to be greater among women than men. It was independently positively associated with height, cigarette smoking, and coffee drinking, and inversely associated with age, blood pressure level, and physical activity at work. The inter-individual variability in HR response to different postures is partially explained by individual variables such as age, sex, height, blood pressure level, and health-related habits. Author (Herner)

A95-91451

USE OF A SPREADSHEET PROGRAM FOR CIRCADIAN ANALYSIS OF BIOLOGICAL/PHYSIOLOGICAL DATA

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Biological/physiological data sampled over a period of 24 h can be subjected to a mathematical analysis to determine the presence of circadian rhythmicity. Several procedures have been proposed, most being complex. To render such an analysis simpler and easy to use by nonmathematicians, we developed and tested the conisor technique using a commonly available commercial spreadsheet (Excel). It can be used to analyze equally or unequally time-spaced data over 24 h with missing data, as well as to calculate the significance and the main limit of the resultant circadian rhythm (mesor, amplitude, acrophase and their confidence limits). Examples of its application to hourly samples of plasma cortisol and minute-by-minute rectal temperatures are shown. Author (Herner)

A95-91452

ULTRASHORT MICROWAVE SIGNALS: A DIDACTIC DISCUSSION

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Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 792-794 (HTN-95-01220) Copyright

As a consequence of the variation with frequency of the attenuation and phase velocity of electromagnetic waves in tissue, the shape (variation of the electric field with time) of short electromagnetic pulses incident on tissue changes with depth of penetration. We show that a conjecture that such well-known and long understood changes in pulse shape may generate harmful biological effects is not credible. We also consider the suggestion that such pulses may be useful in medical imaging and the mapping of the electrical properties of complex tissues and show that such use is impracticably difficult for fundamental reasons. Author (Herner)

A95-91466* National Aeronautics and Space Administration, Washington, DC.

MINERAL INDUCED FORMATION OF SUGAR PHOSPHATES
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Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August 1995 p. 297-234 Research supported by the Swiss NSF, Ciba AG Basel, and Firmenich & Co., Geneva (Contract(s)/Grant(s): NAGW-1031; NAGW-2881; NSF EAR-89-16501; NSF EAR-89-16467) (HTN-95-01234) Copyright

Glycolaldehyde phosphate, sorbed from highly dilute, weakly alkaline solution into the interlayer of common expanding sheet structure metal hydroxide minerals, condenses extensively to racemic aldohexose-2, 4-diphosphates, and aldohexose-2, 4, 6-triphosphates. The reaction proceeds mainly through racemic erythrose-2, 4-phosphate, and terminates with a large fraction of racemic altrose-2, 4, 6-phosphate. In the absence of an inductive mineral phase, no detectable homogeneous reaction takes place in the concentration- and pH range used. The reactant glycolaldehyde phosphate is practically completely sorbed within an hour from solutions with concentrations as low as 50 micron; the half-time for conversion to hexose phosphates is of the order of two days at room temperature and pH 9.5. Total production of sugar phosphates in the mineral interlayer is largely independent of the glycolaldehyde phosphate concentration in the external solution, but is determined by the total amount of GAP offered for sorption up to the capacity of the mineral. In the presence of equimolar amounts of rac-glyceraldehyde-2-phosphate, but under otherwise similar conditions, aldopentose-2, 4, -diphosphates also form, but only as a small fraction of the hexose-2, 4, 6-phosphates. Author (Herner)

A95-91467

REACTIONS INVOLVING CARBAMYL PHOSPHATE IN THE PRESENCE OF PRECIPITATED CALCIUM PHOSPHATE WITH FORMATION OF PYROPHOSPHATE: A MODEL FOR PRIMITIVE ENERGY-CONSERVATION PATHWAYS

ADALBERTO VIEYRA Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, FREDERICO GUEIROS-FILHO Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, JOSE ROBERTO MEYER-FERNANDES Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, GLORIA COSTA-SARMENTO Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, and FERNANDO DE SOUZA-BARROS Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August 1995 p. 335-350 Research supported by the FAPERJ, FUJB/UFRJ, CNPq and FINEP (HTN-95-01235) Copyright

The formation of carbamyl phosphate (CAP) in dilute solutions of cyanate (NCO(-)) and orthophosphate (Pi) was measured both in the absence and in the presence of a precipitated matrix of calcium phosphate (Pi.Ca). The second-order rate constant and the free energy of CAP synthesis were not modified by the presence of the solid matrix, indicating that synthesis occurs in the homogeneous Pi-containing solution. The elimination reaction of CAP to form

NCO(-) and Pi followed first-order kinetics and the rate constant was the same whether or not calcium phosphate was present. Elimination was not complete, and the steady level of remaining CAP was that expected from the free energy of synthesis. The formation of pyrophosphate (PPi) was detected in CAP-containing medium only in the presence of calcium, showing a close correlation with the amount of precipitated Pi.Ca. Phosphorolysis of CAP followed a sigmoidal time course, compatible with adsorption of CAP to the solid matrix as a prelude to trans-phosphorylation. Addition of 5'-AMP and of short linear polyphosphates inhibited phosphorolysis of CAP. It is proposed that the presence of a solid phosphate matrix and the relative concentrations of cyano compounds, as well as those of nucleotides and inorganic polyphosphates, could have played a crucial role in the conservation of chemical energy of CAP and in its use in prebiotic phosphorylation reactions.

Author (Herner)

A95-91468

ADSORPTION OF 5'-AMP AND CATALYTIC SYNTHESIS OF 5'-ADP ONTO PHOSPHATE SURFACES: CORRELATION TO SOLID MATRIX STRUCTURES

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Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August 1995 p. 351-373 Research supported by the FAPERJ, FUJB/UFRJ, CNPq and FINEP (HTN-95-01236) Copyright

A non-enzymatic formation of 5'-ADP starting from phosphorylation of 5'-AMP in the presence of either calcium phosphate or calcium pyrophosphate precipitates is reported. This reaction is taken as a model for study of heterogeneous catalysis of transphosphorylation in prebiotic conditions. Experiments were performed in completely aqueous media and in media containing dimethyl sulfoxide (ME2SO2), to simulate periods of dehydration in primitive aquatic environments. It has been observed that the nucleotide is adsorbed onto both calcium phosphate and calcium pyrophosphate in accordance with Langmuir isotherms. Adsorptive capacity and affinity of the precipitates for nucleotide are changed by the presence of ME2SO, suggesting that the interaction between biomonomers and surfaces can be modulated by the degree of hydration of the anionic components of these compounds. In completely aqueous environments, formation of 5'-ADP from 5'-AMP adsorbed on precipitates of calcium phosphate and calcium pyrophosphate is very small. However, in the presence of 60% ME2SO this synthesis increases by factors of 3 and 6 for surfaces of calcium phosphate and calcium pyrophosphate, respectively, and follows first-order kinetics. Determinations of free energy changes show that phosphorylation of 5'-AMP adsorbed to these precipitates is thermodynamically favorable. Depending on the precipitation time of the samples and the composition of the medium, structural analysis of these precipitates by electron and X-ray diffraction shows changes in their crystallinity grade. It is proposed that these changes are responsible for the modulation of the quantity of adsorbed nucleotides to the surface of solid matrices as well as the catalytic activity of the precipitates. Author (Herner)

A95-91469

ADSORPTION OF SMALL BIOLOGICAL MOLECULES ON SILICA FROM DILUTED AQUEOUS SOLUTIONS: QUANTITATIVE CHARACTERIZATION AND IMPLICATIONS TO THE BERNAL'S HYPOTHESIS

VLADIMIR A. BASIUK Universidad Nacional Autonoma de Mexico, Mexico, TARAS YU. GROMOVOY Academy of Sciences of the Ukraine, Kiev, Ukraine, and ELENA G. KHIL'CHEVSKAYA Academy of Sciences of the Ukraine, Kiev, Ukraine
Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August

51 LIFE SCIENCES (GENERAL)

1995 p. 375-393 Research supported by the CONACyT (HTN-95-01237) Copyright

To describe quantitatively the adsorption of prebiotically important compounds of low molecular weight (amino acids, short linear particles, cyclic peptides, the Krebs's cycle and other carboxylic acids, nucleosides and related phosphates) on silica surface from diluted neutral aqueous solutions, equilibrium constants (K) and free energies (-delta G) of adsorption were determined from the retention values measured by means of high-performance liquid chromatography on a silica gel column and from the isotherms measured under static conditions. For most carboxylic acids (including amino acids and linear peptide) -delta G values were negative and K less than 1, thus showing very weak adsorption. Cyclic dipeptides (2, 5-piperazinediones) exhibited higher adsorbability; -delta G greater than 0 and K greater than 0 were found for most of them. Influence of the structure of alpha-substituent on the adsorbability is analyzed. A linear dependence of -delta G on the number of aliphatic carbon atoms in a sorbate molecule was found for the series of aliphatic bifunctional amino acids, related dipeptides and 2, 5-piperazinediones, as well as for the row from glycine to triglycyl glycine. The adsorption of nucleosides and their phosphates is characterized by much higher K and -delta G values (of the order of $10(\exp 2)$ and $10(\exp 4)$, respectively). The adsorption data available from our work and literature are summarized and discussed with implications to the Bernal's hypothesis on the roles of solid surfaces in the prebiotic formation of biopolymers from monomeric 'building blocks'.

Author (Herner)

A95-91470 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE SYNTHESIS OF GLUTAMIC ACID IN THE ABSENCE OF ENZYMES: IMPLICATIONS FOR BIOGENESIS

HAROLD MOROWITZ George Mason University, Fairfax, VA, US, ETA PETERSON NASA-Ames Research Center, Moffett Field, CA, US, and SHERWOOD CHANG NASA-Ames Research Center, Moffett Field, CA, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August 1995 p. 395-399 (HTN-95-01238) Copyright

This paper reports on the non-enzymatic aqueous phase synthesis of amino acids from keto acids, ammonia and reducing agents. The facile synthesis of key metabolic intermediates, particularly in the glycolytic pathway, the citric acid cycle, and the first step of amino acid synthesis, lead to new ways of looking at the problem of biogenesis.

Author (Herner)

A95-91471 ENANTIOSELECTIVE AUTOCATALYSIS. 2: RACEMIZATION STUDIES ON A 1, 4-BENZODIAZEPINOXAZOLE DERIVATIVE

WILLIAM A. BONNER Stanford University, Stanford, CA, US Origins of Life and Evolution of the Biosphere (ISSN 0169-6149) vol. 25, no. 4 August 1995 p. 401-414 (HTN-95-01239) Copyright

Since the bromofluoro-1, 4-benzodiazepinoxazole derivative I may undergo spontaneous resolution on crystallization from methanol solution, it provides an ideal substrate on which to study the phenomenon of enantioselective autocatalysis involving spontaneous resolution under racemizing conditions (SRURC). In order to augment the understanding of factors which might be important in such a process we have now undertaken to study the racemization of I in more detail by observing its rate under a wide variety of experimental conditions.

Author (Herner)

A95-91851 BLOOD VOLUME AND ERYTHROPOIESIS IN THE RAT DURING SPACEFLIGHT

MARK M. UDDEN Baylor College of Medicine, Houston, TX, US, THEDA B. DRISCOLL Baylor College of Medicine, Houston, TX, US, LINDA A. GIBSON University of Tennessee Medical Center, Knoxville, TN, US, CYNTHIA S. PATTON Baylor College of Medicine, Houston, TX, US, MARK H. PICKETT Baylor College of Medicine,

Houston, TX, US, J. B. JONES University of Tennessee Medical Center, Knoxville, TN, US, RONALD NACHTMAN Baylor College of Medicine, Houston, TX, US, ZUHAIR ALLEBBAN University of Tennessee Medical Center, Knoxville, TN, US, ALBERT T. ICHIKI Baylor College of Medicine, Houston, TX, US, ROBERT D. LANGE University of Tennessee Medical Center, Knoxville, TN, US et al. Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 6 June 1995 p. 557-561 (HTN-95-92913) Copyright

A decreased red blood cell mass (RBCM) and plasma volume (PV) have been consistently found in humans after return from spaceflight. Rats flown on the Spacelab Life Sciences-1 mission were studied to assess changes in RBCM, PV, erythropoiesis, and iron economy. The RBCM and PV increased in both ground control and flight animals as expected for growing rats. However on landing day, both the RBCM and PV, when normalized for body mass, were significantly decreased in the spaceflight animals. During an 8-day postflight observation period, iron incorporation into circulating red blood cells was diminished in the flight animals. During the first 4 day postflight, increases in reticulocyte counts were significantly smaller in the flight than the control animals. Fewer erythropoietin-responsive progenitor cells were recovered from the bone marrow of flight animals after landing than control rats. Serum erythropoietin (EPO) levels were the same in both groups. Thus, rats subjected to a 9-day spaceflight had less increase in RBCM than controls and diminished erythropoiesis during an 8-day post-spaceflight observation period. The rat, like humans, appears to require a smaller blood volume in microgravity.

Author (Herner)

A95-91852 NO DETECTABLE BIOEFFECTS FOLLOWING ACUTE EXPOSURE TO HIGH PEAK POWER ULTRA-WIDE BAND ELECTROMAGNETIC RADIATION IN RATS

THOMAS J. WALTERS Systems Research Laboratories, Inc., Brooks AFB, TX, US, PATRICK A. MASON Operational Technologies Corp., Brooks AFB, TX, US, CLIFFORD J. SHERRY Systems Research Laboratories, Inc., Brooks AFB, TX, US, CATHY STEFFEN Systems Research Laboratories, Inc., Brooks AFB, TX, US, and JAMES H. MERRITT Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 6 June 1995 p. 562-567 (Contract(s)/Grant(s): F33615-90-C-0604) (HTN-95-92914) Copyright

A wide range assessment of the possible bioeffects of an acute exposure to high peak power ultra-wide band (UWB) electromagnetic radiation was performed in rats. The UWB-exposure consisted of 2 min of pulsed (frequency: 60 Hz, pulse width: 5-10 ns) UWB (bandwidth: 0.25-2.50 GHz) electromagnetic radiation. Rats were examined using one of the following: (1) a functional observational battery (FOB); (2) a swimming performance test; (3) a complete panel of blood chemistries; or (4) determination of the expression of the c-fos protein in immunohistologically-stained sections of the brain. No significant differences were found between UWB- or sham-exposed rats on any of the measured parameters.

Author (Herner)

A95-91909 CAVITATION/BOUNDARY EFFECTS IN A SIMPLE HEAD IMPACT MODEL

GUY S. NUSHOLTZ Chrysler Motor Corp., Auburn Hills, MI, US, E. BENJAMIN WYLIE Chrysler Motor Corp., Auburn Hills, MI, US, and LEE G. GLASCOE Chrysler Motor Corp., Auburn Hills, MI, US Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 661-667 (HTN-95-12209) Copyright

An experimental and numerical analysis of the impact response of a simple model of the human head is presented. A water-filled 14-cm diameter cylinder was struck by a 10 kg free flying mass. Rigid-body acceleration-time-history and the pressure at the fluid-cylinder interface were monitored during the impact event. Comparisons between the experimental results and the results of a computational model were made. The computational model used is a two-dimensional finite difference code simulating the physical

experiment. The code incorporates a thin layer of air and the potential for vaporization along the inside of the cylinder. The study indicates that during a severe impact to the human head, the stresses generated within the brain can result in cavitation on the far side of impact followed by a sudden cavity collapse which can be quite violent. The study identifies how a skull-brain interface and cavitation can potentially affect the internal pressure response of the brain when subjected to a sudden impact. Author (Herner)

A95-91914**EXCIMER LASER PHOTOREFRACTIVE KERATECTOMY (PRK) FOR MYOPIA - PRESENT STATUS: AEROSPACE CONSIDERATIONS**

STANLEY DIAMOND Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 690-693 (HTN-95-12214) Copyright

Excimer laser photorefractive keratectomy (PRK) to reduce myopia has been studied the past 3 yrs at multicenters authorized by the FDA. The excimer laser ablates the central cornea to a new calculated power. A review of the cases reported in the literature reveals the following information: Corneal scarring may be reflected in the loss of best-corrected vision. Regression of the refractive effect is a complication. Predictability was the percentage of eyes obtaining 20/40 or better vision; this varied from 62.5-91%. Conversely, 9.0-37.5% were 20/50 or worse. Low to moderate myopes had better visual success. Accuracy was the refractive correction within +/- 1.00 D (spherical equivalent); this varied between 64.7-93%. The higher percentages were with low to moderate degrees of myopia. Loss of best corrected vision was due to scarring and haze, and occurred more frequently with high myopia and deeper ablations. Patient satisfaction after 2 yrs was reported as 82.6-90%; 17.4% were not satisfied. Advantages: (a) PRK effectively and safely corrected myopia and myopic astigmatism; (b) there was no diurnal variation of refraction or vision; (c) vision remained fairly stable with some regression up to 24 mo and; (d) accuracy of correction to +/- 1.00 D was fair. Disadvantages: a) post-operative scarring and haze was present after 6 mo to 2 yrs of follow-up in some cases. Scarring was less with low myopia and worse with high myopia; b) regression of correction and blur; and c) poor night vision, halos, and glare sensitivity occurred after pupil dilation. Aerospace considerations: PRK appeared to be effective, safe, and satisfactory, with sufficient predictability and accuracy for a high percentage of the selected patients of the studies. Aviators require more critical visual criteria for air safety and long-term stability of vision. The goal of refractive surgery on normal sighted eyes of pilots is that the uncorrected vision attained must be at least as good or better than the pre-surgical best-corrected vision. The predictability, accuracy, and complications reported to the present time appeared to pose adverse and unacceptable risks for air transport pilots. Author (Herner)

A95-92251**STRONTIUM-90 CONCENTRATIONS IN HUMAN TEETH IN SOUTH UKRAINE, 5 YEARS AFTER THE CHERNOBYL ACCIDENT**

Y. D. KULEV Department of Radiobiology, Institute of Biology of the Southern Seas, Sevastopol, USSR, G. G. POLIKARPOV Department of Radiobiology, Institute of Biology of the Southern Seas, Sevastopol, USSR, E. V. PRIGODEY Central Children's Dental Clinic, Sevastopol, USSR, and P. A. ASSIMAKOPOULOS Nuclear Physics Laboratory, The University of Ioannina, 45332 Ioannina, Greece Science of the Total Environment (ISSN 0048-9697) vol. 155, no. 3 September 14, 1994 p. 215-219 Copyright (c) 1995 Elsevier Science B.V., Amsterdam. All rights reserved. (GTN-95-00489697-4145; HTN-95-Z0667) Copyright

Approximately 1000 human teeth, collected in South Ukraine, in 1990-1991, were measured for Sr-90 concentration. The teeth were grouped into 18 samples according to the age and sex of the donors. Measured levels of Sr-90 concentrations were lower by a

factor of 10 than measurements taken in the mid-1960s and mid-1970s. An interesting feature of the data is a 3-fold enhancement of contamination levels in the 25-45 year-old age group of the male population. A possible explanation for this anomaly is that this age group contains a significant number of men who were mobilized immediately after the Chernobyl accident for clean-up operations within the 30-km zone around the damaged nuclear power plant. Author (Elsevier)

A95-92252**THE BIOLOGICAL SYSTEM OF THE ELEMENTS (BSE) FOR TERRESTRIAL PLANTS (GLYCOPHYTES)**

BERND MARKERT Department for Environmental High Technology, Internationales Hochschul Institute, Markt 23, 02763 Zittau, Germany. Science of the Total Environment (ISSN 0048-9697) vol. 155, no. 3 September 14, 1994 p. 221-228 Copyright (c) 1995 Elsevier Science B.V., Amsterdam. All rights reserved. (GTN-95-00489697-4147; HTN-95-Z0668) Copyright

The position and classification of the chemical elements in the Periodic System of the Elements (PSE) does not permit any statement to be made about their functional essentiality or their acute or chronic toxicity to living organisms. This is due to the fact that it is based on purely physico-chemical aspects. An attempt has therefore been made to develop a Biological System of the Elements (BSE), which primarily considers aspects of basic biochemical and physiological research. This includes: (a) the interelement relations of single elements within an individual expressed as a linear correlation coefficient, (b) the physiological functionality of single elements paying attention to evolutionary development during the emergence of organic life from the inorganic environment, and (c) the uptake form of individual elements and their compounds by the living organism. From the resulting configuration of the chemical elements in the BSE it can be expected that in future elements such as Br, Sr, Cs, Ge and Te will be classified as physiologically essential, whereas elements such as Tl, Pb, Ga, Sb, In, Bi, Hg and Cd will continue to exclusively exercise a toxic function on living systems in elevated concentrations and certain forms of bonding. Author (Elsevier)

A95-92257**MOBILITY AND DISSIPATION OF CADUSAFOS IN BANANA FIELDS IN MARTINIQUE**

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The behavior in soil of the nematocide cadusafos (S,S-di-sec-butyl O-ethyl phosphorodithioate) was studied in four banana fields for eight weeks in Martinique (French West Indies). Pluviometry and soil characteristics influenced the movement of cadusafos. Migration and dissipation of the compound varied in different soil types: the time necessary to observe 50% dissipation of the applied dose in the 0-25 cm layer varied from 9-10 days in sandy loam soils (volcanic regosol and andosol) to 18 days in kaolinite clay soil (ferrisol) and approximately 30 days in montmorillonite clay soil (vertisol). Migration was also more rapid in sandy soils. Adsorption parameters ($K_{sub fa}$) were discussed using Freundlich equation and desorption parameters ($K_{sub 1}$, $K_{sub 2}$ and $Q_{sub ads}$) were evaluated using a model with two compartments corresponding with two different energy levels. These parameters confirmed the

51 LIFE SCIENCES (GENERAL)

respective propensity of each soil sample to retain the pesticide and could be correlated with some soil properties (sand or clay content, cation exchange capacity). Author (Elsevier)

A95-92258

DEGRADATION OF PHENANTHRENE AND PYRENE BY MICROORGANISMS ISOLATED FROM MARINE SEDIMENT AND SEAWATER

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Microorganisms which are able to degrade phenanthrene and pyrene were isolated from both seawater and sediment samples collected from a polycyclic aromatic hydrocarbon (PAH) polluted environment, Kitimat Arm, British Columbia, Canada. Four strains from a seawater culture were isolated and examined. No additional PAH induction was necessary in the enrichment process, indicating that these PAH degrading microorganisms are previously exposed to PAHs in the environment under study. Microorganisms enriched with phenanthrene as the sole carbon and energy source also degraded pyrene readily. A metabolite, pyrene cis-4,5-dihydrodiol was observed from pyrene degradation, and this metabolite was further degraded after pyrene was utilized by the microorganisms. Author (Elsevier)

A95-92259

C8 SOLID-PHASE EXTRACTION OF THE PYRETHROID INSECTICIDE FENVALERATE AND THE CHLOROACETANILIDE HERBICIDE METAZACHLOR FROM POND WATER

PER WOIN Laboratory of Chemical Ecology and Ecotoxicology, Department of Ecology, University of Lund, S-223 62 Lund, Sweden Science of the Total Environment (ISSN 0048-9697) vol. 156, no. 1 September 15, 1994 p. 67-75 Copyright (c) 1995 Elsevier Science B.V., Amsterdam. All rights reserved.

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A method was developed for the simultaneous extraction of the pyrethroid insecticide fenvalerate and the chloroacetanilide herbicide metazachlor from water using a solid-phase C8 column. After elution from the C8 column, the concentrated eluate was analysed using a capillary gas chromatograph equipped with an electron-capture detector. The method was used to confirm residues of the compounds in spiked tap water, pond water and river water. The recovery rates were high (84% for the fenvalerate and 101% for the metazachlor) and there was no need for clean-up. Author (Elsevier)

A95-92260

ANNUAL NUTRIENT EXCHANGES BETWEEN THE CENTRAL LAGOON OF VENICE AND THE NORTHERN ADRIATIC SEA

A. SFRISO Department of Environmental Sciences, Calle Larga S. Marta, 2137, 30123 Venice, Italy, A. MARCOMINI Department of Environmental Sciences, Calle Larga S. Marta, 2137, 30123 Venice, Italy, and B. PAVONI Department of Environmental Sciences, Calle Larga S. Marta, 2137, 30123 Venice, Italy Science of the Total Environment (ISSN 0048-9697) vol. 156, no. 1 September 15, 1994 p. 77-92 Copyright (c) 1995 Elsevier Science B.V., Amsterdam. All rights reserved.

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The exchange rates of nitrogen and phosphorus compounds between the Adriatic Sea and the inner parts of the central lagoon of Venice, highly populated by macroalgae, have been estimated by monitoring monthly, for 1 year, a number of stations located both

along the main channels and in shallow areas of the lagoon as well as in the sea. Total inorganic nitrogen (TIN), between February and September, was 3-4 times higher in the sea station than in the lagoon. During the same period, the lagoon inflow of TIN through the two channels (Lido and Malamocco) that connect the central lagoon with the sea was 1.2 times higher than the total loads entering the whole lagoon by freshwater sources. In contrast, phosphorus concentrations were higher (15-45%) only in April-June. Four seasonal campaigns were also carried out both in flood and ebb tide at the lagoon mouths. Results confirm the TIN and phosphate inflow from the sea to the lagoon between March and September. On a yearly basis, nutrient concentrations were negatively correlated with chlorinity. The nutrient concentrations monitored concurrently at two stations located on a freshwater stream entering the lagoon (Osellino river) were approximately 1 order of magnitude higher than those of the lagoon and sea stations. The annual mean phosphate concentration of the Osellino river, monitored in these campaigns, was approximately 50% of that measured in 1982. Author (Elsevier)

N95-28685 Woods Hole Oceanographic Inst., MA. Dept. of Biology.

AUTOMATED ANALYSIS OF ZOOPLANKTON SIZE AND TAXONOMIC COMPOSITION USING THE VIDEO PLANKTON RECORDER Final Report, 1 Jan. 1993 - 31 Dec. 1994

CABELL S. DAVIS and SCOTT M. GALLAGER 31 Dec. 1994 6 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract(s)/Grant(s): N00014-93-1-0602)

(AD-A289725; WHOI-7800-35/8687-1) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The goal of this project was to develop methods for automated analysis of zooplankton size and taxonomic composition using images from the Video Plankton Recorder (VPR). Our three main objectives are to: (1) use our existing hardware to develop methods for detecting, in real time (60 fields per second, fps), the presence of in-focus organisms on the video and storing the images to disk; (2) develop pattern recognition software for classification of organisms into major taxonomic groupings (copepods, chaetognaths, doliolids, etc.); and (3) develop specifications for transferring the software routines to hardware to enable real-time sorting of zooplankton according to major taxa. The first objective was accomplished in year 1 and significant progress was made on the second two objectives in year 2. Our new 3-year grant which begins 1/1/95 will allow us to complete objectives 2 and 3 and develop a system for real-time visualization of planktonic taxa distributions while at sea. DTIC

N95-28947# Society of Instrument and Control Engineers, Tokyo (Japan).

PROCEEDINGS OF THE 33D SICE (THE SOCIETY OF INSTRUMENT AND CONTROL ENGINEERS) ANNUAL CONFERENCE, PART 1

1994 374 p Conference held in Tokyo, Japan, 26-28 Jul. 1994 (DE95-758947; CONF-9407173-PT-1) Avail: CASI HC A16/MF A03

This is proceedings of the English papers presented to the 33rd SICE Annual Conference. As for vision control, reports are made on image recognition, visual servo, obstacle detection, and artificial intelligence. As to neuro and fuzzy, reported are learning rule in control, artificial intelligence traffic signal lights using fuzzy logic, and fuzzy petri net scheme for fuzzy production rule expression. With respect to robot, discussed are intelligent manipulator, and navigation control by robot system. With respect to measurements, described are measurement of internal resistivity distribution by tomography technique, minute drag measurement of the fluid, precision measurement, etc. As to bio-system, studies are made on muscle activation pattern and arterial tree, and as biomedical measurement, on heart behavior, and Alzheimer's disease. Reports are further made on control system, signal processing, robust control, industrial application of control technology, etc. The paper on estimation and identification is presented. DOE

N95-29088# Massachusetts Inst. of Tech., Cambridge, MA.
**PROCEEDINGS OF THE 11TH CONGRESS OF THE
 INTERNATIONAL SOCIETY FOR ARTIFICIAL CELLS,
 BLOOD SUBSTITUTES AND IMMOBILIZATION
 BIOTECHNOLOGY**

ROBERT S. LANGER 1 Nov. 1994 213 p Meeting held in Boston,
 MA, 24-27 Jul. 1994

(Contract(s)/Grant(s): DAMD17-94-J-4017)

(AD-A290342) Avail: CASI HC A10/MF A01

This journal covers artificial cells, blood substitutes, and immobilization biotechnology. The emphasis of this journal is to allow for interdisciplinary interactions. Therefore, approaches based on biotechnology, chemical engineering, medicine, surgery, biomedical engineering, basic medical sciences, chemistry, and others were welcomed. DTIC

N95-29155# Michigan State Univ., East Lansing, MI. Dept. of
 Psychology.

**ELECTRICAL AND ELECTRONIC PROPERTIES OF SELF-
 ASSEMBLED LIPID BILAYERS Final Report, Apr. 1991 -
 Jul. 1994**

H. T. TIEN 12 Oct. 1994 7 p

(Contract(s)/Grant(s): DAAL03-91-G-0062)

(AD-A290507; ARO-28750.1-LS-SM) Avail: CASI HC A02/MF A01

Cell membranes play a pivotal role in signal transduction and information processing. This is owing to the fact that most physiological activities involve some kind of lipid bilayer-based receptor-ligand contact interactions. There are many outstanding examples such as ion sensing, antigen-antibody binding, and ligand-gated channels, to name a few. One approach to study these interactions in vitro is facilitated by employing artificial bilayer lipid membranes (BLMs). We have focused the efforts on ion and/or molecular selectivity and specificity using newly available self-assembled BLMs on solid support (i.e. s-BLMs), whose enhanced stability greatly aid in research areas of membrane biochemistry, biophysics and cell biology as well as in biosensor designs and molecular devices development. In this report, our current work along with the experiments done in collaboration with others on s-BLMs will be presented. DTIC

N95-29263 Air Force Systems Command, Wright-Patterson AFB,
 OH. National Air Intelligence Center.

**RESEARCH ON PGI2 AND TXA2 EFFECTS AT TIMES OF
 HYPERBARIC OXYGENATION OF DOMESTIC RABBITS
 WITH ACUTE CEREBRAL ISCHEMIA REIRRIGATION
 DAMAGE**

TENG YANSHENG and GAO GUANGKAI 15 Dec. 1994 16 p
 Transl. into ENGLISH from Shung-Hua Shen Ching Ching Shen Ko
 Tsa Chih, China, v. 25, no. 1, Feb. 1992 p 31-34 Limited
 Reproducibility: More than 20% of this document may be affected by
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(AD-A289606; NAIC-ID(RS)T-0310-93) Avail: Issuing Activity
 (Defense Technical Information Center (DTIC))

There were 33 New Zealand white rabbits taken and randomly divided into a control group, a hyperbaric air group, and a hyperbaric oxygenation (HBO) group. All were reirrigated types following the creation of acute, incomplete cerebral ischemia. Respective measurements were taken of the overall carotid artery and interior jugular vein blood gases as well as cortical brain tissue homogenate amounts of 6-Keto-PGF1 and TXB2 contained. In conjunction with this, pathological investigations were made. The results were that: the amounts of 6-Keto-PGF1 contained for the HBO group were clearly greatly increased (P less than 0.01). TXB2 clearly dropped (P less than 0.05). Blood P02 in the HBO group clearly went up (P less than 0.01). Pathological investigations showed that the HBO groups brain tissue damage was relatively light. Conclusion: there were clear effects on PGI2 and TXA2 with HBO when there was reirrigation after acute cerebral ischemia in the domestic rabbits. This is possibly one mechanism of HBO therapy for acute cerebral ischemia. DTIC

N95-29320# New Mexico State Univ., Las Cruces, NM. Dept. of
 Civil Engineering.

**MODELING JOINT EFFECTS OF MIXTURES OF
 CHEMICALS ON MICROORGANISMS USING
 QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP
 TECHNIQUES, PHASE 3 Final Report, 23 Oct. 1991 - 22 Oct.
 1994**

N. NIRMALAKHANDAN, V. R. ARULGNANENDRAN, J. PRAKASH,
 B. SUN, and J. PEACE 22 Oct. 1994 90 p

(Contract(s)/Grant(s): AF-AFOSR-0394-91)

(AD-A290153; AFOSR-95-0015TR) Avail: CASI HC A05/MF A01

A laboratory procedure was developed to measure the toxicity of 35 organic chemicals in the soil medium using the respirometric technique. These toxicity assays were carried out using a commercially available surrogate test culture of microorganisms. Reproducibility tests were done on 12 of the chemicals yielding an average standard deviation of 0.034 and a coefficient of variation of 0.08. These tests were also repeated at different moisture holding capacities of 33%, 50%, 80%, and 100% for six chemicals yielding an average standard deviation of 0.20 and coefficient of variation of 0.27. Using a part of the experimental IC50 results as a training set, quantitative structure activity relationship (QSAR) models were developed to predict the toxicity of 12 chemicals in the testing set. Joint toxicity of 35 different combinations of mixtures in the soil were also measured at equitoxic ratios. The joint effects in these mixtures were analyzed for simple additivity. Results indicate that the test chemicals exhibited simple additivity when acting jointly in a uniform mixture. A QSAR approach is proposed to predict mixture toxicity based on single chemical QSAR models. DTIC

N95-29375*# National Aeronautics and Space Administration. John
 F. Kennedy Space Center, Cocoa Beach, FL.

**EFFECT OF IRRADIANCE, SUCROSE, AND CO2
 CONCENTRATION ON THE GROWTH OF POTATO
 (SOLANUM TUBEROSUM L.) IN VITRO**

NEIL C. YORIO (Dynamac Corp., Rockville, MD.), RAYMOND M.
 WHEELER, and RUSSELL C. WEIGEL (Florida Inst. of Tech.,
 Melbourne, FL.) Jun. 1995 27 p

(NASA-TM-110654; NAS 1.15:110654) Avail: CASI HC A03/MF
 A01

Growth measurements were taken of potato plantlets (*Solanum tuberosum* L.) cvs. Norland (NL), Denali (DN), and Kennebec (KN), grown in vitro. Studies were conducted in a growth chamber, with nodal explants grown for 21 days on Murashige and Skoog salts with either 0, 1, 2, or 3% sucrose and capped with loose-fitted Magenta 2-way caps that allowed approximately 2.25 air exchanges/hour. Plantlets were exposed to either 100 or 300 micro mol/sq m/s photosynthetic photon flux (PPF), and the growth chamber was maintained at either 400 or 4000 micro mol/mol CO2. Regardless of PPF, all cvs. that were grown at 4000 micro mol/mol CO2 showed significant increases in total plantlet dry weight (TDW) and shoot length (SL) when sucrose was omitted from the media, indicating an autotrophic response. At 400 micro mol/mol CO2, all cvs. showed an increase in TDW and SL with increasing sucrose under both PPF levels. Within any sucrose treatment, the highest TDW for all cvs. resulted from 300 micro mol/sq m/s PPF and 4000 micro mol/mol CO2. At 4000 micro mol/mol CO2, TDW showed no further increase with sucrose levels above 1% for cvs. NL and DN at both PPF levels, suggesting that sucrose levels greater than 1% may hinder growth when CO2 enrichment is used. Author

N95-29471# Genetics Society of America, Bethesda, MD.

**GENETICS AND THE UNITY OF BIOLOGY [GENETIQUE ET
 UNITE EN BIOLOGIE]**

1995 305 p Presented at the 16th International Congress of
 Genetics, Toronto, Canada, 20-27 Aug. 1988; sponsored by the
 Genetics Society of Canada, the National Research Council Canada,
 The Royal Society of Canada, and the Biological Council of Canada
 (Contract(s)/Grant(s): DE-FG05-88ER-60672)

(DE95-006484; CONF-8808142-PT-3) Avail: CASI HC A14/

51 LIFE SCIENCES (GENERAL)

MF A03

International Congresses of Genetics, convened just once every five years, provide a rare opportunity for overview in the field of genetic engineering. The Congress, held August 20-27, 1988 in Toronto, Canada focused on the theme Genetics and the Unity of Biology, which was chosen because the concepts of modern genetics have provided biology with a unifying theoretical structure. This program guide contains a schedule of all Congress activities and a listing of all Symposia, Workshops and Poster Sessions held. DOE

N95-30114# Argonne National Lab., IL.

PARALLEL CONTINUATION-BASED GLOBAL OPTIMIZATION FOR MOLECULAR CONFORMATION AND PROTEIN FOLDING

THOMAS F. COLEMAN and ZHIJUN WU (Cornell Univ., Ithaca, NY.) 1994 22 p Presented at the Supercomputing '94 Meeting, Washington, DC, 14-18 Nov. 1994

(Contract(s)/Grant(s): W-31-109-ENG-38)

(DE95-005860; ANL/MCS/CP-83621; CONF-941118-10) Avail: CASI HC A03/MF A01

This paper presents the authors' recent work on developing parallel algorithms and software for solving the global minimization problem for molecular conformation, especially protein folding. Global minimization problems are difficult to solve when the objective functions have many local minimizers, such as the energy functions for protein folding. In their approach, to avoid directly minimizing a 'difficult' function, a special integral transformation is introduced to transform the function into a class of gradually deformed, but 'smoother' or 'easier' functions. An optimization procedure is then applied to the new functions successively, to trace their solutions back to the original function. The method can be applied to a large class of nonlinear partially separable functions including energy functions for molecular conformation and protein folding. Mathematical theory for the method, as a special continuation approach to global optimization, is established. Algorithms with different solution tracing strategies are developed. Different levels of parallelism are exploited for the implementation of the algorithms on massively parallel architectures. DOE

N95-30292* Interface Video Systems, Inc., Washington, DC.

LIFE SCIENCES PROGRAM (Videotape) 1995

Videotape: 17 min. 45 sec. playing time, in color, with sound (NASA-CR-197658; NONP-NASA-VT-95-46006) Avail: CASI VHS A02/BETA A22

This Life Science Program video examines the variety of projects that study both the physiological and psychological impacts on astronauts due to extended space missions. The hazards of space radiation and microgravity effects on the human body are described, along with these effects on plant growth, and the performance of medical procedures in space. One research technique, which is hoped to provide help for future space travel, is the study of aquanauts and their life habits underwater. CASI

52

AEROSPACE MEDICINE

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

A95-87488

CELL FUSION IN SPACE: PLASMA MEMBRANE FUSION IN HUMAN FIBROBLASTS DURING SHORT TERM MICROGRAVITY

J. F. JONGKIND Erasmus Univ., Netherlands, P. VISSER Erasmus Univ., Netherlands, and A. VERKERK Erasmus Univ., Netherlands Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space

Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 21-25 (Contract(s)/Grant(s): ESA-AO-SRLS/89/6-NL; SRON-MG-029) Copyright

During short-term microgravity in sounding rocket experiments (6 min.) the cytoskeleton undergoes changes and therefore it is possible that cell processes which are dependent on the structure and function of the cytoskeleton are influenced. A cell fusion experiment, initiated by a short electric pulse, was chosen as a model experiment for this sounding rocket experiment. Confluent monolayers of primary human skin fibroblasts, grown on coverslips, were mounted between two electrodes (distance 0.5 cm) and fused discharging a capacitor (68 microF; 250 V; 10 msec) in a low conductive medium. During a microgravity experiment in which nearly all the requirements for an optimal result were met (only the recovery of the payload was delayed) results were found that indicated that microgravity during 6 minutes did not influence cell fusion since the percentage of fused products did not change during microgravity. Within the limits of discrimination using morphological assays microgravity has no influence on the actin/cortical cytoskeleton just after electrofusion. Author (Herner)

A95-87511

STATE OF ERYTHROCYTE MEMBRANE IN MAN AND MONKEYS AFTER SPACE FLIGHT

YU. V. YARLIKOVA Inst. of Biomedical Problems, Moscow, Russia and S. M. IVANOVA Inst. of Biomedical Problems, Moscow, Russia Life and gravity: Physiological and morphological responses; Meeting F1.1 of the COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-87485 Advances in Space Research (ISSN 0273-1177) vol. 17, no. 6-7 1996 p. 179-182 Copyright

The lipid and phospholipid composition of the erythrocyte membrane (EM) was investigated in man after long space flight (SF) and monkey after short space. The result obtained confirm structural changes in EM under the influence of SF factors and show that an increase of free cholesterol (Ch) and cholesterol ethers (ChE) fractions and in the Ch&ChE/phospholipid (PL) ratio combined with a decrease of PL fractions. It was noticed that the magnitude of these changes is depend on duration of space flight. Author (Herner)

A95-87815

LASER-TISSUE INTERACTIONS: PHOTOCHEMICAL, PHOTOTHERMAL, AND PHOTOMECHANICAL

STEVEN L. JACQUES M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 706-712*

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The variety of laser sources available for medical applications continues to grow. An overview of the photochemical, photomechanical, and photothermal mechanisms of interactions is presented.

Author (Herner)

A95-87816

LASER INDUCED TISSUE TEMPERATURE CHANGES

N. FILONENKO McMaster Medical School, Hamilton, Canada, YU. GUREVICH Toronto Univ., Downsview, Canada, and N. SALANSKY Toronto Univ., Downsview, Canada *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 713-720*

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The paper represents theoretical analysis of the laser induced tissue temperature field for a wide range of optical and thermal conditions typical for photodynamic and low energy laser therapy. The analysis is based on an approximate analytical solution of a steady-state heat conduction equation with a laser generated heat source and boundary conditions which correspond to molecular and/or convective heat exchange with an external medium and due to

blood perfusion. It is shown how to reduce a two-dimensional cylindrically symmetric heat conduction equation to an ordinary differential equation for a multi-layered turbid media. Analytical expressions for the laser induced tissue temperature field were obtained for the Beer's law exponential fluence rate profile within the tissue. Maximum tissue temperature is significantly increasing with the beam radius for constant incident irradiance without heat exchange. Heat exchange with the external medium and due to blood perfusion is more sufficient for large beam radii. Author (Herner)

A95-87817**EXPERIMENTAL AND THEORETICAL ANALYSIS OF INTRALUMINAL LASER HEATING OF TISSUE**

B. ANVARI Texas A&M Univ., College Station, TX, US, M. MOTAMEDI Texas Univ. Medical Branch, Galveston, TX, US, S. RASTEGAR Texas A&M Univ., College Station, TX, US, and J. H. TORRES Texas Univ. Medical Branch, Galveston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 721-726 Copyright*

Thermal response of tissue during intraluminal laser irradiation by Nd:YAG and diode lasers is studied by using a computer model and an experimental procedure. The model uses a diffusion approximation method to the radiative transport equation to calculate the light distribution in two dimensions. Pennes' bio-heat equation is used to estimate the temperature distributions. A finite difference scheme with non-uniform grid spacings is used to solve the bio-heat equation and the diffusion equation for light distribution. Model results suggest that diode lasers are of potential value in producing tissue coagulation and that the volume of the tissue coagulated by a diode laser is comparable to that coagulated by a Nd:YAG laser. The computer model also indicates that blood perfusion can become an important factor for the removal of heat during long exposure times. Experimental results support the model predictions that higher temperatures near the surface are obtained with the diode laser when compared with the Nd:YAG. Surface cooling is experimentally and theoretically shown to be an effective method for avoiding or delaying tissue explosion, and enhancing the size of the coagulation necrosis of tissue. Author (Herner)

A95-87818**NUMERICAL MODELS OF PHOTOTHERMAL TISSUE WELDING PROCESSES**

J. A. PEARCE Texas Univ., Austin, TX, US, T. MCMURRAY Texas Univ., Austin, TX, US, S. THOMSEN M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US, and H. VIJVERBERG M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 727-730 Copyright*

Numerical models can be used to study microscopic scale thermal damage processes in ways not possible with measurements. The individual thermodynamic processes can be studied independently in order to assess their relative roles. For example, it is not clear why lasers of differing wavelengths (and thus differing volume power density distributions) may all be used to obtain fusion between the apposed ends of cut tissues. Also, it is of importance to determine how heating time affects bond strength when fluence is held constant. We present usable kinetic models of thermal damage processes of interest — chiefly, thermal denaturation of tissue collagen — and comparative results from transient finite difference models of laser CO₂ laser irradiation. Author (Herner)

A95-87820**EXPERIMENTAL INVESTIGATION OF PICOSECOND OPTICAL BREAKDOWN IN WATER AND BIOLOGICAL TISSUES**

T. JUHASZ California Univ., Irvine, CA, US, L. TURI Technical Univ. of Budapest, Budapest, Hungary, Z. BOR JATE Univ., Szeged,

Hungary, B. FRUEH California Univ., San Diego, CA, US, and G. SZABO JATE Univ., Szeged, Hungary *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 739-745 Research sponsored by US-Hungarian Science and Technology Fund Copyright*

Time-resolved flash photography has been used to investigate shock waves and cavitation bubbles generated by picosecond optical breakdown in water and bovine cornea. While the dynamics of shock waves have been found to be similar in the two medium, considerable differences in the cavitation bubble dynamics have been observed between the corneal tissue and water.

Author (Herner)

A95-87821**TISSUE OPTICAL PROPERTIES MEASURED WITH ACOUSTIC TRANSDUCER**

ALEXANDER A. ORAEVSKY Rice Univ., Houston, TX, US, STEVEN L. JACQUES M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US, and FRANK K. TITTEL Rice Univ., Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 746-749 Research sponsored by NIH and Whitaker Foundation Copyright*

A technique for the measurement of tissue optical properties based on time-resolved detection of acoustic signals is developed. Stress induced in tissue by laser pulses was measured by a broad-band piezoelectric transducer. Thermal expansion of the irradiated volume of tissue heated by the laser pulses causes pressure increases, which are proportional to the laser fluence and the tissue absorption coefficient. The exponential profile of the acoustic signal formed by the initial stress distribution corresponds to the axial light distribution in the irradiated tissue. Therefore, the profile and the amplitude of the acoustic signal induced by the laser pulse in biological tissue carry complete information about the tissue absorption and scattering properties. The optical properties of soft biological tissues (atherosclerotic aorta, pig, beef and rat liver, and dog prostate) measured with an acoustic transducer is reported for various laser wavelengths from ultraviolet to infrared.

Author (Herner)

A95-87822**LASER ABLATION MECHANISMS FOR BIOLOGICAL TISSUE: STUDY WITH ACOUSTIC TRANSDUCER**

ALEXANDER A. ORAEVSKY Rice Univ., Houston, TX, US, STEVEN L. JACQUES M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US, FRANK K. TITTEL Rice Univ., Houston, TX, US, and P. D. HENRY Baylor Coll. of Medicine, Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 750-753 Research sponsored by NIH and Whitaker Foundation Copyright*

The mechanisms of pulsed laser ablation of soft biological tissues which include thermal and mechanical effects was studied. A quantitative study of laser energy transformation into heat energy and stress waves was performed utilizing an acoustic transducer with a nanosecond temporal resolution. The ablation process was quantified by recoil momentum measurements and simultaneous observed with laser-flash photography. The mutual contribution of heat generation and thermoelastic stress in the mechanism of tissue ablation upon Nd:YAG laser irradiation at 355 nm was investigated. The crucial role of negative phase of the stress transient generated in tissue by a short laser pulse was demonstrated to create metastable state of 'overheated' tissue at temperatures significantly below 100 C. Cavitation induced ablation model is developed. Pulsed laser ablation process is found to consist of two phases, one of which is associated with expansion of cavitation bubbles and the other one is associated with bubble collapse. Author (Herner)

A95-87824

SIMULATION OF AN ULTRAFAST LASER PULSE PROPAGATION IN BREAST TISSUES

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A Monte Carlo model has been developed to study the ultrafast laser pulse propagation in breast tissues and the transmission properties that are pertinent to imaging systems for the detection of breast cancer. Author (Herner)

A95-87825

OVERVIEW OF CURRENT MEDICAL LASER APPLICATIONS: TRIUMPHS AND FAILURES

SHARON THOMSEN M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 763-767*

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Initially, the application of lasers in medicine was the story of an apparatus in search of an application. Lasers were taken from the physics and engineering laboratories into the medical research arena where the high powered, precisely manipulatable light irradiation was aimed at various organs and pathologic lesions to see what would happen. This empirical approach was met with serendipitous triumphs and unexpected failures. It is the combination of the lessons learned from the early experience and the giant advances in laser technology that have led to more reasoned and realistic approaches in the current development of medical lasers and applications. Author (Herner)

A95-87826

DUAL LASER IRRADIATION DURING TISSUE ABLATION: EFFECT OF CARBON LAYER REMOVAL ON ABLATION AND COAGULATION

LEOR RUBEIN M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US and STEVEN L. JACQUES M. D. Anderson Cancer Center, Texas Univ., Houston, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 768-773*

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The role of carbonization during laser ablation of tissue was investigated. A dual-laser system was tested, in which a pulsed alexandrite laser thinned the carbon layer produced by a Nd:YAG laser. The thinning of the carbon layer modified the efficiency of ablation and the extent of surrounding thermal coagulation. Dual-laser irradiation offers a means of selecting between a cutting tool and a coagulation tool. Author (Herner)

A95-87827

PHOTOCHEMICAL CROSS-LINKING OF PROTEINS: POTENTIAL FOR TISSUE WELDING WITHOUT HEAT

M. M. JUDY Baylor Research Inst., Dallas, TX, US, J. L. MATTHEWS Baylor Research Inst., Dallas, TX, US, R. L. BORIACK Baylor Research Inst., Dallas, TX, US, A. BERLACU Baylor Research Inst., Dallas, TX, US, D. E. LEWIS South Dakota State Univ., Brookings, SD, US, and R. E. UTECHT South Dakota State Univ., Brookings, SD, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 774-776* Research sponsored by MicroBioMed, Inc.

(Contract(s)/Grant(s): N00014-90-C-0034)

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We have newly designed and synthesized a class of photochemical 1,8-naphthalimide dyes. Photochemical investigation strongly suggests that these dyes function as photoalkylation agents following activation to an intermediate state by visible light (circa 420 nm) excitation. The activated species reacts readily with nucleophilic amino acid residues, e.g., tryptophan, cysteine, and methionine. One such dye, 1,14-bis-(N-hexyl-3'-naphthalimid-4'-yl)-1,4,11,14-tetraazatetradecane-5,10-dione, incorporating two reactive 1,8-naphthalimide groups at each end of an intervening structural bridge has been used to cross-link the protein monomers of F-actin and prevent its natural depolymerization at low salt concentrations. This observation suggests continued study of these dyes as protein cross-linking and tissue-bonding agents. Author (Herner)

A95-87828

CLINICAL APPLICATION OF LASER CHANNELIZATION OF BLOCKED PERIPHERAL ARTERIES

HOUZHEN HUANG Tongji Hospital, Wuhan, China, JIALING DENG Yangtze Shipping Hospital, Wuhan, China, and CHUANSHAN LAI Xiehe Hospital, Wuhan, China *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 777-779*

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Using an Nd:YAG laser and an optical fiber probe with metal tip, 10 totally occluded peripheral arteries of 8 patients have been successfully channelized without causing hemorrhage or perforation. The total laser energy delivered for the entire procedure was from 360 to 2808 J and the length of channelized segments was from 6 to 45 cm. Seven patients had follow-up examinations with Doppler velocimetry after one year. None of them showed reoccurrence of symptoms. Author (Herner)

A95-87829

USING LASER SPECTROSCOPY TO DIAGNOSE DISEASE

I. ITZKAN Massachusetts Inst. of Tech., Cambridge, MA, US, J. J. BARAGA Massachusetts Inst. of Tech., Cambridge, MA, US, M. FITZMAURICE Case Western Reserve School of Medicine, Cleveland, OH, US, R. P. RAVA Affymax Research Inst., Palo Alto, CA, US, R. MANOHARAN Massachusetts Inst. of Tech., Cambridge, MA, US, and M. S. FELD Massachusetts Inst. of Tech., Cambridge, MA, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 780-786*

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The use of laser induced fluorescence and laser Raman scattering to diagnose disease by distinguishing between normal and abnormal human tissue is rapidly becoming a reality because of new technological advances in spectroscopic hardware. In this paper we describe measurements made using two systems: a near IR Fourier transform Raman (NIR FT Raman) spectrometer, and a Raman system based on a silicon charge coupled device (CCD) detector array. The CCD system provided a two to three order of magnitude increase in data collection speed and makes possible the use of these diagnostic methods in clinical settings. We show Raman spectra of human aorta, normal, atheromatous, and calcified, and all three are clearly distinguishable. We measured the Raman spectra of laboratory samples of compounds of the most important tissue components, and also of mixtures of these compounds. We show that the tissue spectra can be interpreted as a linear superposition of the component spectra, thereby providing a method of quantitatively determining the concentration of the individual constituents. These results were verified by biochemical assays. We also show that these measurements can be performed with good spatial resolution, both transversely and in depth below the surface, making possible 3-D imaging of diseased tissue embedded in normal. Author (Herner)

A95-87830

PHANTOMS FOR FLUORESCENCE SPECTROSCOPY

A. J. DURKIN Texas Univ., Austin, TX, US, S. JAIKUMAR Texas Univ., Austin, TX, US, and R. RICHARDS-KORTUM Texas Univ., Austin, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 787-794*

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In this paper we present a method for devising a tissue phantom in which the experimenter can control the absorption coefficient, scattering coefficient, anisotropy factor and fluorescence quantum yield to investigate the effects of these parameters on fluorescence excitation and emission spectra. The qualities that are desirable for an 'ideal' phantom are presented. Practical difficulties that are encountered in the construction of a phantom are outlined with particular attention given to the selection of an appropriate scatterer. Fluorescence and absorption spectra for mixtures containing various combinations of nictinamide-adenine dinucleotide (NADH), flavin-adenine dinucleotide (FAD), hemoglobin, mordant brown dye and polystyrene microspheres, ingredients that constitute a typical phantom, are presented. In developing such a phantom, we hope to better understand and refine mathematical models of turbid media fluorescence.

Author (Herner)

A95-87831

COMBINING INTRAVASCULAR ULTRASOUND AND FLUORESCENCE SPECTROSCOPY FOR THE REAL-TIME DIAGNOSIS OF ATHEROSCLEROSIS

STEVE WARREN Texas Univ., Austin, TX, US, KARL POPE Texas Univ., Austin, TX, US, YOUSEPH YAZDI Texas Univ., Austin, TX, US, ALFRED JOHNSTON Texas Univ. Medical Branch, Galveston, TX, US, MICHAEL DAVIS Texas Univ. Medical Branch, Galveston, TX, US, and REBECCA RICHARDS-KORTUM Texas Univ., Austin, TX, US *In Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 795-801*

(Contract(s)/Grant(s): NSF BCS-91-67202)

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A system is presented that combines fluorescence spectroscopy and intravascular ultrasound to image coronary artery and aorta in vitro. These imaging modalities provide simultaneous information about tissue chemical composition and structural makeup. Using a concentrated sample of rhodamine 6G, distances obtained from A-mode (pulse-echo) ultrasound were used to compensate fluorescence spectra for decrease in fluorescence intensity due to increases in detector-sample separation distance. In these tests, fluorescence was assumed to exit the sample isotropically, yielding a $1/r(\exp 2)$ decrease in fluorescence as the detector was moved away a distance r from the sample. First results from coronary artery tissue indicate that this $1/r(\exp 2)$ model will not work because tissue reabsorbs high-angle photons emitted deep in the tissue. This causes the fluorescence emission at the surface of the tissue to be non-isotropic. However, compensations have been achieved for tissue assuming a decrease in fluorescence intensity proportional to $1/r(\exp n)$. Using this compensation scheme, a cross-sectional image of coronary artery was constructed from in vitro tissue fluorescence measurements by rotating the view of the detector in 60 deg increments around the inner lumen of the artery. After distance compensation, the 'chemical' image produced resembled the chemical composition profile obtained by visual inspection of the tissue sample.

Author (Herner)

A95-87832

EVALUATION OF A METHOD TO REMOVE REABSORPTION AND SCATTERING EFFECTS FROM TURBID SAMPLE FLUORESCENCE

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We have developed a method that incorporates a transfer function based on two flux Kubelka Munk theory, to remove attenuation effects from turbid sample fluorescence spectra. The transfer function, which depends on the sample optical properties and thickness, relates the fluorescence of a turbid sample to its equivalent dilute sample fluorescence. The turbid sample used for this study was the human aortic media soaked in 5% hemolysed blood. A series of fluorescence spectra of the tissue were measured using a standard scanning spectrofluorimeter. Diffuse reflection and transmission measurements were made using an absorption spectrophotometer with an integrating sphere. Next, 4 micron sections of the same sample were cut using a tissuetek cryostat microtome. The fluorescence spectra of the thin section was measured using the same experimental parameters as for the original sample. The equivalent dilute sample fluorescence was calculated and compared to the measured thin section (dilute sample) fluorescence. Analysis shows that turbid sample fluorescence emission spectra at 340 nm and 420 nm excitation wavelengths are most affected by the reabsorption effects of oxy-hemoglobin. Therefore the turbid sample emission spectra was compared to the spectra of the calculated and measured dilute sample fluorescence at these two excitation wavelengths. The turbid sample fluorescence was an order of magnitude greater than the fluorescence of the dilute samples. Significant reabsorption was observed in the fluorescence spectra of the turbid sample which was minimally present in the fluorescence spectra of the thin section. The spectra of the calculated dilute sample fluorescence was almost identical to that of the measured dilute sample fluorescence. Comparing the peak intensities of the calculated and measured dilute sample fluorescence showed an agreement that was within 5% at all wavelengths in the visible spectra. Hence, our results show that the fluorescence model based on Kubelka Munk theory provides a method to remove attenuation effects from the fluorescence spectra of turbid media.

Author (Herner)

A95-87833

IN VIVO FLUORESCENCE SPECTROSCOPY FOR THE DIAGNOSIS OF SKIN DISEASES

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The feasibility of detection of skin cancer using *n vivo* nictinamide-adenine dinucleotide (NADH) fluorescence is investigated. The results of a series of measurements on normal skin and cancerous skin suggest that the major chromophore is keratin.

Author (Herner)

A95-87834

NON INVASIVE MONITORING OF BLOOD OXYGENATION IN THE BRAIN OF NEWBORNS

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52 AEROSPACE MEDICINE

A new non invasive method for continuously monitoring the blood oxygenation status, especially in the brain of newborn infants is proposed. This approach is based on measurements of the frequency dependent phase shift and amplitude of intensity modulated near infrared light which is transmitted through the skull. The quantization of blood content and oxygenation status of the blood in the brain is unlike with currently available devices feasible.

Author (Herner)

A95-88153 HOW NATURE BUILDS THE PIGMENTS OF LIFE: THE CONQUEST OF VITAMIN B-12

ALAN R. BATTERSBY Univ Chemical Lab, Cambridge, United Kingdom Science (ISSN 0036-8075) vol. 264, no. 5165 June 10 1994 p. 1551-1557
(BTN-94-EIX94431375202) Copyright

In part because humans cannot synthesize vitamin B-12 and must obtain it from organisms that produce it and because B-12 deficiency leads to pernicious anemia, it has been important to understand how microorganisms build this quite complex substance. As shown here, an interdisciplinary attack was needed, which combined the strengths of genetics, molecular biology, enzymology, chemistry, and spectroscopy. This allowed the step-by-step synthetic pathway of B-12 to be elucidated, and this approach has acted as a model for future research on the synthesis of substances in living organisms. One practical outcome of such an approach has been the improved availability of B-12 for animal feedstuffs and human health.

Author (EI)

A95-88558 INTERNATIONAL SYMPOSIUM ON SPACE MEDICINE, 3RD, NAGOYA, JAPAN, MARCH 5-7, 1992

NOBUO MATSUI, editor Nagoya University, Nagoya, Japan and HISAO SEO, editor Nagoya University, Nagoya, Japan Nagoya, Japan Research Institute of Environmental Medicine 1992 410 p. (HTN-95-42627) Copyright

The effects of the aerospace environment on humans and the systems requirements to support further manned space exploration are reviewed. The main topics discussed include: neurophysiology and space motion sickness, cardiovascular physiology, skeletal-muscular physiology, endocrinology and metabolism, and radiation and immunology. Space motion sickness and other effects of microgravity and weightlessness have been studied in space and through simulated environments. These simulations include rodent tail or hindlimb suspension and human studies using water immersion and postural modifications. Countermeasures or methods of reducing the adverse physiological effects of space environments include pre-space exercise, exercise during missions, hydration, and use of anti-G units. With long duration manned missions, radiation protection is especially important. In the space environment, there is a synergy between cosmic radiation and other radiation such as microwaves that magnifies the health hazards. For individual titles, see A95-88559 through A95-88600.

Herner

A95-88559* National Aeronautics and Space Administration, Washington, DC.

CRITICAL ISSUES FOR SPACE LIFE SCIENCES

ARNAULD E. NICOGOSIAN NASA Headquarters, Washington, DC, US, CAROLYN HUNTOON NASA Johnson Space Center, Houston, TX, US, KAREN K. GAISER Lockheed Engineering & Sciences Company, Washington, DC, US, and RONALD C. TEE-TER Lockheed Engineering & Sciences Company, Washington, DC, US *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 1-9
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Human exploration of space requires the interaction of three general systems: environmental health and life support systems, countermeasure systems, and medical care systems. These systems address atmospheric pressure, uncertainties associated with

space radiation, the potential for exposure to toxic materials in the closed environment, spacecraft habitability, human physiology, and microgravity. While these interdependent systems serve the same overall goal — the protection of the human crewmember from the hostile space environment — each has specific essential roles. Individually and in combination the three systems should be responsive to a strategy of risk reduction, so that the scientific possibilities of exploration missions may be maximized.

Author (Herner)

A95-88560 METABOLIC CHANGES IN WEIGHTLESSNESS AND MECHANISMS OF THEIR HORMONAL REGULATION

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There is no doubt to date that adaptation to weightlessness induces substantial functional, metabolic and structural alterations in most of the vital body systems. In a number of observations these changes are so profound that they may pose restriction on flight duration or cause health problems to cosmonauts on their return to Earth gravity. In the above connection, it is evident that investigations into the weightlessness-induced phenomenology and pathogenic mechanisms of changes observed in gravity-free environment will provide a solid basis for development of preventive and therapeutic means against unfavorable effects of weightlessness and for ensuring spaceflight safety. Results of biochemical and morphological studies on rats flown on board the Soviet biosatellites of the Cosmos series may help in the analysis and understanding of the data of clinical biochemical examination of cosmonauts. These results taken together allow to determine common mechanisms and tendencies of metabolic shifts in mammals exposed to weightlessness and, in the first place, in those endocrine systems which are responsible for hormonal control and evolution of adaptive processes. It should also be noted that functional assessment of endocrine systems by, in parallel with biochemical parameters, more stable morphological criteria furnishes an explanation of the character and tendencies of weightlessness-induced functional changes in animals sacrificed 4-7 hrs after landing.

Author (revised by Herner)

A95-88561 COMPARISON OF SPACE ADAPTATION AND VESTIBULAR COMPENSATION

MAKOTO IGARASHI Nihon University, Tokyo, Japan and CHARLES M. HENLEY, III Baylor College of Medicine, Houston, TX, US *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 25-31
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Can vestibular compensation be an appropriate experimental model to increase our understanding of space adaptation? As far as the function of body equilibrium system, in particular that of sensory-neural-motor system is concerned, both phenomena represent systemic behavior of adapting to a new condition produced by the alteration of afferent information. However, the key issue here is to comparatively discuss similarities and dissimilarities between these two phenomena (Igarashi, 1991). Is there any transferable information from the side of vestibular compensation to space adaptation? If there is, any procedure to accelerate vestibular compensation should hasten space adaptation and preventing or at least minimizing the distress of space motion sickness. Both phenomena are clearly, but with a tremendous complexity, contributed to by cross-modality afferents such as visual and spinal ascending, and also from the control of the hierarchical nervous system. Both phenomena belong to 'sensory-neural-motor plasticity' in a general sense. From the ecological viewpoint, both phenomena similarly require the solid establishment of spatial orientation in order to execute neces-

sary motor functions. We need to gain more knowledge about these two phenomena; however the brain stem vestibular nuclei, cerebellum (Schaefer, et al., 1979; Igarashi, et al., 1978; Igarashi and Ishikawa, 1985), reticular formation, hypothalamus etc. are clearly involved in both situations. In addition, during the course of sensory-neural-motor adaptation, hierarchical neural structures such as cerebrum, hippocampus, basal ganglia etc., definitely have an important role in various psychophysiological functions such as selective attention, alertness, learning, memory storage, and most importantly three-dimensional spatial map storage.

Author (Herner)

A95-88562
SPACEMOTION SICKNESS: VARIOUS CURRENT HYPOTHESIS, POSSIBILITIES OF PREDICTION, PREVENTION AND TREATMENT

RUDOLF VON BAUMGARTEN Universitat of Mainz, Mainz, Germany *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 33-49 Copyright

During evolution on earth most animals and also man developed the vestibular system for orientation in the three dimensional environment and for equilibrium during standing and locomotion. The accelerations experienced at these times rarely exceeded the ones occurring during self-locomotion or when tilting the head. For these motions the vestibular system developed to near perfection and could in all situations inform the brain about the position of the body, maintain standing even in the dark (mainly by the otoliths) and stabilize the direction of gaze to a target during head and body movements. With the invention by man of moving platforms like boats, railroads, cars, airplanes and finally spacecraft within a relatively short timespan in history, new kinetic problems occurred to which the vestibular system was not well suited: On any of these moving platforms additional accelerations occur, mixing with the gravito-inertial vectors of selfmovement in a bizarre and often unexperienced way. It is therefore not surprising, that man and also animals can become seasick, carsick, airsick, and spacesick. Physical and psychological factors that provoke space sickness are discussed, as well as methods of prevention. Author (Herner)

A95-88563* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DURATION VERSUS RESPONSE TO SPACE-FLIGHT EXPOSURE

CAROLYN S. LEACH NASA. Johnson Space Center, Houston, TX, US *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 51-62 Copyright

The duration of human expeditions into space has been as short as a few hours and as long as a year, and although we still need much more information, we can identify some trends indicating effects of flight duration on the physiologic response to space flight. Evidence suggests that after a period of dynamic change that varies for each physiologic system, some physiologic variable stabilize at levels that may differ from those at 1 G. Other variables appear to undergo change from time to time even after months in space, and others have not been observed to reach a plateau. Effects on the neurovestibular system begin very early and certain ones diminish rapidly. Effects of weightlessness on fluid and electrolyte physiology appear to reach a peak after that of neurophysiologic effects. It is possible that the initial responses of these two systems follow a more similar time course than is now apparent. Responses of the cardiovascular system reach a peak that approaches clinical significance after about 3 weeks. The mass of red blood cells is maximally altered after about a month. Bone mineral and lean body mass are lost gradually for at least 6 months, perhaps longer.

Author (Herner)

A95-88564
THE FLUID CONTENT OF THE SHELL TISSUES OF THE HUMAN BODY UNDER DIFFERENT EXPERIMENTAL CONDITIONS

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It was the aim of the study to demonstrate that changes of the tissue thickness in circumscribed tissue areas along the body axis can be related to fluid changes of the human body. In hemodialysis patients the tissue thickness in the front and the tibia decreased in relation to the fluid removed. In the female relatively more fluids were withdrawn from the upper half of the body as compared to male. In women after delivery within 24 hours 2 liters of fluids were given up by the shell tissues. After all the method seems to be well suited to follow the fluid shift in the astronauts firstly and secondly to relate the loss of their body mass with the fluid content of their superficial tissues. Author (Herner)

A95-88565
EFFECT OF SPACE FLIGHT ON THE IMMUNE SYSTEM IN MAN

A. COGOLI ETH Hoenggerberg, Zurich, Switzerland *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 69-83 Copyright

More than thirty years of manned space flight have clearly demonstrated that man can work and live for at least one year in space without immediate effects on his health. Very little is known, however, on possible 'hidden' effects which may appear later after flight due to muscle and bone degradation in 0g or to the damages at the cellular level caused by cosmic radiation or to depression of the immune system. Concerning the immune system, it is difficult to develop diagnostic tests to provide immediate information on its efficiency in humans. In laboratory animals this is much easier since the specific immune response can be measured experimentally after immunization with an antigen. The first report on changes in lymphocyte function was published by Konstantinova et al. in 1973. Later, immunological tests were carried out by Kimzey et al. on US astronauts on the Apollo missions and on Skylab. The immunological parameters measured were (1) lymphocyte activation after exposure to mitogens, (2) cellular immunity by skin-test, (3) immunoglobulin, alpha-interferon and interleukins levels in peripheral blood. Especially with the development of analytical kits, based on monoclonal antibodies, the analysis of lymphocyte subpopulations as well as of interleukins in the blood is becoming a common procedure. However, it is difficult to correlate the changes of these parameters with a real pathological situation. The main change observed in astronauts consists of the depression of the level of lymphocyte activation after flight. No health consequences were reported and the activation values returned to the preflight baseline within one week. Nevertheless the fact that lymphocyte function is impaired cannot be ignored. Author (revised by Herner)

A95-88566* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE EFFECT OF SPACE FLIGHT ON SPATIAL ORIENTATION

MILLARD F. RESCHKE NASA. Johnson Space Center, Houston, TX, US, JACOB J. BLOOMBERG NASA. Johnson Space Center, Houston, TX, US, DEBORAH L. HARM NASA. Johnson Space Center, Houston, TX, US, WILLIAM H. PALOSKI KRUG Life Sciences, Houston, TX, US, and HIROTAKA SATAKE Gifu University School of Medicine, Gifu, Japan *In* International Symposium on

Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 85-103
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Both during and following early space missions, little neurosensory change in the astronauts was noted as a result of their exposure to microgravity. It is believed that this lack of in-flight adaptation in the spatial orientation and perceptual-motor system resulted from short exposure times and limited interaction with the new environment. Parker and Parker (1990) have suggested that while spatial orientation and motion information can be detected by a passive observer, adaptation to stimulus rearrangement is greatly enhanced when the observer moves through or acts on the environment. Experience with the actual consequences of action can be compared with those consequences expected on the basis of prior experience. Space flight today is of longer duration, and space craft volume has increased. These changes have forced the astronauts to interact with the new environment of microgravity, and as a result substantial changes occur in the perceptual and sensory-motor responses reflecting adaptation to the stimulus rearrangement of space flight. We are currently evaluating spatial orientation and the perceptual-motor systems' adaptation to microgravity by examining responses of postural control, head and gaze stability during locomotion, goal oriented vestibulo-ocular reflex (VOR), and structured quantitative perceptual reports. Evidence suggests that humans can successfully replace the gravitational reference available on Earth with cues available within the spacecraft or within themselves, but that adaptation to microgravity is not appropriate for a return to Earth. Countermeasures for optimal performance on-orbit and a successful return to earth will require development of preflight and in-flight training to help the astronauts acquire and maintain a dual adaptive state. An understanding of spatial orientation and motion perception, postural control, locomotion, and the VOR will aid in this process. Author (Herner)

A95-88568
VOLUME REGULATION IN HUMANS DURING WEIGHTLESSNESS

FLEMMING BONDE-PETERSEN ESA/ European Astronauts Centre, Cologne, Germany and P. NORSEK DAMEC RES University Hospital, Denmark *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 117-131
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Data from manned space flights indicate that central blood volume is increased during the initial hours of weightlessness. Furthermore, it has consistently been demonstrated that the astronauts develop a loss of body mass as early as the initial days of a space mission. This observation indicates that astronauts develop a fluid deficit in response to weightlessness. Results from the Skylab missions indicate that the loss of fluid as assessed by the decrease in body mass, is attributable in part to a decrease in fluid intake and partly to an augmented renal water excretion. Whether a natriuresis ensues during the initial hours of weightlessness is not known at present. However, despite major investments in time and effort over the past three decades, the presently available information concerning the renal and endocrine adaptation to weightlessness is inconsistent and difficult to interpret. Author (Herner)

A95-88569
AN OBSERVATION OF VESTIBULAR SPINAL RELATIONSHIP

MITSUHIRO KOEDA Chukyo University, Aichi, Japan and GENYO MITARAI Chukyo University, Aichi, Japan *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 133-139
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To investigate the vestibular influence on the spinal motor activity, alteration of the soleus H-reflex by rotating chair simulation was observed in human subjects, who were relaxing on the chair

only with keeping the center of head over the rotational axis. The H-reflex, recorded from the right leg, was consistently suppressed during rotation, suggesting that the semicircular canal afferents result in inhibition of the spinal motor activity. The inhibition became larger with increasing of exposure time and also of acceleration intensity, and was regardless of rotating direction. This graded nature and non-laterality of the inhibition may be an appearance of a programmed control of higher motor center. The vestibular afferents may inhibit the spinal motor system which is not required for any purposeful activation under the relaxation condition. The mediating pathway may be through the vestibulo-reticulo-spinal tract. The similar phenomenon may be observed under weightlessness.

Author (Herner)

A95-88571
INFLUENCE OF LATERAL TILT IN OPTOKINETIC NYSTAGMUS AND OPTOKINETIC AFTER-NYSTAGMUS IN HUMANS

HIROYUKI SUZUKI Nagoya University, Nagoya, Japan, SATORU WATANABE Nagoya University, Nagoya, Japan, OSAMU OGAWA Nagoya University, Nagoya, Japan, and TAKUYA YAMAMOTO Nagoya University, Nagoya, Japan *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 151-157
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We examined the otolith input influence on both horizontal optokinetic nystagmus (OKN) and subsequent optokinetic after-nystagmus (OKAN) using a large-field optokinetic stimulation with a constant acceleration combined with a static change of position using a tilting-bed. Eight subjects faced a 1.5m dome-screen from a distance of 1.15m, and were tilted on their sides from their upright posture to 45 and 90 deg. OK stimuli were projected on the screen 4 times at each tilting position. The stimulus profile was immediately followed by 60s of darkness for OKAN recording. With the pursuit tracking a spot oscillating in a 20 deg sinusoidal wave from 0.2 to 1.0Hz, the amplitude gains were almost equal between the 5 positions. On the other hand, the slow phase optokinetic break-off point was highest in the upright position and decreased in all other tilting positions. Both the OKAN duration and the time-constant of its slow phase decay also decreased with tilting positions. We can conclude that otolith input influences OKN generation, and affects retinal nystagmus to a much greater extent than foveal nystagmus. Author (Herner)

A95-88572
VALIDATION OF THE OTOLITH ASYMMETRY HYPOTHESIS AS A CAUSE OF SPACE MOTION SICKNESS

SHIRLEY G. DIAMOND UCLA School of Medicine, Los Angeles, CA, US and CHARLES H. MARKHAM UCLA School of Medicine, Los Angeles, CA, US *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 159-166
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Space motion sickness (SMS) occurs in half to two-thirds of all persons travelling in space (Davis et al., 1988), usually beginning two to three hours after launch, at which time the space vehicle is already in orbit and the astronauts have been in microgravity for some time. Typically, SMS will persist for three or four days and then improve. For the remainder of the mission, the astronauts will usually have no further problems of this nature, although some may experience malaise when they return to earth. SMS is presumed to have a different etiology than motion sickness on earth, evidenced by the fact that susceptibility to one of these similar syndromes is no predictor of susceptibility to the other. The obvious difference between the space milieu and the ordinary earth environment is the extreme decrease in gravity. The otolith organs in the inner ear are the focus of the asymmetry hypothesis of vestibular function proposed to underlie the genesis of SMS (von Baumgarten & Thumler, 1978). This hypothesis asserts that in some persons this bilateral system of gravity receptors may have inherent anatomical or physi-

ological differences in the two sides. This slight asymmetry may be very well compensated in the usual lifelong 1 G environment, but when such a person is exposed to novel gravitational states, such as the hypogravity of space flight, the prior compensatory equilibration may be disturbed. This hypothesized failure of compensation may be a factor causing unstable eye torsion, a reflex governed by the otolith organs. To investigate this hypothesis, two series of experiments were conducted on NASA's KC-135 parabolic flight aircraft.
Author (Herner)

A95-88573
EFFECTS OF IMAGINARY TARGET ON INDUCED EYE MOVEMENTS BY LINEAR ACCELERATION

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The otolith organs perceive gravitational force as well as the linear acceleration generated by head motion. In microgravity condition comparing with 1G condition, there should be difference of perceptual behavior and reflexes governed by the otolith organs. We have reported the influence of gravity vector on eye movements during lateral periodic linear acceleration (Hashiba et al. 1991). Recently, effects of imaginary gaze on vestibulo-ocular reflex (VOR) have been emphasized not only in canalicular-ocular reflex but also in otolithic-ocular reflex. We investigated the imaginary gaze effects on the eye movements induced by lateral linear acceleration under different two head positions. The eye movement responded intensively when subjects tried to gaze at an imaginary space fixed target, on the other hand the eyes stabilized significantly when the subjects tried to gaze at an imaginary body fixed target. We concluded the imaginary gaze effects could originate in non-visually induced smooth pursuit eye movements. The gravitational force still influenced the eye movements elicited during linear acceleration in certain experimental conditions. This fact supports our previous findings.
Author (Herner)

A95-88574
GRADED CHANGE OF FORCES ON THE OTOLITHS AS A TOOL TO INVESTIGATE EQUILIBRIUM IN MAN

JOACHIM WETZIG Johannes-Gutenberg-University, Mainz, Germany, K. HOFSTETTER-DEGEN Johannes-Gutenberg-University, Mainz, Germany, and R. VON BAUMGARTEN Johannes-Gutenberg-University, Mainz, Germany *In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 177-185*
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To describe the cooperation of the left and right otolith organ we enlisted off-center (eccentric) rotation of the subject, imparting different centrifugal stimuli on the left and right otolith system, respectively. In doing so we could prove, that in clinically normal subjects the perception of a luminous line was dependent on the centrifugal force acting on the head. Asymmetries seen in the responses of some subjects pointed to a need for further validation on known pathological cases. Here we present the results gathered on a group of clinically verified vestibular defectives (verum) and a normal (control) group. Both groups were subjected to standardized clinical tests to reconfirm the unilateral vestibular loss in the verum group. In the control group they had to establish the normalcy of the responses of the vestibular system. Both groups then underwent testing on our eccentric rotary chair. Responses of setting the luminous line to the subjective vertical while being rotated differed in (1) slope of the regression line, (2) angle between left and right eye's regression lines and (3) scatter of repeated settings at any give

force. Usually the verum group showed shallower angles of the regression lines, more pronounced angles between the left and right eye's line and a greater scatter. There were, however, two subjects where the parameters did not differ markedly from the control group's settings. Nevertheless the results of the trials indicate that this test may indeed for the first time offer a chance to look at isolated otolith apparatus in vivo while requiring only a manageable amount of hardware.
Author (Herner)

A95-88576
DIFFICULTIE OF TARGET MOTION PERCEPTION IN SPACE

KAZUO KOGA Nagoya University, Nagoya, Japan *In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 195-201*
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Three theories have been suggested as to the cause of space motion sickness: (1) eye and vestibular sensory mismatch, (2) abnormal shift of body fluids producing increased intracranial pressure and (3) pre-warning signals for unpleasant physical situations by self-produced neurotoxic substances released in the body. We are interested in the possible functional disabilities/incongruities of eye, head and body movements in 0-G. Space motion sickness might be explained from the viewpoint of lack of coordination of the movements either for eye movement itself or for the eye and head. It is important to ascertain the significance of gravity in the maintenance of human visual stability.
Author (Herner)

A95-88577
CARDIOVASCULAR SYSTEM AND ITS REGULATION IN SPACE FLIGHTS

A. D. EGOROV Institute of Biomedical Problems, Moscow, Russia *In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 203-211*
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The most noticeable effects upon the human body are induced by weightlessness. Elimination of the deformation and the mechanical tension of the body structures which are gravity-related on the Earth is the primary component of the mechanism of weightlessness effects which is responsible for modification of gravireceptor impulse input, fluid redistribution and reduction of the functional load on the musculoskeletal system. A theoretical analysis based on physiological concepts of the function of mechanoreceptors makes it possible to advance a hypothesis concerning a change in the ratio of afferent impulsion from various receptor groups as well as a decrease of its total impulse flux. Deficient impulsion from the gravireceptors in weightlessness may be accompanied by a lower activity of the dorsal (sympathetic) compartment of the hypothalamus and hypotalamo-hypophyseal system that participates in the regulation of adrenals, thyroid gland and other endocrine glands. It can therefore be expected that in weightlessness the secretion of corticosteroids, catecholamines and thyroid hormones declines, the sympathetic influences diminish and the vagal tone predominates leading to a decreased tone and to pressor responses of small vessels to neurohumoral stimuli. All these can facilitate of cardiovascular changes in space flight.
Author (Herner)

A95-88578* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

COUNTERMEASURE DEVELOPMENT TO SPACE ADAPTATION

F. T. LAROCHELLE NASA, Johnson Space Center, Houston, TX, US, J. CHARLES NASA, Johnson Space Center, Houston, TX, US, D. L. HARM NASA, Johnson Space Center, Houston, TX, US, S. M. FORTNEY NASA, Johnson Space Center, Houston, TX, US, and S. SICONOLFI NASA, Johnson Space Center, Houston, TX, US *In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 213-219*
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At the Johnson Space Center we are actively involved, with the collaboration of other NASA Centers and the scientific community at large, in the search for ways to counter the negative affects of spaceflight beginning with the improvement in our understanding of the adaptation. Heretofore this search will be broadly referred to as countermeasures development and includes not only the preservation of physiological well-being but also psychological well-being. The psychological integrity of crews will, undoubtedly, become progressively more important as lengths, remoteness, and risks of missions increase. The character and priorities of our countermeasure development is very much dependent upon the character of the mission and requires a very close liaison between Medical Operations and the investigators. Because of the demands which countermeasure implementation imposes upon crew schedules and because of the potential weight, power, and budget impacts of the hardware and its development, a countermeasure can only become operational when it is either adequately validated or the human risk of not applying the existing technology exceeds the other negative impacts not directly related to crew health and safety.

Author (Herner)

A95-88581

NO INCREASE OF SOUND VELOCITY IN VENOUS BLOOD AND PLASMA WITH LOWER BODY SUCTION ON 6TH DAY IN MICROGRAVITY

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Within the frame of the Austrian-Soviet manned space flight mission 'Austromir', we measured sound velocity (SV) in blood and plasma samples during a lower body 'negative' pressure (LBNP) maneuver in one cosmonaut preflight, inflight (6th day in orbit), and postflight (2 days after landing) in order to investigate the dynamics of capillary fluid shift in the legs which we supposed to be changed by adaptation to microgravitational conditions. Antecubital blood was taken at the beginning (3 min) and after shut-down (+2 min) of 40 min LBNP (stepwise increase from 15 mmHg to 35 mmHg suction). A newly developed SV measuring device for precise (0.1%) detection of protein concentration changes was employed. Our data suggest a complete lack of LBNP-induced hemo-concentration on the 6th day in weightlessness. Postflight, there was an increased SV elevation with LBNP as compared to preflight control, suggesting greater hemoconcentration with early readaptation to a 1-g environment.

Author (Herner)

A95-88582

AGE-RELATED CHANGES AND GENDER DIFFERENCE IN SYMPATHETIC OUTFLOW TO MUSCLES AGAINST GRAVITATIONAL STRESS IN HUMANS

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The activity of postganglionic sympathetic efferent nerve fibers to muscles (muscle sympathetic nerve activity) plays an important role in the control of systemic blood pressure by innervating the smooth muscles of arterioles in the skeletal muscles. It enhances its activity when the blood pressure falls, and suppresses its activity

when the blood pressure elevates. Microneurographic technique has made it possible to record this activity directly in humans. We have reported the factors affecting this activity, one of which is gravitational stress. Burk et al. reported an increase in this muscle sympathetic nerve activity (MSNA) due to postural changes from the supine to upright position. We have also shown that MSNA increases by head-up tilting linearly to the sine function of the tilt angle, a value which signifies the longitudinal body axis component of gravity; +Gz. The hemodynamic mechanism in which MSNA plays an important role is most likely influenced by aging. The effect of aging on the sympathetic nervous system have so far been studied mainly by plasma norepinephrine level, most of which showed basal level increases with advancing age. On the other hand, the gender difference in this sympathetic activity has not so far been reported. In the present study, we aimed to clarify how sympathetic nervous system was modified by aging and gender difference. Because the plasma norepinephrine level only indirectly reflects sympathetic nerve activity, we applied a microneurographic technique and analyzed the effects of aging on this muscle sympathetic nerve activity, especially on its spontaneous activity in the supine position at rest (resting activity), on the increase from the resting activity by postural changes during passive and graded head-up tilting (responsiveness to orthostasis), and on the activity in upright standing position (standing activity).

Author (Herner)

A95-88583

AGE-RELATED CHANGES OF SYMPATHETIC OUTFLOW TO MUSCLES IN HUMANS DURING HEAD-OUT WATER IMMERSION

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Among simulations of microgravity condition on the earth, head-out water immersion is the most popular method, because of its simplicity and low cost. It utilizes the hydrostatic pressure to induce a cephalad fluid shift and the buoyancy to reduce the somatosensory input to the human body. We have analyzed the response of sympathetic outflow to muscle (muscle sympathetic nerve activity; MSNA) in human subjects using a microneurographic technique under microgravity simulated by headout water immersion. MSNA plays an important role in controlling the blood pressure in humans. This activity is composed of rhythmic, pulse-synchronous burst discharges recorded from muscle nerve fascicles. It is activated when the blood pressure drops, and is suppressed when the blood pressure rises. We have reported that the suppression of this activity during head-out water immersion occurred concomitantly with the increase in stroke volume, cardiac output, and the reduction in heart rate. We have also previously reported that MSNA is age-dependent, increasing its basal level and decreasing the responsiveness to orthostatic stress. In this study, we analyzed if the suppressive response of muscle sympathetic outflow to head-out water immersion was also age-dependent or not.

Author (Herner)

A95-88584

EFFECT OF ANP ON CAPILLARY PERMEABILITY: A POSSIBLE ROLE IN PUFFY FACE

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Medicine 1992 p. 267-272

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As the cause of puffy face observed under weightlessness, shift of blood from lower extremity to upper body and the increase in capillary permeability might be involved. As the mechanism responsible for the shift of blood from lower to upper body, the regional difference in vascular compliance might be involved. The shift of blood volume to central circulation might stimulate Atrial Natriuretic Peptide (ANP) secretion and cause fluid shift from vascular space to interstitial space. To test these hypotheses, we determined vascular compliance of hindquarters of rats, using the continuous determination of circulating blood volume. The effect of ANP on capillary permeability was also determined using the continuous determination of circulating blood volume on rats. Using human subjects, we found that the products of right atrial pressure and heart rate correlate well with blood level of ANP. All these together, coincide well with the increase in extracellular fluid space of upper-body under weightlessness. Author (Herner)

A95-88585

SWEATING RESPONSE TO SIMULATED WEIGHTLESSNESS

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Human thermoregulatory function in space has not been well understood. It may be assumed to link closely with changes in cardiovascular activities in weightlessness, such as blood redistribution, increase in blood return, and subsequent cardiovascular responses. Moreover, effects of release from gravitational pressure acting upon skin areas in nongravity on thermoregulatory responses should also be considered, since skin pressure has been demonstrated to affect reflexly various automatic nervous functions, especially regional sweating activity. In this paper, our studies concerning effects of weightlessness on sweating activity are summarized. Conventionally, weightlessness has been simulated either by 6 deg head-down tilt or by body immersion in water for laboratory experiments on human subjects, and the first section of our studies was concerned with postural changes, and the second one dealt with body immersion. Author (Herner)

A95-88586* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

NASA'S EXTENDED DURATION ORBITER MEDICAL PROGRAM

SAM LEE POOL NASA. Johnson Space Center, Houston, TX, US and CHARLES F. SAWIN NASA. Johnson Space Center, Houston, TX, US *In International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 283-287*

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The physiological issues involved in safely extending Shuttle flights from 10 to 16 days have been viewed by some as academic. After all, they reasoned, humans already have lived and worked in space for periods exceeding even 28 days in the United States Skylab Program and onboard the Russian space stations. The difference in the Shuttle program is in the physical position of the astronauts as they reenter the Earth's atmosphere. Crewmembers in the earlier Apollo, Skylab, and Russian programs were returned to Earth in the supine position. Space Shuttle crewmembers, in contrast, are seated upright during reentry and landing; reexperiencing the Earth's g forces in this position has far more pronounced effects on the crewmember's physiological functions. The goal of the Extended Duration Orbiter (EDO) Medical Project (EDOMP) has been to ensure that crewmembers maintain physiological reserves

sufficient to perform entry, landing, and egress safely. Early in the Shuttle Program, it became clear that physiological deconditioning during space flight could produce significant symptoms upon return to Earth. The signs and symptoms observed during the entry, landing, and egress after Shuttle missions have included very high heart rates and low blood pressures upon standing. Dizziness, 'graying out,' and fainting have occurred on ambulation or shortly thereafter. Other symptoms at landing have included headache, light-headedness, nausea and vomiting, leg cramping, inability to stand for several minutes after wheel-stop, and unsteadiness of gait.

Author (revised by Herner)

A95-88587

DOES SYMPATHETIC NERVE RESPONSE TO MUSCLE CONTRACTION CHANGE UNDER WEIGHTLESSNESS SIMULATED BY WATER IMMERSION?

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Crucial physiological responses to microgravity exposure are reduced skeletal muscle mass and impaired force development. Recently several studies have suggested that sympathetic efferent nerves may influence muscle hypertrophy due to physical training and atrophy due to disuse. On the other hand, it has been confirmed that sympathetic nerve innervating skeletal muscle in humans is strongly stimulated by exerting fatiguing muscle contraction. On the contrary, muscle sympathetic nerve activity (MSA) is extremely suppressed under weightlessness simulated by head-out water immersion. These findings lead us to consider that reduced skeletal muscle mass and reduced muscle function under microgravity may be related, at least in part, to decreased sympathetic outflow to muscle. Because it has been pointed out that the effects of exercise training as a countermeasure on muscle atrophy and hypofunction have minor effects in space or under simulated weightlessness than at 1 G, we compared the muscle sympathetic nerve response to static exercise both on earth and under weightlessness simulated by head-out water immersion. Author (revised by Herner)

A95-88595

CHANGES IN WATER- AND ELECTROLYTE-REGULATING HORMONES BY HEAD-DOWN TILT UNDER STRESS CONDUCTION (INSULIN INDUCED HYPOGLYCEMIA) IN MAN

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It has been suggested that the gravitational change from 1G to 0G causes a body fluid shift from the lower part of the body to the upper part and the central hypervolemia occurs by this fluid shift. In order to compensate the central hypervolemia, levels of several water- and electrolyte-regulating hormones are supposed to change. Gauer et al. postulated that the cephalad fluid shifts decreases antidiuretic hormone (ADH) secretion resulting in the marked diuresis. However, results obtained from the actual space flight were different from those observed in simulated weightlessness. In the

Skylab mission, it was reported that the urinary excretion of ADH and aldosterone increased on the first few days after arrival to the space. Also no increase in urine volume was reported. In head down tilt (HDT) and water immersion (WT), levels of stress related hormones such as cortisol and catecholamines lowered, while those levels elevated in actual space flight. These results suggest that the stress may affect changes in water- and electrolyte-regulating hormones caused by cephalad body fluid shift. Thus, in the present study, the effect of stress reaction on changes in water- and electrolyte-regulating hormones during HDT was studied. As the stresser, insulin-induced hypoglycemia was used. Our results, suggesting that the stress reaction alters changes in water- and electrolyte-regulating hormones by cephalad shift, may explain the discrepancies in hormonal changes between the actual space flight and the simulated weightlessness on the earth. Author (revised by Herner)

A95-88596**LYMPHOCYTE EXPERIMENT ON SLS-1**

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The in-vitro activation of human lymphocytes is a system widely used to study several important aspects of cell biology. Furthermore it mimics the events occurring in-vivo during an antigenic challenge. Our group has investigated the influence of different gravity conditions on this activation. Human lymphocytes can be easily purified from peripheral blood by density gradient centrifugation and are activated after the exposure to an antigen or a mitogen of the cells in culture. In all our experiments we used the mitogen concanavalin A (Con A). After the addition of the mitogen, the cells start to grow and T-cells secrete several lymphokines. The maximum of activation is usually observed after 3 days of incubation at 37 C. The degree of activation is measured by the amount of tritium-labeled thymidine incorporated into the DNA of the cells. An investigation was conducted with lymphocytes attached to microcarrier beads on the Spacelab mission Spacelab Life Sciences-1 (SLS-1) in June 1991. Author (Herner)

A95-88597**FIBRINOLYTIC ACTIVITY DURING WATER IMMERSION AND ITS CHANGE WITH EXERCISE IN THE WATER**

T. OKADA Aichi Medical University, Aichi, Japan, J. SAKAI Aichi Medical University, Aichi, Japan, H. SHIONO Aichi Medical University, Aichi, Japan, T. MATSUI Aichi Medical University, Aichi, Japan, S. SANADA Aichi Medical University, Aichi, Japan, Y. MURASE Aichi Medical University, Aichi, Japan, J. XU Aichi Medical University, Aichi, Japan, F. C. YU Aichi Medical University, Aichi, Japan, S. WAKAMATSU Aichi Medical University, Aichi, Japan, T. OGURI Aichi Medical University, Aichi, Japan et al. *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 377-386 Copyright

Effects of weightlessness on fibrinolytic activity were studied in 8 healthy volunteers, 20 to 23 years old, with water immersion facilities. Tissue plasminogen activator (t-PA) and three components of t-PA inhibitor (PAI-1) levels in the plasma were measured by ELISA. After two hours of water immersion, subjects were asked to have moderate exercise in the water. The effects of exercise on fibrinolytic activity were also examined. Plasma fibrinogen levels decreased during water immersion, but elevated to the initial levels immediately after the exercise. Both values of active and latent PAI-1 dropped significantly 30 minutes after the water immersion, while t-PA levels remained unchanged. After the exercise in the water, plasminogen activator activity in euglobulin fractions increased,

more strikingly than on the ground. Free t-PA levels significantly increased for all subjects, and the average rate of the increase was 3.5 times, which is comparable with the change reported in maximum exercise on the ground. These results suggest that the enhancement of fibrinolytic activity in simulated microgravity is probably attributed to the decreased in PAI-1, and that the exercise induces further enhancement by the release of t-PA from the vessel endothelial cells. Space microgravity environment may provide favorable conditions for preventing thrombosis. Author (Herner)

A95-88599**POSSIBLE EFFECTS OF MICROGRAVITY AND/OR COSMIC RADIATION ON GENE EXPRESSION OF STRESS PROTEINS**

KUMIO OKAICHI Nara Medical University, Nara, Japan, TUTOMU MURAMATU Nara Medical University, Nara, Japan, MAKOTO IHARA Nara Medical University, Nara, Japan, and TAKCO OHNISHI Nara Medical University, Nara, Japan *In* International Symposium on Space Medicine, 3rd, Nagoya, Japan, March 5-7, 1992. A95-88558 Nagoya, Japan Research Institute of Environmental Medicine 1992 p. 397-401 Research sponsored by the Ministry of Education, Science and Culture of Japan Copyright

Many environmental elements induce stress responses in organisms. It is essential for organisms to synthesize specific proteins, known as heat shock proteins, against these various types of stress. Since the methods of the measurement of the induced gene expression have been established by the use of advanced techniques such as northern blotting and western blotting, it has become easy to detect the induction of heat shock proteins. Our recent experimental results have indicated that not only heat treatment but also ultraviolet light-irradiation induced a heat shock protein (HSP72), one of the most famous stress proteins, in human cultured cells. In addition there is evidence that microgravity inhibits cell differentiation. In order to investigate whether the space condition of microgravity and/or cosmic radiation play(s) a role in environmental stress on mammalian cells, we propose the simple application in space experiments to detect the induced level in the mammalian cell cultured systems. Author (Herner)

A95-88874**NUCLEAR FRAGMENTATION OF HIGH-ENERGY HEAVY-ION BEAMS IN WATER**

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As a part of the physical-technical program of the heavy-ion therapy project at GSI we have investigated the nuclear fragmentation of high-energy ion beams delivered by the heavy-ion synchrotron SIS, using water as a tissue-equivalent target. For a direct comparison of fragmentation properties, beams of B-10, C-12, N-14, and O-16 were produced simultaneously as secondary beams from a primary O-18 beam and separated in flight by magnetic beam analysis. The Z-distributions of beam fragments produced in the water target were measured via energy loss in a large ionization chamber and a scintillator telescope. From these data we obtained both total and partial charge-changing cross sections. In addition we have performed Bragg measurements using two parallel-plate ionization chambers and a water target of variable length. The detailed shape of the measured Bragg curves and the measured cross

sections are in good agreement with model calculations based on semi-empirical formulae. Author (Herner)

A95-89826

OCCLUSION-FREE MONOCULAR THREE-DIMENSIONAL VISION SYSTEM

VASSILIOS E. THEODORACATOS Univ. of Oklahoma, Norman, OK, United States Optical Engineering (ISSN 0091-3286) vol. 33, no. 10 10 1994 p. 3476-3483 refs (BTN-95-EIX95292661227) Copyright

This paper describes a new, occlusion-free, monocular three-dimensional vision system. A matrix of light beams (lasers, fiber optics, etc.), substantially parallel to the optic axis of the lens of a video camera, is projected onto a scene. The corresponding coordinates of the perspective image generated on the video-camera sensor, the focal length of the camera lens, and the lateral position of the projected beams of light are used to determine the 'perspective depth' $z(\text{sup } *)$ of the three-dimensional real image in the space between the lens and the image plane. Direct inverse perspective transformations are used to reconstruct the three-dimensional real-world scene. This system can lead to the development of three-dimensional real-image sensing devices for manufacturing, medical, and defense-related applications. If combined with existing technology, it has high potential for the development of three-dimensional television. Author (EI)

A95-90376

SIMULATION OF THE N₂/O₂ PRESSURE CONTROL FUNCTION OF LIFE SUPPORT SYSTEMS WITH RESPECT TO GAS LOSSES DUE TO STRUCTURAL LEAK AND CREW METABOLISM

WERNER HOFACKER and PATRICK ROSENTHAL (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932135; HTN-95-20999) Copyright

A simulation model is described, which allows to analyze the thermophysical behavior of the Atmosphere Pressure Control Section of an Environmental Control and Life Support Subsystem (ECLSS) under simultaneous changing boundary conditions. The HERMES Spaceplane is taken as an example to show the above mentioned effects on the pressure of the atmosphere in the space vehicle. It is shown that the influence of temperature change and eventual gas losses is high compared to the effect of crew metabolism. The simulation model is used to check the function of the N₂-pressure and O₂-partial pressure control equipment against the prevailing requirements for normal and emergency mode. Author (revised by Herner)

A95-90379* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PREFLIGHT AND POSTFLIGHT MICROBIOLOGICAL RESULTS FROM 25 SPACE SHUTTLE CREWS

DUANE L. PIERSON NASA Johnson Space Flight Center, US, VIRGINIA J. BASSINGER, THOMAS C. MOLINA, EMELIE G. GUNTER, THERON O. GROVES, LOUIS J. CIOLETTI, and S. K. MISHRA (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932139; HTN-95-21002) Copyright

Clinical-microbiological investigations are an important aspect of the crew health stabilization program. To ensure that space crews have neither active nor latent infections, clinical specimens, including throat and nasal swabs and urine samples, are collected at 10 days (L-10) and 2 days (L-2) before launch, and immediately after landing (L+0). All samples are examined for the presence of bacteria and fungi. In addition, fecal samples are collected at L-10 and examined for bacteria, fungi and parasites. This paper describes clinical-microbiological findings from 144 astronauts participating in 25 Space Shuttle missions spanning Space Transportation System (STS)-26 to STS-50. The spectrum of microbiological findings from the specimens included 25 bacterial and 11 fungal species. Among the bacteria isolated most frequently were *Staphylococcus aureus*, *Enterobacter aerogenes*, *Enterococcus faecalis*, *Escherichia coli*,

Proteus mirabilis and *Streptococcus agalactiae*. *Candida albicans* was the most frequently isolated fungal pathogen. Author (Herner)

A95-90380* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

INFECTIOUS DISEASE RISKS ASSOCIATED WITH EXPOSURE TO STRESSFUL ENVIRONMENTS

ICHARD T. MEEHAN University of Colorado Health Sciences Center, US, MOREY SMITH University of Colorado Health Sciences Center, US, and CLARENCE SAMS NASA Johnson Space Center, US (ISSN 0148-7191) 1993 4 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932140; HTN-95-21003) Copyright

Multiple environmental factors associated with space flight can increase the risk of infectious illness among crewmembers thereby adversely affecting crew health and mission success. Host defences can be impaired by multiple physiological and psychological stressors including: sleep deprivation, disrupted circadian rhythms, separation from family, perceived danger, radiation exposure, and possibly also by the direct and indirect effects of microgravity. Relevant human immunological data from isolated or stressful environments including spaceflight will be reviewed. Long-duration missions should include reliable hardware which supports sophisticated immunodiagnostic capabilities. Future advances in immunology and molecular biology will continue to provide therapeutic agents and biologic response modifiers which should effectively and selectively restore immune function which has been depressed by exposure to environmental stressors. Author (Herner)

A95-90381* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

EVALUATION OF 3% HYDROGEN PEROXIDE FOR USE AS AN ENVIRONMENTAL DISENFECTANT ABOARD THE SPACE STATION FREEDOM

HELEN L. LUCIA University of Mississippi, US, S. K. MISHRA, EMELIE G. GUNTER, and DUANE L. PIERSON NASA Johnson Space Center, US (ISSN 0148-7191) 1993 3 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932142; HTN-95-21004) Copyright

We evaluate the ability of a 3% (8800 micromolar) solution of hydrogen peroxide to kill 12 strains of bacteria and 12 strains of fungi. A 1:4 dilution of 3% H₂O₂ equivalent to 1100 micromolar, was lethal to all the tested strains. If the situation calls for a nonaggressive disinfectant without residue or toxic aftereffects, 3% H₂O₂ seems an ideal choice. Author (Herner)

A95-90383* National Aeronautics and Space Administration, Washington, DC.

PHYSICS, CHEMISTRY AND PULMONARY SEQUELAE OF THERMODEGRADATION EVENTS IN LONG-MISSION SPACE FLIGHT

PAUL TODD University of Colorado, US, MICHAEL SKLAR University of Colorado, US, W. FRED RAMIREZ University of Colorado, US, GERALD J. SMITH University of Colorado, US, GEORGE W. MORGENTHAUER University of Colorado, US, and GUENTER OBERDOERSTER University of Rochester School of Medicine & Dentistry, US (ISSN 0148-7191) 1993 12 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 Research sponsored by NASA Office of Space Science and Applications (SAE PAPER 932144; HTN-95-21006) Copyright

An event in which electronic insulation consisting of polytetrafluoroethylene undergoes thermodegradation on the Space Station Freedom is considered experimentally and theoretically from the initial chemistry and convective transport through pulmonary deposition in humans. The low-gravity environment impacts various stages of event simulation. Vapor-phase and particulate thermodegradation products were considered as potential spacecraft contaminants. A potential pathway for the production of ultrafine

particles was identified. Different approaches to the simulation and prediction of contaminant transport were studied and used to predict the distribution of generic vapor-phase products in a Space Station model. A lung transport model was used to assess the pulmonary distribution of inhaled particles, and, finally, the impact of adaptation to low gravity on the human response to this inhalation risk was explored on the basis of known physiological modifications of the immune, endocrine, musculoskeletal and pulmonary systems that accompany space flight. Author (revised by Herner)

A95-90863**TOUCHLESS DETERMINATION OF 3-D-ARBITRARY SURFACES WITH HIGH ACCURACY USING 500 KHZ AIR ULTRASOUND**

R. M. SCHMITT Fraunhofer Inst., St. Ingbert, Germany, M. KLEIN Inst. for Space Medicine, Cologne, Germany, and F. W. BAISCH Inst. for Space Medicine, Cologne, Germany *In International Symposium on Acoustical Imaging, 19th, Bochum Germany, April 3-5, 1991. A95-90812 New York Plenum Press (Acoustical Imaging, Vol. 19) 1992 p. 945-950*

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The idea to develop a system for 3-D surface mapping has been triggered by manned space operations. In the state of weightlessness due to zero gravity larger blood volume shifts from the lower part of the body towards the head and the cardiovascular system are observed. Due to this effect astronauts are facing major discomforts as edematous face and eye swellings. Understanding the mechanism of the cardiovascular response to zero gravity can help to alterations especially in more frequently missions and those of longer duration. One way to monitor limb volume diminuation in the lower body is to monitor limb volume. For this reason the ultrasound system has been designed, developed and tested in a first set of experiments, which is described. Author (Herner)

A95-91439**THE EFFECT OF VARYING TIME AT -GZ ON SUBSEQUENT +GZ PHYSIOLOGICAL TOLERANCE (PUSH-PULL EFFECT)**

R. D. BANKS Defence and Civil Institute of Environmental Medicine, Ontario, Canada, J. D. GRISSETT Naval Aerospace Medical Research Laboratory, Pensacola, FL, US, P. L. SAUNDERS Naval Aerospace Medical Research Laboratory, Pensacola, FL, US, and A. J. MATECZUN Naval Aerospace Medical Research Laboratory, Pensacola, FL, US Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 723-727 Research supported by the Naval Medical Research and Development Command

(HTN-95-01207) Copyright

Previous studies have demonstrated decreased +Gz tolerance when preceded by 0 Gz or -Gz, referred to as the 'push-pull effect.' The purpose of this experiment was to observe the effect of varying time duration at -Gz on the push-pull effect. During single sessions, six subjects (three men, three women) were subjected to five relaxed exposures to +2.25 Gz on the Naval Aerospace Medical Research Laboratory (NAMRL) Coriolis Acceleration Platform (CAP). The first and last exposures were control runs that were preceded by +1 Gz. Each experimental run was preceded by -2 Gz for 2, 5, or 15 s. Blood pressure (BP) was monitored using the Finapres at the level of the clavicle. Visual light loss was assessed at +2.25 Gz using a light bar. Mean BP was significantly reduced when the +2.25 Gz exposures were preceded by -2 Gz. Following 15 s of -2 Gz, mean BP decreased more and was slower to recover than for 2 and 5 s of -2 Gz. Reported incidents of visual light loss were: 1 following 2 s, 2 following 5 s, and 4 following 15 s at -2 Gz. There were no reports of visual light loss during control runs. During relaxed conditions, the push-pull effect is augmented by increasing duration of the preceding -Gz. Author (Herner)

A95-91442**UNDETECTED NEUROPSYCHOPHYSIOLOGICAL SEQUELAE OF KHAT CHEWING IN STANDARD AVIATION MEDICAL EXAMINATION**

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Khat (*Catha edulis* Forsk) is a plant whose leaves contain cathinone, a natural amphetamine. Its leaves are chewed for their effect of central nervous system stimulation and sympathomimesis. We examined 25 regular (daily) khat chewing flight attendants (RC), 39 social (occasional) khat-chewing flight attendants (SC), and 24 nonkhat-chewing aircrew members (NC) who presented for FAA medical examinations, using (EEG) frequency analysis and 4 psychometric tests measuring perceptual-visual memory and decision-speed. Memory function test scores were significantly lower in khat chewers than NC's, and in RC's than SC's. They correlated significantly negatively with both duration and quantity of khat abuse in both khat-chewing groups. While EEG analysis revealed a statistically significant shift towards fast frequency bands in RC's compared to SC's or NC's, it did not significantly correlate with, or influence, any of the tested memory functions. The results suggest an adverse effect of khat chewing on perceptual-visual memory and decision-speed regardless of EEG frequency changes, and are discussed in relation to aviation safety and standard FAA Aviation Medical Examination. Author (Herner)

A95-91449**COMPARISON OF AIRLINE PASSENGER OXYGEN SYSTEMS**

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The principal sources of oxygen for inflight passenger use, scheduled and unscheduled, are examined. Present practices of assessment of the passenger's 'fitness to fly' are described. Three partner airlines, British Airways, U.S. Air, and Qantas, catering for more than 8000 oxygen requests annually, are compared. Analysis for customer use suggests that medical oxygen requests are frequently not clinically justified. The growth in demand, for both scheduled and unscheduled use of an expensive resource, supports the need for a 'recommended best practice' among carriers. Passengers with respiratory disorders who will most benefit from inflight oxygen are vulnerable either to hypoxia or asthma. Author (Herner)

A95-91847**PHYSIOLOGICAL ASSESSMENT OF THE RNZAF CONSTANT WEAR IMMERSION SUIT: LABORATORY AND FIELD TRIALS**

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Laboratory and field immersion trials were undertaken to determine the thermal protection afforded by a constant wear immersion suit (CWIS) in operation with the Royal New Zealand Air Force (RNZAF). Six males wore each of two ensembles during head-out laboratory immersions in 5.0 +/- 0.1 C water for a maximum of 3 h. Ensembles 1 and 2 consisted of the CWIS in addition to minimal and maximal likely undergarment insulations, respectively. Open sea field trials were conducted for a maximum of 2 h, with subjects wearing ensemble two and remaining strike aircrew apparel (ensemble three). Analysis of rectal temperature (Tre) changes permitted calculation of time to hypothermia (t35) and the survival estimate of 34 C (t34). The difference between minimal and maximal operational insulation was a 4.3-fold increase in insulation, which facilitated a 2.7-fold increase in mean t34. The thermal protection afforded by the CWIS during field trials was not sufficient to ensure survival for the 12-h expected rescue time. It is suggested that undergarment insulation be selected

based upon the thermoregulatory characteristics of the aircrew, and that survival suit design be altered to ensure that skin temperature gradients are maintained with the extremities being coldest.

Author (Herner)

A95-91848

THE RELATIONSHIP OF DIET TO AIRSICKNESS

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This descriptive, correlational study examined meal frequencies and dietary intakes as they related to airsickness in a population of novice civilian pilots. Food and nutrient intakes and dietary patterns of pilots prior to flight were measured for association with airsickness. A 24-h dietary recall was used in recording dietary intake and meal frequencies during a typical flight day. Correlation analysis was used to determine relationships between dietary intake and airsickness. Of the female pilots, 75% experienced airsickness; and 24% of the male pilots experienced it. Female pilots' mean 24 h dietary intakes of vitamins A, C, and iron were low. The findings indicate eating high sodium foods such as preserved meats, corn chips and potato chips, and eating foods high in thiamin like pork, beef, eggs, or fish correlated significantly with increased airsickness. Consumption of foods high in protein such as milk products, cheeses and preserved meat by the males correlated significantly with increased airsickness. The frequency of meals eaten during the day also correlated with increased airsickness. Of the airsick pilots, 75% consumed three or more meals in the previous 24 h, as compared to 41% of the nonairsick pilots. Higher density foods (more kilocalories) also increased the airsickness occurrences of both the male and female pilots.

Author (Herner)

A95-91849

CHARACTERISTICS OF THE VENOUS HEMODYNAMICS OF THE LEG UNDER SIMULATED WEIGHTLESSNESS: EFFECTS OF PHYSICAL EXERCISE AS COUNTERMEASURE

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In order to test the hypothesis that increases in calf venous distensibility in microgravity are partly due to the changes affecting the surrounding skeletal muscles (muscular atrophy), 12 healthy volunteers were exposed for 28 days to microgravity simulated by -6 deg head-down bed rest. Half these subjects were exposed to countermeasures during bed rest. One group received repeated LBNP (Lower Body Negative Pressure) sequences. Another group received physical training including isotonic type exercise and isometric or isokinetic work by all muscle mass of upper and lower limbs (from the 8th until the 28th d). The other six subjects forming the control group were not subjected to any countermeasure. Calf venous hemodynamics were determined by mercury strain gauge plethysmography with venous occlusion. Distensibility (ΔV_{max}), venous emptying, venous outflow at the 6th day of emptying (VO_6), half-emptying time ($T_{(sub\ 1/2)}$), and maximum venous outflow (MVO) were also measured. Nuclear magnetic resonance (NMR) was used to study changes in volume of calf muscles. Plethysmographic measurements made for each subject prior to, during (once a week), and after bed rest show a parallel increase in calf venous distensibility in both groups of subjects until the 20th day of bed rest. Filling and emptying times then tended to stabilize in the group treated with countermeasures (group CM) whereas high

venous distensibility was observed until the end of bed rest and 5 day thereafter in the control group (group C). A significant correlation was shown to exist between the increased venous distensibility and the decrease in calf muscle mass for both groups. This observation tends to confirm the role of the skeletal striated muscle in the control of distensibility of calf capacitance vessels and confirms the involvement of skeletal muscles in the increase of venous distensibility under conditions of prolonged exposure to simulated microgravity.

Author (Herner)

A95-91853

SELF-TONOMETRY UNDER MICROGRAVITY CONDITIONS

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Microgravity leads to a 'fluid shift' towards the upper parts of the body and, therefore, to a rise of the intraocular pressure. Parabolic flights have also demonstrated some rise of the intraocular pressure. During the first German Spacelab mission D1, changes of the intraocular pressure were investigated for the first time in space. The first pressure readings were obtained 44 min after entering microgravity and showed a pressure rise of 20 to 25% compared to the baseline data. To get earlier measurements in microgravity a fully automatic self-tonometer was developed which functioned independent of position and microgravity. It was used during an 8-day manned space mission in March 1992. Measurements of the intraocular pressure have been performed 16 min after reaching microgravity. The pressure readings revealed a 92% rise of the intraocular pressure compared to the daytime-correlated baseline data on Earth.

Author (Herner)

A95-91854

CIRCADIAN RHYTHM DESYNCHRONOSIS IN MILITARY DEPLOYMENTS: A REVIEW OF CURRENT STRATEGIES

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The combined problems of changing work schedules and work places are not uncommon in military operations. For example, during the Persian Gulf War, many military units underwent short notice transmeridian deployment with immediate commencement of 24-h operations upon arrival. Some of these individuals likely suffered from circadian desynchronization, blunting their effectiveness. The United States Air Force approved limited use of one short acting hypnotic medication to assist aircrew sleep disorders in the operational theater and, until recently, one stimulant medication to enhance alertness. Multiple theoretical strategies for circadian rhythm management are available. However, many U.S. Air Force flight surgeons are not trained on how best to use medications in combination with other circadian rhythm strategies. We present a condensed review of current human circadian rhythm coping strategies pertinent to military operations.

Author (Herner)

A95-91855

SPATIAL DISORIENTATION-IMPLICATED ACCIDENTS IN CANADIAN FORCES, 1982-92

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In a recent survey of CF18 aircrew human factors, 44% of pilots reported experience with spatial disorientation (SD), of whom 10% had experienced more than 3 episodes. In order to investigate further, we have completed a retrospective study of SD-implicated category A accidents (where an aircraft is destroyed, declared missing, or damaged beyond economic repair) in the Canadian Forces (CF) during 1982-92. An overview of all SD occurrences (including accidents and incidents) across aircraft types is also presented. Information was gathered concerning the genesis and severity of disorientation so that research effort and pilot training could be approximately implemented. Mishap investigation summaries involving category A accidents where SD was implicated were obtained from the CF Directorate of Flight Safety and reviewed. We also examined in detail the Board of Inquiry Reports of these accidents. The role of disorientation in these accidents was assessed. There were 62 category A accidents between 1982-92 and, in 14, SD had been assigned as a possible cause factor in the accident records. When divided into the categories of Recognized SD (RSD), Unrecognized SD (USD), and Incapacitating SD (ISD), all but two fell into the category of USD (the pilots were unaware of the disorientation). Of the SD accidents, 11 involved a total loss of 24 lives. The majority of the accidents happened during the day, and pilots' cumulative flying experience did not appear to be a significant factor. According to our assessment, there were two episodes of vestibular origin, involving the somatogravic illusion. Three episodes of disorientation occurred over frozen lakes, one over glassy water, and one over ocean. Two accidents occurred during tactical training involving more than one aircraft. The causes of two accidents remain undetermined, with SD listed along with other possible causal factors. The suggestion follows that more research effort and pilot education and training should be placed on somatogravic illusions and visual limitations under adverse flying conditions, and pilots should be made more aware of these 14 accident scenarios.

Author (Herner)

**A95-91856
CONSIDERATIONS FOR HUMAN EXPOSURE STANDARDS
FOR FAST-RISE-TIME HIGH-PEAK-POWER
ELECTROMAGNETIC PULSES**

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Development of new emitter systems capable of producing high-peak-power electromagnetic pulses with very fast rise times and narrow pulse widths is continuing. Such directed energy weapons systems will be used in the future to defeat electronically vulnerable targets. Human exposures to these pulses can be expected during testing and operations. Development of these technologies for radar and communications purposes has the potential for wider environmental exposure, as well. Current human exposure guidelines do not specifically address these types of pulses, though limits are stated for pulsed emissions. The process for developing standards includes an evaluation of the relevant bioeffects data base. A recommendation has been made that human exposure to ultrashort electromagnetic pulses that engender electromagnetic transients, called precursor waves, should be avoided. Studies that purport to show the potential for tissue damage induced by such pulses were described. The studies cited in support of the recommendation were not relevant to the issues of tissue damage by propagated pulses. A number of investigations are cited in this review that directly address the biological effects of electromagnetic pulses. These studies have not shown evidence of tissue damage as a result of exposure to high-peak-power pulsed microwaves. It is our opinion that the current guidelines are sufficiently protective for human exposure to these pulses.

Author (Herner)

**A95-91899
BLOOD VOLUME REGULATING HORMONES RESPONSE**

**DURING TWO SPACE RELATED SIMULATION
PROTOCOLS: FOUR-WEEK CONFINEMENT AND HEAD-
DOWN BED-REST**

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The volume of regulating hormones (renin, aldosterone, arginine vasopressin and atrial natriuretic factor), electrolytes and creatinine concentrations, and blood pressure were measured in two different four-week experimental protocols: respectively -6 deg head-down bed-rest (HDBR) (5 subjects) and confinement (6 subjects). We observed a significant increase (P less than 0.01 at D2 vs D-5) of systolic blood pressure during confinement and a different level of response for some hormones, especially for arginine vasopressin (300% increase during confinement instead of 50% during bed-rest). The renin-angiotensin-aldosterone system was enhanced during confinement and head-down bed-rest. In both conditions, we obtained a similar pattern of response for blood volume regulating hormones. During confinement, two main factors were inactivity and stress activation of the sympathetic nervous system. In the bed-rest study the response is principally due to the fluid shift and blood volume adaptation but it is not possible to exclude the role of inactivity and stress.

Author (Herner)

**A95-91902
EFFECT OF SICKNESS SEVERITY ON HABITUATION TO
REPEATED MOTION CHALLENGES IN AIRCREW
REFERRED FOR AIRSICKNESS TREATMENT**

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The aim of this study was to determine whether varying the predetermined malaise level at which provocative motion challenges were stopped would affect the habituation rate. At the rate of 2 per day, 21 motion challenges were delivered, stopping either at initial symptoms or at moderate nausea, on a cross-over design randomized between subjects (n = 20). The cross-coupled motion challenge had an incrementing profile of rotational velocity from 2-90/s in steps of 2/s every 30 s, with 8 head movements per 30 s, of approximately 45. The number of head movements tolerated before the onset of nausea increased over the 21 challenges, but the effects of the treatment variation on habituation were not significant. The number of motion challenges, rather than the severity of malaise level achieved, was the more important factor determining habituation.

Author (Herner)

**A95-91903
P6 ACUPRESSURE REDUCES SYMPTOMS OF VECTION-
INDUCED MOTION SICKNESS**

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The purpose of the study was to examine the effectiveness of P6 acupressure on nausea associated with visually-induced motion sickness. There were 64 subjects randomly divided into 4 groups: P6 acupressure, dummy-point acupressure, sham P6 acupressure,

and control. Each subject sat in an optokinetic drum for a 12-min baseline and 12-min drum rotation period. Subjects' electrogastrograms (EGG's) and subjective symptoms of motion sickness were obtained. The results indicated that the subjects in the P6 acupressure group reported significantly less nausea during drum rotation period than those in the dummy-point acupressure, sham acupressure, and control groups. The scores for symptoms of motion sickness of the P6 acupressure group were significantly lower than those in the sham acupressure and control groups. Also, the subject in the P6 acupressure group showed significantly less abnormal gastric myoelectric activity, tacharrhythmia, than those in the sham acupressure and control groups. However, the subjects in the dummy-point acupressure group did not report significantly fewer symptoms and show less tacharrhythmia than those in the sham acupressure and control groups. We conclude that P6 acupressure reduces the severity of symptoms of visually-induced motion sickness and gastric tacharrhythmia. Author (Herner)

A95-91904
EFFECT OF ALCOHOL ON THE THRESHOLD FOR
DETECTING ANGULAR ACCELERATION

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We investigated the effects of a low blood alcohol level (mean BAC = 0.037%) on subjects' ability to detect acceleration and deceleration of angular motion. The angular motion thresholds of six alcohol and six placebo subjects, all of whom had private pilot certificates, were tested under double-blind conditions in an enclosed simulator apparatus prior to drinking, after drinking, and at a time when the BAC's of alcohol subjects had reached zero. Mean threshold values for the three threshold determination sessions were 0.282, 0.376, and 0.343 deg/s(exp -2) respectively for the alcohol subjects, and 0.263, 0.262, and 0.262 deg/s(exp -2) for placebo subjects. A significant alcohol x test-session interaction reflected the elevated thresholds shown by all alcohol subjects after consuming alcohol. Of the six alcohol, four continued to have elevated thresholds after their BAC's reached zero. Alcohol and placebo subjects showed similar performance on the ancillary tasks of maintaining altitude and reporting a specified number when it appeared on a digital display. Both groups also reported that they had experienced similar levels of discomfort symptoms before and after drinking. The results indicate that a pilot's ability to detect angular motion can be compromised by low BAC levels, and this effect may continue for some pilots after their BAC reaches zero.

Author (Herner)

A95-91905
LONG TERM STABILITY OF SOMATOSENSORY EVOKED
POTENTIALS AND THE EFFECTS OF MICROGRAVITY

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Exposure to microgravity causes a height increase of up to 70 mm that places traction on the spine and may possibly lead to spinal cord dysfunction. Somatosensory evoked potentials (SSEP) have been widely used to monitor spinal cord function. This study was carried out to determine the long-term stability of the latency of SSEP's in individual subjects and the feasibility of recording SSEP's in a microgravity environment. Baseline values and variability of the latency of the cortical evoked potentials were established in seven

subjects over periods of 1-2.5 years. These values were then compared with measurements made in six of the subjects during periods of microgravity on a KC-135 aircraft. The latency of the cortical potentials was also measured in the evening and in the morning before rising in a separate group of seven subjects, to determine whether there was any diurnal variation. The mean coefficient of variance of the latency of the SSEP was approximately 1.5% of the latency, and there were no changes in the latency over the period studied. There was no evidence of diurnal variation in the latency of the cortical SSEP. Satisfactory recordings of the SSEP were obtained in five of six subjects tested in microgravity. In three of these five subjects there was a significant decrease in the latency of the cortical SSEP in microgravity. In individual subjects the latency of the cortical SSEP varies within very small limits (1.5%) over 1-2.5 years. The results demonstrate the feasibility of recording SSEP's in the microgravity state. They show that relatively small changes (2-3 ms) in the latency of the SSEP can be detected when prior baseline values are established for each subject. The reason for the decrease in the latency of the cortical SSEP in some subjects on the KC-135 is not known. Author (Herner)

A95-91906
A COMPARISON OF VISUAL AND AUDITORY REACTION
TIME AND P300 LATENCY THRESHOLDS TO ACUTE
HYPOXIA

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To investigate the influence of stimulus modality on the slowing produced by hypoxia, thresholds were estimated using reaction time (RT) and the event-related brain potential P300. Six trained subjects responded to oddball light flashes or tone pips while breathing low-oxygen mixtures that were manipulated to produce arterial blood oxygen saturations (SaO₂) ranging from 77-86%. Both RT and P300 were slowed in a dose-dependent manner. The threshold for slowing was independent of stimulus modality for both measures, and estimated to be in the range 81-82% SaO₂. P300 amplitude dissociated from the response time measures by exhibiting an inverted-U dose-response function. We draw three conclusions from these results: (a) the failure to observe a higher visual threshold for the response time measures is inconsistent with the traditional belief that audition is relatively insensitive to hypoxia; (b) the equal sensitivity of P300 latency and RT to hypoxia implicates stimulus evaluation processes in slowing; and (c) P300 amplitude may reflect the activity of physiological compensatory mechanisms to hypoxia.

Author (Herner)

A95-91907
EFFECT OF TRIAZOLAM ON RESPONSES TO A COLD-
WATER IMMERSION IN HUMANS

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(HTN-95-12207) Copyright

Managing alertness of soldiers during sustained operations is a source of serious concern for military unit commanders. A frequently employed strategy is to induce sleep before an operation, especially operations requiring prolonged travel. Sleep-inducing drugs could have an action on thermoregulation through their effect on alertness and a possible direct effect on the brain. The goal of this study was therefore to evaluate the effect of a commonly prescribed triazolam (Halcion) on thermoregulatory responses to cold-water

immersion. Eight subjects were immersed twice in 18 C water for up to 90 min in the morning; once after ingesting 0.25 mg triazolam (TRZ) the prior evening, and again after placebo (PLB) treatment. There were no significant differences between trials for mean duration of the immersion, the change in rectal temperature and mean skin temperature. Total metabolic heat production was similar for both conditions: 767 +/- 107 vs. 781 +/- 105 kJ/m(exp 2) for TRZ and PLB, respectively. The results should be considered in light of a large variation among the subjects in sensitivity to TRZ, which was unrelated to biometrical characteristics such as surface area-to-mass ratio, lean body mass, % body fat, and physical fitness. Although not statistically significant, there was a trend for a smaller increase in plasma free fatty acid and glycerol concentrations after water immersion with TRZ. The results suggest that the ingestion of a single dose of triazolam 11 h prior to a cold-water immersion is not likely to accelerate the rate of onset of hypothermia. Individual sensitivity, however, may predispose some sensitive subjects to negative effects in this regard. Author (Herner)

A95-91908**CARDIOVASCULAR DECONDITIONING OCCURS DURING A 7-DAY SATURATION DIVE AT 31 ATA**

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(HTN-95-12208) Copyright

Cardiovascular deconditioning (CD) has been reported to occur within 24-48 h of exposure to 4, 11, or 31 ATA environment and following decompression to sea level pressure. The CD was indicated by orthostatic intolerance, exaggerated cardiovascular responses to a passive tilt, an elevated resting heart rate and a reduced stroke volume postdive. In this dive, one of the New Seatopia series, we used a non-syncope criterion, the cardiovascular index of deconditioning (CID); to evaluate CD in 3 male subjects. The CID sums the changes in heart rate and blood pressure in response to orthostatic stress. An elevated CID indicates CD. We used a passive 70 deg head up tilt as the orthostatic stress. The CID was measured before and after about of underwater exercise at pre-dive, during the early, mid, and late exposure of the 7-d 31 ATA, and after the dive. The CID and circulatory responses to tilt were similar before and after the exercise. The CID increased from the pre-dive value of 20 +/- 1.6 to 25 +/- 0.9 on the 2nd day, to 25 +/- 0.8 on the 4th day at 31 ATA, indicating the presence of CD at the early and mid periods of hyperbaric exposure. However, CID was indifferent from the pre-dive on the 7th day at 31 ATA. The increased CID corresponded to decreases in plasma volume during the early and mid periods of 31 ATA exposure. However, CID rose to 29 +/- 2 postdive in agreement with other indicators of CD, but the plasma volume was normal. We concluded that hyperbaric diuresis is one major factor in the development of the acute phase of hyperbaric CD, and the prolonged relative inactivity may account for the late phase of hyperbaric CD. Daily exercises at a moderate intensity were not effective in intervening the development of hyperbaric CD.

Author (Herner)

A95-91911**GREYOUT, BLACKOUT, AND G-LOSS OF CONSCIOUSNESS IN THE BRAZILIAN AIR FORCE: A 1991-92 SURVEY**

KATIA M. ALVIM Air Force Univ., Rio de Janeiro, Brazil Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 675-677

(HTN-95-12211) Copyright

A national survey has been performed with high and medium performance aircraft pilots on the incidence of symptoms due to +Gz acceleration, in order to make up a human centrifuge physiological training profile directed to the needs of the Brazilian Air Force pilots. Anonymous questionnaires were sent to Flight Squadrons of F-5, AMX, Mirage F-103, Xavante AT-26, and Tucano T-27. They consisted of inquiries about the occurrence of visual symptoms and/or loss of consciousness during +Gz(G-LOC) maneuvers, and post-G-LOC symptoms. Some 193 pilots answered the questionnaire: 23 (11.92%) reported greyout and/or loss of peripheral vision; 40 (20.72%) reported blackout; 20 (10.36%) reported G-LOC. Those who reported LOC also reported post-G-LOC symptoms (100%), 16 (80%) being gradual and 4 (20%) instantaneous. Incidence of G-LOC did not depend upon the type of aircraft flown. Considering the pilots who reported G-LOC, 80% were preceded by blackout, which could allow them to relieve +Gz load before they would reach their endpoint for the occurrence of G-LOC. For these reasons we recommend intensive human centrifuge training periodically, similar to the hypoxia-recognition test in the hypobaric chamber, not only for high performance aircraft pilots but for any pilot who can perform aerobatics (thus exposing himself to the adverse effects of 'pulling G'). This will allow each pilot to recognize his consciousness endpoint when undergoing +Gz maneuvers, in a controlled and safe environment. Author (Herner)

A95-91912**COLD WATER IMMERSION SIMULATIONS USING THE WISSLER TEXAS THERMAL MODEL: VALIDATION AND SENSITIVITY ANALYSIS**

BARRY S. SHENDER Naval Air Warfare Center Aircraft, Warminster, PA, US, JONATHAN W. KAUFMAN Naval Air Warfare Center Aircraft, Warminster, PA, US, and RAIJA ILMARINEN Inst. of Occupational Health, Helsinki, Finland Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 678-686

(HTN-95-12212) Copyright

Wissler's Texas Thermal Model (TM) has been used to simulate the effects of thermal stresses on individuals under a variety of conditions. As part of a U.S. Navy effort to develop integrated protection garments, TM was modified to predict tolerance to cold water immersion (CWI) with garments with clo values less than 0.1 (15). With these modifications, TM predictions were validated using experimental data obtained from 39 males and females during anti-exposure suit CWI assessments. Data analyses were based on changes in rectal (T(sub re)) and various skin temperatures (T(sub sk)). A sensitivity analysis was also performed to determine which TM parameters were most affected during simulated CWI. The condition tested was head-out immersion in 4.4 C water by a 72.6 kg man (10 mm mean skinfold thickness). For most of the subject pool, the estimated change in T(sub re), chest, thigh, calf, and arm temperatures were not statistically different from experimental values. However, TM predictions were less accurate with respect to female responses. Based on thermal end points, TM predictions indicated that the following body segments were most sensitive to changes in insulation level (ordered from most to least important): chest and abdomen, leg, head, and arm. The physical parameters mean skinfold thickness, basal metabolic rate, body weight, and exercise metabolic rate had the most impact on TM predictions. The relative benefit of increased insulation on individual body segments was identified to aid garment design. Further, the relative importance of model physical parameters was identified so that judicious initial conditions could be selected to ensure that only garment design changes would be reflected in model predictions.

Author (Herner)

N95-28793# Armstrong Lab., Brooks AFB, TX. Aerospace Medicine Directorate.

A DISCRETE-EVENT SIMULATION MODEL OF MYOCARDIAL ELECTRICAL ACTIVITY: MATHEMATICAL ELECTROPHYSIOLOGY Final Report

R. B. HOWE Dec. 1994 26 p

(Contract(s)/Grant(s): DA PROJ. 775-5)

(AD-A292323; AL/AO-TP-1994-0014) Avail: CASI HC A03/MF A01

This work unit was opened to provide a channel for in-house work on mathematical modeling and computer simulation of the electrocardiogram (ECG) and its underlying electrophysiology. This work was intended to complement work being done in contracted efforts aimed at model-based enhancement of ECG diagnostic criteria for detection of coronary artery disease in USAF aircrew members. Both the contract and in-house efforts have been terminated due to funding constraints and organizational shifts in research focus. In this technical paper, we report on the development of a simulation model of the depolarization and repolarization processes in the ventricles which was to be used as a cardiac electrical source model in simulations of the ECG, as well as attempt to provide some commentary regarding the relation of these efforts to broader contexts. DTIC

N95-28866# Texas Univ. Health Science Center, San Antonio, TX. Dept. of Radiology.

CELLULAR AND MOLECULAR LEVEL RESPONSES AFTER RADIOFREQUENCY RADIATION EXPOSURE, ALONE OR IN COMBINATION WITH X RAYS OR CHEMICALS Final Report, 1 Apr. 1991 - 30 Sep. 1994

MARTIN L. MELTZ, MOHAN NATARAJAN, and ADAPA V. PRASAD 21 Feb. 1995 101 p

(Contract(s)/Grant(s): AF-AFOSR-0206-91)

(AD-A292488; AFOSR-94-0206TR) Avail: CASI HC A06/MF A02

This project was initiated to explore the potential bioeffects of microwave radiation, alone or in combination with ionizing radiation and chemicals. Over the time period of the project, an automated thermal control system, to be used for maintaining the temperature in tissue culture medium during microwave exposures, was designed, constructed, and software was created. While this was underway during the project period, numerous positive control biological experiments were performed on two different cell types, the Epstein Barr Virus transformed 244B human lymphoblastoid cell, and the freshly isolated peripheral human lymphocyte. The 244B cells were used to address the question of whether a physical agent, ionizing radiation, at low doses where cells would predominantly remain viable, would induce the DNA binding protein NF- κ B, and/or four immediate early genes (IEG) (protooncogenes). DTIC

N95-28875*# Baylor Coll. of Medicine, Houston, TX.

THE INFLUENCE OF SPACE FLIGHT ON ERYTHROKINETICS IN MAN. SPACE LIFE SCIENCES MISSIONS 1 AND 2. EXPERIMENT E261 Final Report

CLARENCE P. ALFREY 1995 100 p

(Contract(s)/Grant(s): NAS9-18024)

(NASA-CR-188368; NAS 1.26:188368) Avail: CASI HC A05/MF A02

The purpose of this contract was to design and conduct experiments that would increase our understanding of the influence of space flight on erythrokinetics and the rapid change that occurs in the red blood cell mass during spaceflight. The experiment designated E261, was flown on Space Life Science missions SLS-1 and SLS-2 (STS 40 and STS 58). Unique features of this experiment included radionuclide tracer studies during flight and frequent in-flight blood samples specifically for the first three or four days of the mission. Plasma volume measurements were made early and late in the missions. Radioactive iron kinetics studies were initiated after one or three days in microgravity since the magnitude of the red blood cell mass decrease dictated that bone marrow production must be decreased very early in the flight. The schedule was designed to study the time course of the changes that occur during spaceflight and to possibly define a mechanism for the rapid reduction in red blood cell mass. Derived from text

N95-28915 Pittsburgh Univ., Pittsburgh, PA. Dept. of Psychiatry. **ORGANIZATION OF THE HUMAN CIRCADIAN SYSTEM Annual Report, 1 Jun. 1993 - 31 May 1994**

ROBERT Y. MOORE 31 May 1994 4 p Limited Reproducibility:

More than 20% of this document may be affected by microfiche quality

(Contract(s)/Grant(s): F49620-93-1-0244)

(AD-A288223; AFOSR-94-0682TR) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The overall objective of this project is a detailed description of the primate circadian timing system with special attention to the human. The specific objectives for this year were as follows: (1) characterization of the chemical neuroanatomy of the human suprachiasmatic nucleus (SCN); (2) characterization of a putative retinohypothalamic tract in the human; (3) characterization of the projections of the human SCN using antisera to vasoactive intestinal polypeptide (VIP). DTIC

N95-28940 Army Aeromedical Research Lab., Fort Rucker, AL. Aircrew Protection Div.

MILITARY FLYING AND AEROMEDICAL EVALUATION OF CARDIAC ARRHYTHMIAS Final Report

KEVIN T. MASON Dec. 1994 19 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A291595; USAARL-95-7) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The evaluation and management of cardiac arrhythmias in military aircrew members are complex, and perhaps, more aggressive than clinical cardiologists, internists, and family physicians expect. However, these policies are based on the needs of the services, mission completion requirements, public safety, and an extensive, ongoing, observational epidemiology research program of the military flying population. This paper summarizes the general considerations of the flying environment as they relate to cardiac arrhythmias. A discussion of the screening principles and epidemiologic confounders is followed by a summary of the joint U.S. Air Force and U.S. Army waiver policy on cardiac arrhythmias and flying duties. DTIC

N95-28941 Army Aeromedical Research Lab., Fort Rucker, AL.

ACTUAL EFFECTIVENESS OF HEARING PROTECTION IN HIGH LEVEL IMPULSE NOISE

JAMES H. PATTERSON, JR. and DANIEL L. JOHNSON Aug. 1994 19 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A291604; USAARL-94-48) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Current exposure limits for high intensity impulse noise contain factors for hearing protection which are based on very limited data. Recent studies in the U.S. and in France have provided new insights into the protection afforded by hearing protective devices. For impulses with an A-duration of approximately 3.0 microseconds, protection was found to be adequate for peak pressures up to 190 dB SPL for 6 impulses and 187 dB for 100 impulses. Protection was found to be adequate for 6 impulses with an A-duration of approximately 0.8 microsecond up to 196 dB SPL. For this A-duration, protection was adequate for 12 impulses up to 190 dB SPL and for 50 and 100 impulses at 187 dB SPL. The hearing protectors used in these studies were earmuffs with perforations in the cushions which provided essentially attenuation below 500 Hz. In a series of French studies, hearing protection was found to be adequate for impulses produced by a variety of weapons with peak pressures ranging from 165 dB SPL to 180 dB SPL. These included small arms with A-durations less than 1.0 artillery with A-durations of approximately 3.0 microseconds and other weapons with durations between these extremes. A variety of insert hearing protectors (earplugs) was used in these studies. DTIC

N95-29022# California Univ., Berkeley, CA.

COMPUTER MODELS OF RETINAL FUNCTION Final Report, 1 Feb. 1991 - 30 Jun. 1994

FRANK WERBLIN 30 Jun. 1994 9 p

(Contract(s)/Grant(s): AF-AFOSR-0196-91)

(AD-A290156; AFOSR-95-0013TR) Avail: CASI HC A02/MF A01

The vertebrate retina consists of a series of sheets of neurons

each containing a patterned representation, or neural image, corresponding to the incoming visual scene. Most of the operations can be described as convolutions implementing small kernels involving local neighborhoods. These patterns become more complex as the visual signal passes through the retina as each new convolution builds upon previous ones. Because we have access only to single cells, these patterns of activity have never been recorded. As a first step in visualizing these patterns we have attempted to simulate them using modern image processors operating in real time, that like the retina invoke local convolutions, in an effort to understand the mechanisms, and the physiological roles of each of these biological image processing operations. In addition, we have now developed methods for measuring these patterns in living retinas. The comparison between the modeled and measured patterns will show us what components of retinal function have not yet been incorporated into our understanding, as expressed by the models. These studies will help us to understand biological image processing by forcing us to assemble the retina using well-defined physiological functional building blocks, derived from retinal function. A long-term objective of this research is the implementation of biological image processing algorithms for man made systems such as tracking, target identification, guidance, and navigation. DTIC

N95-29059# California Inst. of Tech., Pasadena, CA.
LARGE-SCALE NEURONAL THEORIES OF THE BRAIN
 CHRISTOF KOCH and JOEL L. DAVIS 1994 348 p
 (AD-A290200) Avail: CASI HC A15/MF A03

This book originated at a small and informal workshop held in December of 1992 in Idyllwild, CA, where eighteen colleagues from a broad range of disciplines, including biophysics, electrophysiology, neuroanatomy, psychophysics, clinical studies, mathematics, and computer vision, discussed 'Large Scale Models of the Brain,' that is, theories and models that cover a broad range of phenomena, including early and late vision, various memory systems, selective attention, and the neuronal code underlying figure-ground segregation and awareness. The bias in the selection of the speakers toward researchers in the area of visual perception reflects both the academic background of one of the organizers as well as the (relative) more mature status of vision compared with other modalities. This should not be surprising given the emphasis we humans place on 'seeing' for orienting ourselves, as well as the intense scrutiny visual processes have received due to their obvious usefulness in military, industrial, and robotic applications. DTIC

N95-29086# Army Medical Center, Aurora, CO.
ANALYSIS OF WOUNDS BY EVAPORATIVE WATER LOSS
IN MAN Final Report, 1 Jun. 1992 - 31 Jul. 1994
 SHARON L. HAMMOND, HENRY C. JEFFERSON, and SAMUEL CUCINELL 21 Sep. 1994 7 p
 (Contract(s)/Grant(s): MIPR-92MM2583)
 (AD-A290327) Avail: CASI HC A02/MF A01

Cytokine growth factors are known to increase wound healing in animals and may be found to soon have an impact on human wounds, wound infections, and debridements. In order to assess the impact of these factors one must first establish a quantitative method of measurement for wound healing. This protocol's intent was to devise such a method using evaporative water loss otherwise referred to as transcutaneous water evaporative loss (TWEL). We attempted to apply an evaporimeter to assist in the measurement of TWEL. Patients entered into the study were those who had undergone recent breast biopsies with TWEL readings taken immediately after the biopsy and approximately five additional readings at clinic visits once a week. Data thus far, however, has been noncontributory to the analysis due to multiple difficulties with the evaporimeter and establishing a method for using the evaporimeter in this type of a wound healing process. DTIC

N95-29139 Massachusetts Univ. Medical Center, Worcester, MA.
STUDIES OF ALTERED RESPONSE TO INFECTION
INDUCED BY SEVERE INJURY Midterm Report, 14 Apr.
1992 - 14 Oct. 1994

CAROL L. MILLER-GRAZIANO 15 Nov. 1994 46 p Limited
 Reproducibility: More than 20% of this document may be affected by microfiche quality
 (Contract(s)/Grant(s): DAMD17-92-C-2033)
 (AD-A288907) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The Systemic Inflammatory Response Syndrome (SIRS) that frequently occurs post-injury, is a major cause of post-trauma mortality and is characterized by both immunosuppression and cytokine aberrations. This research focuses on identifying the relative contributions of T cell and monocyte (MO) aberrations to SIRS. In the first half of the contract, we have shown that MO TNF(alpha) production (a major contributor to SIRS) is aberrantly increased in trauma patients by: (1) failure to rapidly degrade TNF(alpha) mRNA leading to prolonged TNF(alpha) protein production; (2) insensitivity to normal downregulation by prostaglandin E(sub 2) and TGF(beta); (3) increased sensitivity of MO to TNF(alpha) induction by LTB(sub 4); (4) increased MO autocrine stimulation by TNF(alpha) due to stimulation through unshed TNFR; (5) decreased production of the TNF(alpha) immunoregulatory cytokine IL-10 by patients MO and T lymphocytes; and (6) decreased T lymphocyte production of IF. DTIC

N95-29141# Army Aeromedical Research Lab., Fort Rucker, AL.
A COMPARISON OF THE AEROMEDICAL ADMINISTRATION
REQUIREMENTS FOR US AIR FORCES AND MAJOR
ALLIES Final Report

KEVIN T. MASON Dec. 1994 28 p
 (Contract(s)/Grant(s): DA PROJ. 301-62787-A-878)
 (AD-A290137; USAARL-95-5) Avail: CASI HC A03/MF A01

Although numerous international agreements provide for interchangeability of aircrew medical categories for the medical examination of aircrew visiting or jointly serving with sister air forces or allied air forces, the basic administrative processes remain unique between air forces. Publication of information regarding aeromedical administration would facilitate an understanding of regulatory references, requirements, and terminology between air forces. A better understanding and sharing of information might provide for further standardization of basic administrative terms and processes for aircrew medical examination. The Air Standardization Coordinating Committee tasked the U.S. Army Aeromedical Research Laboratory to develop such a publication. DTIC

N95-29153# Minnesota Univ., Minneapolis, MN. Office of Research and Technology Transfer Administration.
COUPLING OF BRAIN MUSCARINIC RECEPTORS TO
SECOND MESSENGERS Final Report, 1 Oct. 1991 - 30 Sep.
1994

ESAM E. EL-FAKAHANY 28 Oct. 1994 5 p
 (Contract(s)/Grant(s): DAAL03-91-G-0337)
 (AD-A290498; ARO-29594.1-LS) Avail: CASI HC A01/MF A01

Stimulating muscarinic acetylcholine receptors results in activation of various signal transduction pathways. The goal of the research was to investigate the selectivity of coupling of the currently known 5 subtypes of muscarinic receptors to these different second messenger pathways. Results indicate that m1, m3 and m5 muscarinic receptors are coupled to enhanced phosphoinositide hydrolysis, while m2 and m4 receptors are coupled to a decrease in cyclic AMP formation. Results also demonstrate efficient coupling of m5 muscarinic receptors to generation of nitric oxide. DTIC

N95-29158*# Pennsylvania Univ. Medical Center, Philadelphia, PA. Inst. for Environmental Medicine.

CO₂-O₂ INTERACTIONS IN EXTENSION OF TOLERANCE TO ACUTE HYPOXIA Final Report, 1 Apr. 1992 - 31 Mar. 1995

C. J. LAMBERTSEN 20 Apr. 1995 72 p
(Contract(s)/Grant(s): NAG9-597)
(NASA-CR-198575; NAS 1.26:198575; REPT-4-20-95) Avail: CASI HC A04/MF A01

Objectives and results of experimental projects are summarized. The scope of information desired included (1) physiological and performance consequences of exposures to simulated microgravity, in rest and graded physical activity, (2) separate influences of graded degrees of atmospheric hypercapnia and hypoxia, and (3) composite effects of hypoxia and hypercapnia. The research objectives were selected for close relevance to existing quantitative information concerning interactions of hypercapnia and hypoxia on respiratory and brain circulatory control. They include: (1) to determine influences of normoxic immersion on interrelations of pulmonary ventilation, arterial PCO₂ and PO₂, and brain blood flow, in rest and physical work; (2) to determine influence of normoxic immersion on respiratory reactivity to atmospheric hypercapnia at rest; (3) to determine influence of atmospheric hypoxia on respiratory reactivity to hypercapnia at rest and in work; and (4) to provide physiological baselines of data concerning adaptations in acute exposures to aid in investigation of rates of adaptation or deteriorations in physiological or performance capability during subsequent multi-day exposures. A list of publications related to the present grant period is included along with an appendix describing the Performance Measurement System (human perceptual, cognitive and psychomotor functions). Derived from text

N95-29161# Armstrong Lab., Brooks AFB, TX. Aerospace Medicine Directorate.

FLYING WAIVERS FOR HISTORY OF ANGIOPLASTY AND MYOCARDIAL INFARCTION

JEB S. PICKARD and JOE E. BURTON 18 Nov. 1994 4 p
(Contract(s)/Grant(s): AF PROJ. 7755)
(AD-A292505; AL/AO-TM-1995-0001) Avail: CASI HC A01/MF A01

Angioplasty has become common for the treatment of significant coronary disease (SCAD). In many cases an aeromedically significant lesion (50% or greater stenosis) may be dilated to less than 50%, raising the question of whether these patients could be considered under minimal coronary artery disease (MCAD) criteria, and allowed to fly. Suitability of MCAD to fly is based on a study of ACS patients with 20-40% lesions, who had an annual cardiac event rate of 0.6%. An extensive literature review by AOC presented at ASMA in May 1994 showed that the lowest cardiac event rate, after one year following successful angioplasty, was 2.4% per year with no subsequent decline. A lesion classified as SCAD which is subsequently dilated to less than 50% cannot be considered to be equivalent to MCAD. The Aeromedical Consult Service recommends that aviators who require angioplasty be permanently disqualified from all classes of flying duties. DTIC

N95-29173# Madigan Army Medical Center, Takoma, WA.
REFRACTIVE CHANGES DURING PROLONGED EXPOSURE TO ALTITUDE FOLLOWING REFRACTIVE SURGERY Final Report

THOMAS MADER and CHRISTOPHER L. BLANTON 24 Oct. 1994 12 p
(AD-A290263) Avail: CASI HC A03/MF A01

This document reports corneal changes in patients exposed to altitude after radial Keratotomy and photorefractive Keratectomy. Refractive parameters were measured during the exposure. The results of these measurements are discussed. Radial keratotomy patients (11 eyes), 6 photorefractive keratectomy patients (12 eyes) and 9 control myopes (17 eyes) had the following measured at sea level: cycloplegic and manifest refraction, kerntometry, and pachymetry both central and peripheral. Patients also had videokeratography performed prior to being taken to altitude. Sub-

jects then had these same parameters measured daily at 14,110 feet on Pike's Peak, CO for 3 days. Radial keratotomy patients demonstrated a significant hyperopic shift and corneal flattening during exposure to altitude when compared to control myopic eyes. Patients who had undergone photorefractive kerntectometry did not demonstrate a statistically significant shift in refraction or keratometry when compared with control myopes. Significance: Anecdotal reports have shown hyperopic shifts in radial kerntotomy patients after exposure to altitude. We confirmed this in a study population. Photorefractive keratectomy patients do not appear to be susceptible to this refractive shift. DTIC

N95-29188# Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst.

INHALATION TOXICOLOGY RESEARCH INSTITUTE Annual Report, 1 Oct. 1993 - 30 Sep. 1994

STEVEN A. BELINSKY, JOE L. MAUDERLY, MARK D. HOOVER, and PAULA L. BRADLEY Nov. 1994 227 p
(Contract(s)/Grant(s): DE-AC04-76EV-10103)
(AD-A292037; ITRI-144) Avail: CASI HC A11/MF A03

The Inhalation Toxicology Research Institute (ITRI) is a Federally Funded Research and Development Center operated for the U.S. Department of Energy (DOE) by The Lovelace Biomedical and Environmental Research Institute, a nonprofit subsidiary of The Lovelace Institutes. ITRI is designated as a 'Specific Mission laboratory' within the DOE Office of Health and Environmental Research, Office of Energy Research. Approximately 80% of the Institute's research is funded by DOE; the remainder is funded by a variety of governmental, trade association, and industry sources. The mission of ITRI is to conduct basic and applied research to improve our understanding of the nature and magnitude of the human health impacts of inhaling airborne materials in the home, workplace, and general environment. Institute research programs have a strong basic science orientation with emphasis on the nature and behavior of airborne materials, the fundamental biology of the respiratory tract, the fate of inhaled materials and the mechanisms by which they cause disease, and the means by which data produced in the laboratory can be used to estimate risks to human health. Disorders of the respiratory tract continue to be a major health concern, and inhaled toxicants are thought to contribute substantially to respiratory morbidity. As the largest laboratory dedicated to the study of basic inhalation toxicology, ITRI provides a national resource of specialized facilities, personnel, and educational activities serving the needs of government, academia, and industry. DTIC

N95-29190* National Aeronautics and Space Administration, Washington, DC.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 403)

Jul. 1995 101 p
(NASA-SP-7011(403); NAS 1.21:7011(403)) Avail: CASI HC A06

This bibliography lists 217 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during July 1995. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance. Author

N95-29224# Federal Aviation Administration, Oklahoma City, OK.
THE POTENTIAL FOR PULMONARY HEAT INJURY RESULTING FROM THE ACTIVATION OF A CABIN WATER SPRAY SYSTEM TO FIGHT AIRCRAFT CABIN FIRES Final Report

ROBERT P. GARNER May 1995 11 p
(DOT/FAA/AM-95/17) Avail: CASI HC A03/MF A01

A cabin water spray system (CWSS) has been suggested as a means of attenuating the severity of smoke and fire commonly associated with aircraft accidents. All aspects of passenger and cabin safety must be considered when evaluating a new safety system or concept. The purposes of this report are to briefly review the pathophysiological changes occurring in the respiratory system

52 AEROSPACE MEDICINE

as a result of thermal injury and to quantitatively estimate the risk of creating a more hazardous cabin environment by activation of CWSS. Changes in the heat content of the cabin atmosphere resulting from CWSS activation were calculated using parameters consistent with current aircraft and proposals for CWSS design. The results suggest that only a very small volume of the aircraft cabin would have an increase in heat content that could result in thermal injury. Author

N95-29238# Naval Health Research Center, San Diego, CA.
EFFECTS OF CHROMIUM PICOLINATE ON BODY COMPOSITION IN A REMEDIAL CONDITIONING PROGRAM Interim Report

L. K. TRENT and D. THIEDING-CANCEL 6 Dec. 1994 20 p
(AD-A292079; NHRC-94-20) Avail: CASI HC A03/MF A01

Recent evidence suggests that nutritional supplementation with chromium picolinate might help reduce excess body fat and increase lean muscle mass. This study explored the efficiency of chromium picolinate as a weight-reduction aid for obese personnel enrolled in the Navy's mandatory remedial conditioning program (Level 1). Participants were 95 active-duty Navy members (79 men, 16 women) enrolled in several remedial programs, which met a minimum of three times per week for at least 30 minutes of aerobic exercise. The study employed a double-blind, placebo-controlled protocol. Percent body fat was computed from body circumference measurements obtained at baseline and again after 16 weeks. Participants also completed a pre-post questionnaire concerning their lifestyle habits. Half of the participants received a daily capsule containing 400 micrograms of chromium picolinate; the other half received a placebo. At the end of 16 weeks, the group as a whole had lost a small amount of weight and body fat; however, the Chromium group failed to show a significantly greater reduction in either percent body fat or body weight, or a greater increase in lean body mass, than did the Placebo group. It was concluded that chromium picolinate was ineffective in enhancing body fat reduction in this group. DTIC

N95-29360# Systems Research Labs., Inc., Dayton, OH.
PULSE WAVEFORM AND PULSE AMPLITUDE ANALYSIS DURING LOWER BODY NEGATIVE PRESSURE Final Report, Dec. 1993 - Mar. 1994

RAINER K. EFFENHAUSER and LLOYD D. TRIPP, JR. Apr. 1994 41 p
(Contract(s)/Grant(s): F33615-89-C-0574)
(AD-A290521; AL/CF-TR-1994-0091) Avail: CASI HC A03/MF A01

The use of lower body negative pressure (LENP) as an acceleration pre-conditioning technique for space applications was investigated. The purpose of this study was to evaluate changes in cephalic blood flow during LBNP. The intent was to see if detection or warning of impending syncope was possible, and to simulate effects which occur under exposure to + Gz. Ten subjects underwent the following LBNP profile while in a standing position: Five minutes of baseline at ambient pressure, followed by increments of -10 mm Hg every three minutes to a minimum of -50 mm Hg. They remained at -50 mm Hg for a maximum of twenty minutes or until presyncopal symptoms occurred. An additional five minutes of post-LBNP baseline data were collected. The analog pulse waveform signals were obtained from a pulse oximeter sensor located approximately at eye level on the subject's ear lobe. The pulse waveform analysis included pulse area, amplitude, and duration. Six of the ten subjects experienced presyncopal symptoms during the LBNP profile. Significant changes were observed in several variables at the presyncopal endpoint and included: pulse waveform area ($P=0.0048$), pulse waveform amplitude ($P=0.0236$). In the non-presyncopal group, pulse waveform area ($P=0.0208$), amplitude ($P=0.0070$), and duration ($P=0.0030$) demonstrated significant changes compared to baseline values after exposure to LBNP. DTIC

N95-29557# Hebrew Univ., Jerusalem (Israel).
MEMBRANE FLUIDITY AND SHAPE OF HUMAN RED

BLOOD CELLS ARE ALTERED BY PHYSIOLOGICAL LEVELS OF HYDROSTATIC PRESSURE

GREGORY BARSHTSTEIN, LEV BERGELSON, ARIE DAGAN, ENRICO GRAFTON, and SAUL YEDGAR 1994 22 p
(AD-A290595) Avail: CASI HC A03/MF A01

The effect of hydrostatic pressure at physiological levels, such as that applied to humans in diving or hyperbaric chamber, on human red blood cell (RBC) membrane fluidity and morphology was studied. Membrane fluidity was determined by fluorescence anisotropy (FA) of lipid probes (mainly diphenyl hexatriene (DPH), and of tryptophan), as well as by energy transfer from the tryptophan to the lipid probes, in ghosts prepared prior to or after application of pressure to intact RBC. The morphology of intact RBC, prior to or after application of pressure, was evaluated by scanning electron microscopy. It was found that: (1) The FA of DPH, which resides in different apolar membrane regions, was increased as a function of the pressure applied and the duration of the treatment. At 15 atm the FA increased by 50%, reaching a plateau after 60 min of application of pressure; (2) Increased FA, to various extents, was observed also with the lipid probes which reside in the membrane lipid core, but not with probes which monitor the polar/apolar phospholipid interface, or the cell surface; (3) The same treatment increased tryptophan anisotropy by about 20%. (4) Tryptophan energy transfer to the lipid probes which resides in the lipid core was increased to various degrees which were related to the increase of the FA of these probes; and (5) Following application of 15 atm for 1 hour, at least 60% of the RBC change their shape from discocytes to stomatocytes. These results demonstrate that hydrostatic pressure at physiological levels, might induce reduction of the membrane fluidity of RBC, which affects the physical state of protein environment, and might alter RBC morphology. DTIC

N95-29627# Institute of Aviation Medicine, Oslo (Norway).
EFFECT OF HYPOXIA ON ARTERIAL BLOOD GASES IN SUBJECTS WITH LUNG DYSFUNCTION

MORTEN RYG and CARL C. CHRISTENSEN In AGARD, Recent Issues and Advances in Aeromedical Evacuation (MEDEVAC) 14 p
Feb. 1995
Copyright Avail: CASI HC A03/MF A02

Although air transportation is an efficient way of evacuating casualties out of combat zones, even the mild hypoxia in a pressure cabin may adversely affect the oxygen supply of subjects whose lung function is compromised. Obviously, the wounded are difficult to study systematically. It is, however, possible to evaluate pulmonary limitations of oxygen transport by investigating persons with various lung diseases. This paper presents the effects of very light physical work in hypoxia on subjects with chronic obstructive lung disease (COPD). These patients are characterized by obstruction of the airways, resulting in low expiratory air flow rates, and low maximal ventilation rates (Cotes 1993). We analyze the consequences of inadequate alveolar ventilation and increased resistance to diffusion in the lung for oxygen partial pressures in alveoli and arterial blood, and on arterial oxygen saturation. We also try to evaluate the usefulness of standard clinical tests in predicting susceptibility of lung patients to hypoxia. Derived from text

N95-29629# Hellenic Air Force General Hospital, Athens (Greece).
FLIGHT NURSE SCHOOL IN THE HELLENIC AIR FORCE

KAL. PAPASTOGIANNIDOU and ALEX. KATSIKA In AGARD, Recent Issues and Advances in Aeromedical Evacuation (MEDEVAC) 5 p
Feb. 1995
Copyright Avail: CASI HC A01/MF A02

The necessity of specialized nursing personnel for air evacuated patients in peace and war time led Medical Service of the Hellenic Air Force (HAF) to train officer nurses in the USA F.N. School in order to create a similar school in our country. This School was established in 1988 and the first FN's graduated the same year. At this moment, the training courses are for officers with a near future schedule for petty officers. The structure and performance of school conducted in accordance to US FN School in Brooks AFB San

Antonio TEXAS, corresponded to the needs and abilities of our country. The ultimate purposes concerning the foundation of the school are: (1) to advance the quality of nursing care; (2) to install the minimum demands - standards of care for FN; 3) to access FN nursing enlightenment to all levels of medical personnel; (4) the readiness to respond in every emergency condition involving air evacuation demands in agreement with an appropriate program; (5) the attachment of education to all FN; and (6) to advance assurance quality with a predetermined procedure. Course is mandatory and operates on a theoretical base with a minimum of practical application. The experiences gained from FN during the involvement in three (3) scheduled air drills were fewer than expected. Flight nursing offers a unique and broad field to professional nursing with an opportunity to serve patients, community, integrating nursing as a basic part of aerospace medicine. Author

N95-29757# Army Medical Research and Development Command, Fort Detrick, MD.

HUMAN FLUID BALANCE AND DEHYDRATION DURING COLD WEATHER MILITARY OPERATIONS

BEAU J. FREUND and MICHAEL N. SAWKA Dec. 1994 40 p
(AD-A289192; USAMRMC-T95-4) Avail: CASI HC A03/MF A01

Not unlike exposure to hot environments, exposure to the cold can disrupt body fluid balance. While the mechanisms responsible for cold-induced dehydration (i.e., cold diuresis, increased respiratory water losses, fluid losses associated with wearing bulky winter clothing, poor fluid availability/delivery, inadequate thirst sensation, etc.) are somewhat different than those for hot environments, the impact of the fluid imbalance is often quite similar. For example, cold-induced dehydration can negatively influence both physical and cognitive performance as well as disrupt normal thermoregulation. It is also thought that dehydration may increase the susceptibility to peripheral cold injuries. This paper reviews the literature regarding factors influencing body fluid balance in the cold as well as the impact of the fluid imbalance on soldier performance and mission accomplishment. Described are potential countermeasures for preventing or delaying body fluid imbalances in the cold, including recent advances in hyperhydration techniques. DTIC

N95-29846# Naval Health Research Center, San Diego, CA.

ADAPTATIONS TO THREE WEEKS OF AEROBIC/ ANAEROBIC TRAINING IN WEST COAST U.S.: NAVY SEA-AIR-LAND PERSONNEL (SEAL'S) Final Report, Jun. - Aug. 1991

I. JACOBS, W. K. PRUSACZYK, and H. W. GOFORTH, JR. Dec. 1994 25 p
(AD-A291500; NHRC-94-28) Avail: CASI HC A03/MF A01

SEAL's must optimize physical training 'efficiency' i.e., adaptation per unit training time. This study was designed to determine if a single training program could simultaneously elicit aerobic and anaerobic adaptations. SEAL's were assigned to groups matched for initial aerobic and anaerobic fitness. Each group trained on cycle ergometers for 30 min 3 times per week as follows: continuous (CNT; n=8) at 70 percent VO(sub 2peak); intermittent (TNT; n=6) at an average of 70 percent VO(sub 2peak) (10 x (2 min x 50 percent VO(sub 2peak) + 1 min x 110 percent VO(sub 2peak))); supramaximal (SMX; n=6) (3-5 x 30 sec maximal effort sprints spaced over 30 min). Before and after 3 weeks of training, measurement of time to exhaustion (TE), VO(sub 2peak), and blood lactate concentration (LA) during submaximal exercise were used to assess aerobic fitness, and maximal O2 deficit to evaluate anaerobic capacity. After training, VO(sub 2peak) did not change significantly for any group. Mean TE increased (p less than 0.05) for all groups, averaging 18.1 to 19.3 min. LA at 180 w decreased (p less than 0.05) for all groups, with pre to post changes of 3.3 to 2.1 mmol(dot)/L. Maximal O2 deficit increased (p less than 0.05) for TNT and SMX averaging 38 to 46 mL O2(dot)/kg, but did not increase (p more than 0.05) for CNT. There were no other significant differences across training groups for any training adaptations. The results indicate that TNT or SMX training can induce rapid improvements in both aerobic and anaerobic fitness using a single 30-min bout. DTIC

N95-29872# Hebrew Univ., Jerusalem (Israel).

EFFECT OF MILD HYDROSTATIC PRESSURE ON RED BLOOD CELLS Final Report, Aug. 1991 - Oct. 1994

SAUL YEDGAR 26 Dec. 1994 5 p
(Contract(s)/Grant(s): N00014-91-J-1880)
(AD-A290520) Avail: CASI HC A01/MF A01

We studied the effect of physiological levels of hydrostatic pressure, such as that applied in diving or hyperbaric treatment, on (1) flow (rheological) properties and (2) membrane fluidity and morphology of red blood cells (RBC). It was found that application of such pressure (1) enhances the aggregability of RBC (studied by a computerized image analysis which was developed for this purpose), and higher than normal flow rate was required to disperse the cells; and (2) reduces RBC membrane fluidity (studied by fluorescence anisotropy of lipid probes and tryptophan), and changes the cell morphology (studied by scanning electron microscopy) from normal discocytes to stomatocytes. Physical and rheological properties of RBC, as well as their shape, play a major role in blood flow and in their cellular-biochemical functions. Thus, the alterations in RBC reported here may be pertinent to the microcirculatory and physiological disorders observed among humans subjected to elevated pressure. DTIC

N95-29927# California Univ., San Francisco, CA.

MOLECULAR PROBES OF GATING AND OPEN CHANNEL CONFORMATIONAL TRANSITIONS OF MECHANOSENSITIVE ION CHANNELS Final Report

JEFFRY B. LANSMAN 14 Nov. 1994 7 p
(Contract(s)/Grant(s): DAAL03-91-G-0329)
(AD-A291170) Avail: CASI HC A02/MF A01

The objective of this project was to elucidate the molecular mechanisms which control the gating behavior and ion transport properties of mechanosensitive ion channels in skeletal muscle. The project utilized recordings of single-channel activity to address two general questions: (1) How does an absence of the cytoskeletal protein, dystrophin, influence the mechanosensitive gating of single channels? (2) What is the mechanism by which positively charged aminoglycoside antibiotics inhibit the flow of current through these channels. DTIC

N95-29933# Wright State Univ., Dayton, OH.

PATTERN-ANALYSIS BASED MODELS OF MASKING BY SPATIALLY SEPARATED SOUNDS Final Report, 15 May 1991 - 30 Sep. 1994

ROBERT H. GILKEY 9 Feb. 1995 25 p
(Contract(s)/Grant(s): AF-AFOSR-0289-91)
(AD-A291270; AFOSR-95-0104TR) Avail: CASI HC A03/MF A01

Work is presented on masked detection, sound localization, neural networks, and the sense of presence. Both free-field and headphone-based studies of masking indicate that traditional models of binaural interaction may be inadequate to explain the reductions in masking that often occur with dichotic, as opposed to diotic, stimulation. The accuracy of localization judgments in the presence of a masker is determined by both the signal-to-noise ratio and the spatial location of the masker. Localization judgments for speech stimuli are in general less accurate than those for some nonspeech stimuli. Neural - network models of sound localization can achieve performance similar to human observers based on monaural information alone or based on interaural information alone. The reports of suddenly-deafened adults suggest that realistic auditory stimulation may be critical for determining the sense of presence in virtual environments. DTIC

N95-29995# Naval Health Research Center, San Diego, CA.

THE EFFECT OF BRIGHT LIGHT AND LEET ON SLEEP AFTER A 10-HOUR PHASE DELAY Final Report, 1 Oct. 1991 - 30 Sep. 1994

TAMSIN L. KELLY, ROZA HYDUK, and DAVID RYMAN Nov. 1994 22 p
(AD-A291264; NHRC-94-23) Avail: CASI HC A03/MF A01

Shift work and jet lag can cause circadian desynchronization.

Bright light and Low Energy Emission Therapy (LEET), separately and together, were tested as interventions to improve sleep after a 10-hr phase delay of the work/rest cycle. Both interventions decreased awakenings during the first daytime sleep period after the phase shift. After 3 nights of bright light administration from 2200-0200 each night, the subjects who received bright light had greater total sleep time, better sleep efficiency, and less wake time during the sleep period as compared to subjects who were exposed to dim light. Three days of LEET treatment for 20-min prior to each daytime sleep period showed a non-significant trend for similar additive benefits, with the group who received both bright light and LEET showing greater total sleep time than the group who received only light, and the group that received only LEET showing greater total sleep time than the control group who received neither intervention.

DTIC

N95-30083# Naval Health Research Center, San Diego, CA.
**SLEEP DURING SEAL DELIVERY VEHICLE (SDV)/DRY
 DOCK SHELTER EXERCISES ANALYZED BY A GRAPHIC
 APPROACH Final Report**

P. NAITOH, T. L. KELLY, P. HUNT, and H. W. GOFORTH, JR. Nov. 1994 28 p

(AD-A290916; NHRC-94-30) Avail: CASI HC A03/MF A01

Naval Special Warfare (NSW) personnel frequently participate in missions involving extended work hours and nocturnal waking periods. This can have a negative effect on sleep patterns, which in turn could have detrimental impact on cognitive performance. Environmental factors aboard submarines that degrade quantity and quality of sleep and increase fatigue of NSW Sea-Air-Land (SEAL) personnel have been previously evaluated by Phil Hunt, CDR, MC, USN, a submarine medical officer (unpublished memorandum). Such factors include (1) persistent light, noise, crowding and activity in the berthing area, and (2) conflicts between the work/rest schedules of the submarine crew and SEAL Delivery Vehicle (SDV)/Dry Deck Shelter (DDS) personnel. Hunt recommended that the berthing area be made more conducive to quality sleep. He also recommended regular use of an aerobic exercise machine which, in addition to physiological benefits, may improve quality and quantity of sleep. Sleep surveys are an important tool to assist in the development of an appropriate work/rest schedule for a given mission scenario. These techniques have been used previously in relation to many different occupations, both in the military and the civilian sectors (e.g., Investigation of the Navy Workweek at Sea, 1975, by the Navy Personnel Research and Development Center, San Diego, and The Standard ShiftWork Index, 1991, by the Shiftwork Research Team at the University of Sheffield, England). A guide to optimizing sleep during special warfare operations has been published (Naitoh & Kelly, 1992); however, the sleep log/sleep questionnaire analysis techniques necessary to assess wake/sleep patterns were not explained in that report.

DTIC

53

BEHAVIORAL SCIENCES

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

A95-91578
**THE EFFECTS OF MOTION CUES IN REGULATING
 UNSTABLE AIRCRAFT SYSTEMS**

YASUMICHI SADATSUKI Tokyo Univ., Japan and MASAKI KOMODA Tokyo Metropolitan Inst. of Tech., Japan *In Aircraft Symposium, 30th, Tsukuba, Japan, Sep. 30 - Oct. 2, 1992. A95-91491 Japan Japan Aerospace Association 1992 p. 568-571 In JAPANESE*

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Motion and visual cues are of most importance for the evalua-

tion of a pilot flying a flight simulator. Should any differences exist between the available information from the ground-based flight simulators and that from actual flights, they would affect the control behavior of pilots. In this paper, transfer functions of pilots are identified from the obtained data using a ground-based flight simulator where no motion cues are available. The results are compared with those obtained from actual flight tests of an in-flight simulator for the same unstable model.

Author (Herner)

A95-91579
**H(SUB INFINITY) PILOT MODEL BASED ON THE NEAL-
 SMITH CRITERIA**

NORIIHIRO GOTO Kyushu Univ., Japan, SATOSHI FUJITA Kyushu Univ., Japan, and KUNIIHIRO CHATANI Kyushu Univ., Japan *In Aircraft Symposium, 30th, Tsukuba, Japan, Sep. 30 - Oct. 2, 1992. A95-91491 Japan Japan Aerospace Association 1992 p. 572-575 In JAPANESE*

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Neal-Smith criteria for evaluating aircraft handling qualities are formulated as an H(sub infinity) problem to obtain the H(sub infinity) pilot model. Kwakernaak's analytical method is used to solve the problem. Frequency domain weighting functions are selected so as to comply with the method. Numerical results show that the H(sub infinity) pilot model satisfies the Neal-Smith criteria and reflects the human pilot control characteristics reasonably well. This type of modeling is promising to analytically predict the relationship between aircraft characteristics and pilot model parameters.

Author (Herner)

A95-91580
**IDENTIFICATION OF PILOT DYNAMICS INCLUDING
 FEEDBACK STRUCTURES**

NORIIHIRO GOTO Kyushu Univ., Japan, KAZUO MORIYAMA Japan Air Lines Co. Ltd., Japan, and TOSHIKAZU MOTODA National Aerospace Lab., Japan *In Aircraft Symposium, 30th, Tsukuba, Japan, Sep. 30 - Oct. 2, 1992. A95-91491 Japan Japan Aerospace Association 1992 p. 576-579 In JAPANESE*

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In controlling the flight path of an aircraft, it is assumed that the pilot either makes a direct output feedback single-loop or closes an attitude feedback inner loop. This work proposes an improved identification procedure capable of selecting a proper feedback structure from the two candidates. Utilizing the autoregressive scheme, the procedure makes the singular value analysis of the transfer function matrix from the innovations to the output in addition to the correlation analysis of the innovations. A digital simulation work proves the validity of the procedure, and a flight simulation work using human pilots shows that the direct output single-loop is preferably employed.

Author (Herner)

A95-91581
**IN-FLIGHT SIMULATION OF APPROACH FLIGHTS BY
 USING A FLIGHT REFERENCE DISPLAY FOR STOL
 AIRCRAFT**

KEIJI TANAKA National Aerospace Lab., Japan, KOHEI FUNABIKI National Aerospace Lab., Japan, MASARU NAKAMURA National Aerospace Lab., Japan, YUSHI TERUI National Aerospace Lab., Japan, TOHSIHARU INGAKI National Aerospace Lab., Japan, HIROYASU KAWAHARA National Aerospace Lab., Japan, YUKICHI TSUKANO National Aerospace Lab., Japan, and TAKATSUGU ONO National Aerospace Lab., Japan *In Aircraft Symposium, 30th, Tsukuba, Japan, Sep. 30 - Oct. 2, 1992. A95-91491 Japan Japan Aerospace Association 1992 p. 580-583 In JAPANESE*

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This paper describes an in-flight simulation of a flight reference display for powered-lift Short Takeoff and Landing (STOL) aircraft. The in-flight simulator, Variable Stability and Response Airplane (VSRA) of the National Aerospace Laboratory was utilized for this experiment. The results of approach flights to actual runways illustrated the potential of the display for monitoring and regulating

the safety margin as well as suggestions for future improvement. Also it was demonstrated that full motion cues provided by the VSRA yielded ultimate fidelity of flight simulation environment for the display evaluation. Author (Herner)

A95-91646**HOMEOSTAT-A BIOENGINEERING SYSTEM**

M. A. NOVIKOV, A. F. BYSTRITSKAYA, K. N. ESKOV, V. K. VASILYIEV, A. G. VINOKHODOVA, and COLIN DAVIES (ISSN 0148-7191) 1993 8 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 Research sponsored by ESA Long Term Project Office (SAE PAPER 932068; HTN-95-21077) Copyright

The results of a study of interaction effectiveness in the crew under isolation in the ESA EXEMSI 92 campaign are presented. The complexity and original character of the group structure was investigated using the bioengineering system known as the Homeostat apparatus. Even though the crew exhibited complex interaction, it is shown that the Homeostat is suitable for on-line inferring of the crew interaction effectiveness in simulation experiments. Author (Herner)

A95-91901**INTERPERSONAL RELATIONS DURING SIMULATED SPACE MISSIONS**

GRO M. SANDAL Univ. of Bergen, Bergen, Norway, RAGNAR VAERNES Norwegian Underwater Technology Center, Bergen, Norway, and HOLGER URSIN Univ. of Bergen, Bergen, Norway Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 617-624 Research sponsored by the Norwegian Research Council (HTN-95-12201) Copyright

The present article derives from two isolation studies performed for the European Space Agency (ESA) as simulations of space travels, lasting for 4 and 9 weeks. The aim was to study how interpersonal relations were affected by time, and how individual characteristics related to conflicts and tension among crewmembers. A board battery of methods was used, including video-recording, peer-ratings and self-reports. In both studies, group-functioning declined in the middle of the isolation and towards the end of the stay. Dominance and task motivation seemed to be important characteristics for compatibility between crewmembers, and negative relations established early in the isolation remained stable over time. These findings have implications for composition, training, and support of crews for extended spaceflights. Author (Herner)

A95-91910**PSYCHOLOGICAL FIRST-AID: A PRACTICAL AIDE-MEMOIRE**

JOHN LEACH Univ. of Lancaster, Lancaster, UK Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 7 July 1995 p. 668-674 (HTN-95-12210) Copyright

Despite advances made in recent years in medical first aid, psychiatric intervention, survival training and equipment design, many people still perish quickly during and immediately following a disastrous event. In this study, individuals and groups of survivors of life-threatening events were debriefed and the behavior of those who coped well during such a threat to life were compared with those who did not. The behaviors of those who coped well were distilled into a set of principles for psychological first aid; that is, a series of simple actions for use within a disaster which serves to recover victims to functional behavior as quickly as possible, thus uncreasing their change for survival. These principles of psychological first aid have recently been introduced into basic first aid and survival training courses for both military and civilian units. Author (Herner)

N95-28918# Minnesota Univ., Minneapolis, MN. Dept. of Psychology.

IMPROVING PROBLEM-SOLVING AND DECISION-MAKING**SKILLS UNDER STRESS: PREDICTION AND TRAINING****Final Report, Sep. 1991 - Jul. 1994**

PHILLIP L. ACKEERMAN and RUTH KANFER 10 Sep. 1994 81 p (Contract(s)/Grant(s): N00014-91-J-4159) (AD-A292104; REPT-94-01) Avail: CASI HC A05/MF A01

This investigation draws on a theoretical framework developed by Kanfer & Ackerman to: (1) assess individual differences in reactivity to stress, particularly from information processing; and (2) to develop a battery of cognitive ability tests/self-regulation measures for predicting performance under stress. Three studies were conducted. Two studies used a dynamic Target/Threat Identification Task under time-pressure. The remaining study used a complex air traffic controller task (TRACON) over extended practice. Personality, motivation, and self-regulatory activity measures are often significantly associated with performance under task load. However, the mixture of cognitive ability influences and stress-reactions associated with performance on cognitive and perceptual speed abilities account for the major amount of individual differences in performance, and also account for variance that is common to the non-ability predictors and task performance. The Dial Reading and Directional Headings Tests are promising predictors of performance in stressful information processing activities. We conclude that such measures have definite advantages to self-reports in predicting individual differences in performance under stress. DTIC

N95-28937 Harvard Univ., Cambridge, MA. Dept. of Psychology. **INTERMEDIATE LEVELS OF VISUAL PROCESSING Final Report, 1 Oct. 1991 - 30 Sep. 1994**

KEN NAKAYAMA 30 Sep. 1994 4 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract(s)/Grant(s): F49620-92-J-0016) (AD-A291569; AFOSR-95-0110TR) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

We completed a comprehensive theoretical account of visual surface representation based on a new understanding of many of our recently reported perceptual phenomena. In particular, we determined the degree to which the 'generic view principle' can explain these new findings and also extended its domain to a large number of perceptual phenomena (Shimojo and Nakayama, 1992). We apply the generic sampling principle which indicates that the visual system acts as if it were viewing surface layouts from generic, not accidental vantage points. Through the observer's experience of optical sampling, which can be characterized geometrically, the visual system makes associative connections between images and surfaces, passively internalizing the conditional probabilities of image sampling from surfaces. In turn, this enables the visual system to determine which surface a given image most strongly predicts. Thus, visual surface perception can be considered as inverse ecological optics based on learning through ecological optics. Because of its neglect of prior probabilities and higher level knowledge, visual surface perception deviates from strict Bayesian notions of inference. DTIC

N95-29090# Human Resources Research Organization, Alexandria, VA.

COPING AND ADAPTATION: THEORETICAL AND APPLIED PERSPECTIVES Interim Report, Sep. - Dec. 1980

ROSAMARY DAWSON, SHARON BATIA, KATHY BROOKS, and WENDY J. MCGUIRE Nov. 1994 146 p (Contract(s)/Grant(s): MDA903-78-C-2042) (AD-A290513; ARI-RN-95-06) Avail: CASI HC A07/MF A02

Soldiers who have limited skills and affective attributes from which to draw to cope with the barrage of requirements from assignment in Germany are less likely to adapt successfully to that environment. At the level of the individual soldier, actions could be taken to assist in acquisition of vital life coping skills that, in turn, would facilitate successful adaptation to life in Europe and reduce problems with retention and performance. This report describes the theoretical framework for the Life Coping Skills in USAREUR project, develops a model of the coping process, summarizes studies that

53 BEHAVIORAL SCIENCES

have identified needed life coping skills, reviews literature related to adaptation to the military and to foreign countries, and makes recommendations concerning directions and procedures for project tasks. DTIC

N95-29162# Armstrong Lab., Brooks AFB, TX. Aerospace Medicine Directorate.

ASTRONAUT SELECTION (NASA-MIPR) Technical Note

JOHN C. PATTERSON Jan. 1995 3 p

(AD-A292512; AL-AO-TN-1995-0001) Avail: CASI HC A01/MF A01

Since the last technical note, one selection cycle has been run: 26 June - 2 September 1994. A selection cycle had been planned for fall, 1993 but was cancelled by NASA. During the June - September cycle a total of 122 applicants were screened, about 20 applicants for each of the 6 weeks. From these applicants 10 pilots and 9 mission specialist candidates were selected. Among those selected 6 were rated as Exceptionally Well Qualified (EWQ) by the panel, 3 were Qualified+ (Q+), 10 were Qualified (Q), and no selectees were rated Qualified with Reservations (Q-R) nor Disqualified (DQ). Among the entire applicant pool 23 candidates were rated as EWQ. 84 were rated as Q, 15 were rated as Q-R and none were found DQ. Three USAF psychiatrists and two USN psychiatrists served as evaluators; three USAF psychologists, one USA psychologist, and one USN psychologist were evaluators. As in the past briefing and testing began on Sunday at 1200, tests were scored Sunday evening to prepare for the interviews beginning on Monday and lasting through Thursday; out briefs were available for volunteers (as in the past, nearly 100%) on Friday. Staffing occurred each day of interviews at noon and day's end which consisted of a case presentation by the interviewer, testing review by the psychologists observer, group discussion and consensus recommendation. The psychologists divided the applicants tests among them, interpreted the tests and sat in with the psychiatrist as an observer to better integrate the test findings. The psychiatrists dictated reports based on the structured interviews and recommendations. DTIC

N95-29261# Federal Aviation Administration, Oklahoma City, OK. Office of Aviation Medicine.

SHIFT WORK, AGE, AND PERFORMANCE: INVESTIGATION OF THE 2-2-1 SHIFT SCHEDULE USED IN AIR TRAFFIC CONTROL FACILITIES I. THE SLEEP/WAKE CYCLE Final Report

PAMELA S. DELLA ROCCO and CRYSTAL E. CRUZ May 1995 29 p

(DOT/FAA/AM-95/19) Avail: CASI HC A03/MF A01

Air Traffic Control Specialists (ATCS) work rotating shift schedules for most of their careers. Specifically, many work a counterclockwise rotating shift schedule, called the 2-2-1, or some variation of the schedule. The 2-2-1 involves rotating from two afternoon shifts to two mornings and, finally, to a midnight shift over the course of one work week. The purpose of the present study was to investigate sleep patterns during this type of rotating shift and the potential cumulative partial sleep loss in a laboratory-based synthetic work environment. Four groups of five male subjects between the ages of 30 to 35 (n=10) and 50 to 55 (n = 10) participated in the four week study. Subjects were screened on medical and cognitive criteria. The Multiple Task Performance Battery (MTPB) was utilized to provide a motivating synthetic work environment. Subjects were asked to work three 2-hour sessions on the MTPB per eight hour day for the last three weeks of the protocol. During the second and fourth weeks, subjects worked day shift (0800-1630). During the third week, subjects worked the 2-2-1 schedule. Sleep duration and quality, as well as mood, sleepiness and fatigue ratings were reported in log books. Wrist activity monitors were used to verify sleep duration. Average sleep durations decreased over the week of the 2-2-1 from an average of 7.6 hours, on Sunday night prior to the first afternoon shift, to 3.0 hours just prior to the midnight shift. Comparison of sleep duration for the first week of day shifts (excluding weekends) to the 2-2-1 week revealed that total sleep time was significantly less for the 2-2-1

week (p is less than .01). No differences were found between age groups. Data suggest that sleep management interventions could improve adaptation to the quick-rotating shift schedules. This study was the first report from a laboratory-based study of the 2-2-1. It was part of a research program designed to develop fatigue countermeasures for implementation with Air Traffic Control Specialists in the field. Author

N95-29422# Rochester Univ., NY. Center for Visual Science.

REFERENCE FRAMES IN VISION Final Report, 15 Jan. 1991 - 30 Jul. 1994

MARY M. HAYHOE 9 Jan. 1995 9 p

(Contract(s)/Grant(s): AF-AFOSR-0332-91)

(AD-A290117; REPT-5-27959; AFOSR-95-0021TR) Avail: CASI HC A02/MF A01

The goal of this project is to examine the consequences of observer motion for visual function. The research has focussed on two issues: One issue is how a grossly time-varying retinal input (because of eye, head, and body motion) results in the perception of a continuous and directionally stable visual world. A second issue concerns how the information in successive views is related, and the nature of the visual information retained from previous views. Understanding these processes is important for a wide variety of visuo-motor tasks. Progress has been made on the following projects: (1) The role of the visual scene and eye position signals in visual stability; (2) The role of attention in integrating across saccades; (3) Reference frames for spatial memory; (4) Hand-eye coordination during complex tasks; (5) Detectability of changes during saccades; and (6) Short term visual memory of complex scenes. DTIC

N95-29432# Educational Testing Service, Princeton, NJ.

TEST THEORY RECONCEIVED

ROBERT J. MISLEVY Jan. 1995 59 p

(Contract(s)/Grant(s): N00014-91-J-4101; NR PROJ. 042-04)

(AD-A291836; RR-94-2-ONR) Avail: CASI HC A04/MF A01

Educational test theory consists of statistical and methodological tools to support inference about examinees' knowledge, skills, and accomplishments. The evolution of test theory has been shaped by the nature of users' inferences, which until recently, have been framed almost exclusively in terms of trait and behavioral psychology. Progress in the methodology of test theory enabled users to extend the range of inference, sharpen the logic, and ground their interpretations more solidly within these psychological paradigms. In particular, the focus remained on student's over-all tendency to perform in prespecified ways in prespecified domains of tasks; for example, to make correct answers to mixed-number subtraction problems. Developments in cognitive and developmental psychology broaden the range of desired inferences, especially to conjectures about the nature and acquisition of students' knowledge. Commensurately broader ranges of data-types and student models are entertained. The same underlying principles of inference that led to standard test theory can be applied to support inference in this broader universe of discourse. Familiar models and methods - sometimes extended, sometimes reinterpreted, sometimes applied to problems wholly different from those for which they were first devised - can play a useful role to this end. DTIC

N95-29434# Army Aeromedical Research Lab., Fort Rucker, AL. **US ARMY AVIATION EPIDEMIOLOGY DATA REGISTER: GENDER-SPECIFIC ATTRITION AMONG THE US ARMY STUDENT AVIATOR CLASS OF 1987 Final Report**

KEVIN T. MASON and SAMUEL G. SHANNON Jan. 1995 22 p

(Contract(s)/Grant(s): DA PROJ. 301-62787-A-878)

(AD-A291856; USAARL-95-12) Avail: CASI HC A03/MF A01

Graduated aviators from the U.S. Army student aviator cohort of the Class of 1987 were followed in the Aviation Epidemiology Data Register for 6 years to determine if there was a gender-specific difference in attrition from aviation service. Overall, 30 percent attrition was found in 6 years of observation following initial aviator training. There was no significant gender-specific difference in

attrition (p greater than 0.05, life table analysis). Pregnancy was the most common identified cause of female aviator attrition. However, there was no significant increase risk for attrition among all pregnant aviators after delivery (relative risk = 0.545, CI0.95 = 0.144, 2.06). Among male aviators, flying evaluation boards with nonmedical termination of aviation service, death due to aircraft mishaps, and alcohol abuse were common identified causes of attrition. These three conditions accounted for 47 percent of known causes for male aviator attrition. DTIC

N95-29439# Wright State Univ., Dayton, OH.

VISUALIZATION OF CAD OBJECTS USING A STEREOSCOPIC DISPLAY Technical Report

MICHAEL E. BROWN and JENNIE J. GALLIMORE 15 Jan. 1995
3 p

(Contract(s)/Grant(s): N00014-92-J-4096)

(AD-A290034) Avail: CASI HC A01/MF A01

Subjects memorized the shape of a static 3-D object displayed on a stereoscopic CRT (cathode ray tube). In each of a series of trials that followed, single static objects were presented. The angular orientation of each trial object was one of six 36-deg increments relative to the angle of the memorized stimulus. The subject's task was to determine, as quickly and accurately as possible, whether the trial object was the same shape as the memorized object or its mirrored image. One of the two cases was always true. Disparity and interposition were manipulated in a within-subject manner during the initial memorization period and the trials that followed. Subject response time and error rate were evaluated. The experimental objective was to determine the extent to which stereopsis and hidden surface affect subjects' ability to: (1) transfer to and retrieve from long-term memory spatial information about a 3-D object; and (2) visualize spatial characteristics in a quick and direct manner. Improved performance due to hidden surface is the most convincing experimental finding. The study also found a significant but limited stereopsis effect. DTIC

N95-29443# Massachusetts Inst. of Tech., Cambridge, MA.

INTERACTION AND INTELLIGENT BEHAVIOR

MAJA J. MATARIC Aug. 1994 191 p

(Contract(s)/Grant(s): N00014-91-J-4038)

(AD-A290049; AI-TR-1495) Avail: CASI HC A09/MF A02

We introduce basic behaviors as primitives for control and learning in situated, embodied agents interacting in complex domains. We propose methods for selecting, formally specifying, algorithmically implementing, empirically evaluating, and combining behaviors from a basic set. We also introduce a general methodology for automatically constructing higher-level behaviors by learning to select from this set. Based on a formulation of reinforcement learning using conditions, behaviors, and shaped reinforcement, our approach makes behavior selection learnable in noisy, uncertain environments with stochastic dynamics. All described ideas are validated with groups of up to 20 mobile robots performing safe-wandering, following, aggregation, dispersion, homing, flocking, foraging, and learning to forage. DTIC

N95-29458 National Biomedical Research Foundation, Washington, DC.

GEORGETOWN INSTITUTE FOR COGNITIVE AND COMPUTATIONAL SCIENCES Annual Report, 1 Oct. 1993 - 30 Sep. 1994

ROBERT S. LEDLEY and ALAN I. FADEN 4 Nov. 1994 11 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract(s)/Grant(s): DAMD17-93-V-3018)

(AD-A289775) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

Georgetown Institute for Cognitive and Computational Sciences Georgetown University Medical Center has established a Department of Neuroscience to provide the optimal academic structure to support the Georgetown Institute for Cognitive and Compu-

tational Science (GICCS). Several experts in the field were invited to participate in the planning, organization and recruitment of the chair and faculty for the Department of Neuroscience. The chair of this department is being actively recruited; final candidates have been identified and this process is entering its final stages. In addition, we have advertised for faculty positions for GICCS; 42 applications have been received to date. An administrator of the Institute has been hired. The scientific project entitled 'Texture Analysis for Scene Segmentation' led by Dr. Robert S. Ledley has begun. This study will provide an important tool to explore various aspects of biological pattern recognition. DTIC

54

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A95-86876

TELEOPERATOR RESPONSE IN A TOUCH TASK WITH DIFFERENT DISPLAY CONDITIONS

ALBERTO ROVETTA Politecnico di Milano, Milano, Italy, FRANCESCA COSMI, and LORENZO MOLINARI TOSATTI IEEE Transactions on Systems, Man and Cybernetics (ISSN 0018-9472) vol. 25, no. 5 May 1995 p. 878-881 refs (BTN-95-EIX95262697087) Copyright

This paper deals with the evaluation of human biofeedback response in virtual reality and in direct view. The experiments have been performed with a new paradigm for the evaluation of human biofeedback during the telemanipulation performance of a touch task. The controlled motion of one finger is monitored with the surface EMG, while mechanical robotized hand finger follows the motion imposed by the human finger. The biofeedback is detected in a direct way, by the vision of the robotized finger action, and in an indirect way, with the support of three different types of interfaces. The neuromuscular activity presents different features and delays in the four cases: A measurement of the attention and participation in the man/machine interface is obtained, in a first series of experiments. The paradigm adopted in this research is the result of the integration of robotics and neurology. Author (EI)

A95-87329

EXPERIMENTS IN CONTROL OF A FLEXIBLE-LINK ROBOTIC MANIPULATOR WITH UNKNOWN PAYLOAD DYNAMICS: AN ADAPTIVE APPROACH

LAWRENCE J. ALDER Stanford University Aerospace Robotics Laboratory, Stanford, CA, US and STEPHEN M. ROCK Stanford University Aerospace Robotics Laboratory, Stanford, CA, US International Journal of Robotics Research (ISSN 0278-3649) vol. 13, no. 6 December 1994 p. 481-495 (HTN-95-92509) Copyright

This article presents technology that extends the concept of end-point control of a flexible-link robot arm to handle payloads with unknown internal dynamics. The approach is based on merging high-performance control with an innovative identification algorithm in a self-tuning regulator framework. Payload dynamics are identified in real time using recently developed subspace fitting techniques. Sufficient excitation issues are addressed. End-point feedback controllers are formulated using frequency-weighted linear quadratic gaussian design methods. Experimental results demonstrating precision control of a very flexible single-link robot arm with unknown dynamic payloads are presented. Author (Herner)

A95-87470 National Aeronautics and Space Administration, Washington, DC.

MEETING HUMAN NEEDS

ARNAULD E. NICOGOSSIAN NASA Headquarters, Washington, DC, US In Humans and machines in space: The vision, the

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

challenge, the payoff; AAS Goddard Memorial Symposium, 29th, Washington, DC, March 14-15, 1991. A95-87467 San Diego, CA American Astronautical Society (Science and Technology Series, Vol. 81) (ISSN 0278-4017) 1992 p. 61-72 (AAS PAPER 91-313) Copyright

Manned space flight can be viewed as an interaction of three general elements: the human crewmember, spacecraft systems, and the environment. While the human crewmember is a crucial element in the system, certain physiological, psychological, environmental and spacecraft systems factors can compromise human performance in space. These factors include atmospheric pressure, physiology, uncertainties associated with space radiation, the potential for exposure to toxic materials in the closed environment, and spacecraft habitability. Health protection in space, for current and future missions, relies on a philosophy of risk reduction, which in the space program is achieved in four ways—through health maintenance, health care, design criteria, an selection and training. Emphasis is placed upon prevention, through selection criteria and careful screening. Spacecraft health care systems must be absolutely reliable, and they will be automated and computerized to the maximum extent possible, but still designed with the human crewmember's capabilities in mind. The autonomy and technological sophistication of future missions will require a greater emphasis on high-level interaction between the human operator and automated systems, with effective allocation of tasks between humans and machines. Performance in space will include complex tasks during extravehicular activity (EVA) and on planetary surfaces, and knowledge of crewmembers' capability and limitations during such operations will be critical to mission success. Psychological support will become increasingly important on space missions, as crews spend long periods in remote and potentially hazardous environments. The success of future missions will depend on both individual psychological health and group cohesion and productivity, particularly as crew profiles become more heterogeneous. Thus, further human factors are needed in the area of small-group dynamics and performance. Author (Herner)

A95-87471 LIFE SUPPORT SYSTEMS

NORMAN N. LI Allied Signal, Inc., Des Plaines, IL, US *In* Humans and machines in space: The vision, the challenge, the payoff; AAS Goddard Memorial Symposium, 29th, Washington, DC, March 14-15, 1991. A95-87467 San Diego, CA American Astronautical Society (Science and Technology Series, Vol. 81) (ISSN 0278-4017) 1992 p. 79-85 (AAS PAPER 91-320) Copyright

Previous short-duration manned space missions were dependent on open-loop life support systems. This means large quantities of essential life-sustaining materials such as oxygen, water, and food, needed to be stored for use during the mission, and wastes were collected and returned to the earth. Space Station Freedom will contain regenerative systems, which recycle oxygen and water, thereby, closing two of the resource loops. Regenerative life support has been identified as one of the critical technology needs. The life support systems which will be incorporated into the different manned vehicles for the long-duration moon and Mars explorations will require different degrees of capability and system closure. This paper will discuss only the life support systems in regard to atmosphere revitalization, water management and part of waste management (urine treatment). Author (Herner)

A95-87472 REMOTE MEDICAL SYSTEMS FOR THE HUMAN EXPLORATION OF SPACE

HARRY C. HOLLOWAY Uniformed Services University of the Health Sciences, Bethesda, MD, US *In* Humans and machines in space: The vision, the challenge, the payoff; AAS Goddard Memorial Symposium, 29th, Washington, DC, March 14-15, 1991. A95-87467 San Diego, CA American Astronautical Society (Science and Technology Series, Vol. 81) (ISSN 0278-4017) 1992 p. 87-92 (AAS PAPER 91-321) Copyright

The purpose of this presentation is to outline how a medical care system might be designed to deal with health risks associated with long-term exploratory space missions and to point out areas in which further basic and applied research and technology development will be required to develop effective medical responses. In describing this system I will attempt to describe a system that emphasizes primary prevention, integration of the medical system within the life support systems, the appropriateness of the medical system for particular space environments and mission architectures, and systems that are cost effective within the context of particular missions. As will be obvious, the elements described will be at various degrees of scientific and technologic maturity.

Author (Herner)

A95-87666 WASTE DISPOSAL OPTIONS FOR REFRACTORY TEAROUT

LOREN D. ALEXANDER Chemical Waste Management Inc., Oak Brook, IL, US American Ceramic Society Bulletin (ISSN 0002-7812) vol 74, no. 1 January 1995 p. 68-70 (HTN-95-81618) Copyright

Refractory waste needs to be carefully characterized to permit the greatest number of options for its disposal. Classification of refractory waste as debris could be advantageous. The regulations affecting tearout refractory disposal are reviewed. Disposal options are considered. Author (Herner)

A95-87846 ERGONOMICS IN LASER SYSTEM DESIGN

NICHOLAS L. VOLKRINGER IBM East Fishkill Facility, Hopewell Junction, NY, US and JEFFREY J. WILLIAMS IBM East Fishkill Facility, Hopewell Junction, NY, US *In* Lasers '92; Proceedings of the International Conference on Lasers and Applications, 15th, Houston, TX, Dec. 7-10, 1992. A95-87708 McLean, VA STS Press (ISSN 0190-4132) 1993 p. 895-899 Copyright

Ergonomics provides a key leverage for yield and cycle time improvement in laser tooling used in the manufacture of development hardware for IBM's recently announced Series 9000 mainframe. This paper outlines the ergonomic considerations involved in such tool design. Author (Herner)

A95-89092* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PRELIMINARY TEST RESULTS FROM THE CELSS TEST FACILITY ENGINEERING DEVELOPMENT UNIT

MARK H. KLISS NASA. Ames Research Center, Moffett Field, CA, US, R. D. MACELROY NASA. Ames Research Center, Moffett Field, CA, US, C. C. BLACKWELL Bionetics Corp., US, B. A. BORCHERS Bionetics Corp., US, M. E. DREWS Bionetics Corp., US, J. R. LONGABAUGH Bionetics Corp., US, B. S. YENDLER Bionetics Corp., US, and A. I. ZOGRAFOS Bionetics Corp., US (ISSN 0148-7191) 1994 7 p. SAE, International Conference on Environmental Systems, 24th and European Symposium on Space Environmental Control Systems, 5th, Friedrichshafen, Germany, Jun. 20-23, 1994 (SAE PAPER 941542; HTN-95-A1372) Copyright

As part of the NASA Controlled Ecological Life Support System (CELSS) Program, a CELSS Test Facility (CTF) is being planned for installation on the Space Station. The CTF will be used to provide data on the productivity and efficiency of a variety of CELSS higher plant crops grown in the microgravity environment of the Space Station. Tight environmental control will be maintained while data on gas exchange rates and biomass accumulation rates are collected. In order to obtain an early realistic determination of the subsystem and system requirements necessary to provide the environmental conditions specified for CTF crop productivity experiments, an Engineering Development Unit (EDU) has been designed, constructed and is in the process of subsystem and system testing at NASA Ames Research Center. The EDU is a ground test-bed which will be used to characterize the integrated performance of major subsystem technologies, to evaluate hardware candidates and control strategies required for the CTF, and to further define the

ability to meet CTF requirements within present Space Station constraints. This paper reviews the functional requirements for the EDU, and focuses on the performance evaluation and test results of the various subsystems. Preliminary integrated performance results and control system operation are addressed, and plans for future science and technology testing are discussed. Author (Herner)

A95-89094* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

GENERAL PURPOSE FREE FLOATING PLATFORM FOR KC-135 FLIGHT EXPERIMENTATION

BRUCE A. BORCHERS Bionetics Corp., US, BORIS S. YENDLER Bionetics Corp., US, MARK H. KLISS NASA. Ames Research Center, Moffett Field, CA, US, ANDREW A. GONZALES NASA. Ames Research Center, Moffett Field, CA, US, and MARK T. EDWARDS BioServe Space Technologies, US (ISSN 0148-7191) 1994 7 p. SAE, International Conference on Environmental Systems, 24th and European Symposium on Space Environmental Control Systems, 5th, Friedrichshafen, Germany, Jun. 20-23, 1994 (SAE PAPER 941452; HTN-95-A1374) Copyright

The Controlled Ecological Life Support Systems (CELSS) program is evaluating higher plants as a means of providing life support functions aboard space craft. These plant systems will be capable of regenerating air and water while meeting some of the food requirements of the crew. In order to grow plants in space, a series of systems are required to provide the necessary plant support functions. Some of the systems required for CELSS experiments are such that it is likely that existing technologies will require refinement, or novel technologies will need to be developed. To evaluate and test these technologies, a series of KC-135 precursor flights are being proposed. A general purpose free floating experiment platform is being developed to allow the KC-135 flights to be used to their fullest. This paper will outline the basic design for the CELSS Free Floating Test Bed (FFTB), and the requirements for the individual subsystems. Several preliminary experiments suitable for the free floater will also be discussed. Author (Herner)

A95-89095* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE NASA AMES CONTROLLED ENVIRONMENT RESEARCH CHAMBER: PRESENT STATUS

ANTHONY R. GROSS NASA. Ames Research Center, Moffett Field, CA, US, DAVID J. KORSMEYER NASA. Ames Research Center, Moffett Field, CA, US, LYNN D. HARPER NASA. Ames Research Center, Moffett Field, CA, US, and EDWIN L. FORCE NASA. Ames Research Center, Moffett Field, CA, US (ISSN 0148-7191) 1994 9 p. SAE, International Conference on Environmental Systems, 24th and European Symposium on Space Environmental Control Systems, 5th, Friedrichshafen, Germany, Jun. 20-23, 1994 (SAE PAPER 941488; HTN-95-A1375) Copyright

The Controlled Environment Research Chamber (CERC) at the NASA Ames Research Center was created for early-on investigation of promising new technologies for life support of advanced space exploration missions. The CERC facility is being used to address the advanced technology requirements necessary to implement an integrated working and living environment for a planetary habitat. The CERC, along with a human-powered centrifuge, a planetary terrain simulator, advanced displays, and a virtual reality, is able to develop and demonstrate applicable technologies for future planetary exploration. There will be several robotic mechanisms performing exploration tasks external to the habitat that will be controlled through the virtual environment to provide representative workloads for the crew. Finally, there will be a discussion of innovative new multidisciplinary test facilities, and how effective they are to the investigation of the wide range of human and machine problems inherent in exploration missions. Author (Herner)

A95-89096* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CONCEPT FOR A LIFE SUPPORT SYSTEM TESTBED IN

SPACE

ROBERT D. MACELROY NASA. Ames Research Center, Moffett Field, CA, US, MARK H. KLISS NASA. Ames Research Center, Moffett Field, CA, US, and RICHARD MCKENNA Bionetics Corp., US (ISSN 0148-7191) 1994 7 p. SAE, International Conference on Environmental Systems, 24th and European Symposium on Space Environmental Control Systems, 5th, Friedrichshafen, Germany, Jun. 20-23, 1994

(SAE PAPER 941450; HTN-95-A1376) Copyright

The concept of a general purpose life support system testbed for use in space grew out of considerations arising from the recent consolidation of NASA's Advanced Life Support (ALS) Systems programs. Both the physical-chemical and the biological approaches to regenerative life support will require significant amounts of in-space testing in order to prepare for the final development of systems for human life support. Considerations of the technical requirements and rationales for in-space testing has led to the concept of a common testbed that will allow faster and less expensive long duration tests. Author (Herner)

A95-90171

OXYGEN LOSS IN BIOSPHERE 2

JEFFREY P. SEVERINGHAUS Lamont-Doherty Earth Observatory, Palisades, NY, US, WALLACE S. BROECKER Lamont-Doherty Earth Observatory, Palisades, NY, US, WILLIAM F. DEMPSTER Space Biospheres Ventures, Oracle, AZ, US, TABER MACCALLUM Space Biospheres Ventures, Oracle, AZ, US, and MARTIN WAHLEN Scripps Inst. of Oceanography, La Jolla, CA, US EOS (ISSN 0096-3941) vol. 75, no. 3 January 18, 1994 p. 33, 35-37 Research sponsored by Columbia Univ. and DOE (HTN-95-A1596) Copyright

Oxygen concentrations have dropped sharply in the air of Biosphere 2, an enclosed experimental ecosystem located in southern Arizona. O₂ in Biosphere 2 decreased during the first 16 months of closure from the ambient 21 to 14 percent, enough to cause health problems in the human occupants. We present evidence that the O₂ loss is caused by microbial respiration of the excessive amount of organic matter incorporated into the experiments soil and furthermore, that the respired CO₂ is reacting with the structure's concrete to form calcium carbonate. Topics covered include the following: oxygen and carbon budgets for Biosphere 2; excess CaCO₃ in Biosphere 2 concrete; and carbon isotopic evidence. Herner

A95-90338* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

UTILIZATION OF ON-SITE RESOURCES FOR REGENERATIVE LIFE SUPPORT SYSTEMS AT LUNAR AND MARTIAN OUTPOSTS

DOUGLAS W. MING NASA Johnson Space Center, US, D. C. GOLDEN NASA Johnson Space Center, US, and DONALD L. HENNINGER NASA Johnson Space Center, US (ISSN 0148-7191) 1993 11 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932091; HTN-95-20961) Copyright

Lunar and martian materials can be processed and used at planetary outposts to reduce the need (and thus the cost) of transporting supplies from Earth. A variety of uses for indigenous, on-site materials have been suggested, including uses as rocket propellants, construction materials, and life support materials. Utilization of on-site resources will supplement Regenerative Life Support Systems (RLSS) that will be needed to regenerate air, water, wastes, and to produce food (e.g., plants) for human consumption during long-duration space missions. Natural materials on the Moon and/or Mars may be used for a variety of RLSS needs including (1) soils or solid-support substrate for plant growth, (2) sources for extraction of essential plant-growth nutrients, (3) sources of O₂, H₂, CO₂, and water, (4) substrates for microbial populations in the degradation of wastes, and (5) shielding materials surrounding outpost structures to protect humans, plants, and microorganisms

from radiation. In addition to the regolith, the martian atmosphere will provide additional resources at a Mars outpost, including water, CO₂ and other atmospheric gases. Author (Herner)

A95-90339* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SINGLE PHASE SPACE LAUNDRY DEVELOPMENT

GERALD V. COLOMBO Umpqua Research Co., Myrtle Creek, OR, US, DAVID F. PUTNAM Umpqua Research Co., Myrtle Creek, OR, US, TEDDIE D. LUNSFORD Umpqua Research Co., Myrtle Creek, OR, US, NEIL D. STREECH Umpqua Research Co., Myrtle Creek, OR, US, RICHARD R. WHEELER, JR. Umpqua Research Co., Myrtle Creek, OR, US, and HAROLD REIMERS NASA Johnson Space Center, US (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932092; HTN-95-20962) Copyright

This paper describes a newly designed, 2.7 Kg (6 pound) capacity, laundry machine called the Single Phase Laundry (SPSL). The machine was designed to wash and dry crew clothing in a micro-gravity environment. A prototype unit was fabricated for NASA-JSC under a Small Business Innovated Research (SBIR) contract extending from September 1990 to January 1993. The unit employs liquid jet agitation, microwave vacuum drying, and air jet tumbling, which was perfected by KC-135 zero-g flight testing. Operation is completely automated except for loading and unloading clothes. The unit uses about 20 percent less power than a conventional household appliance. Author (Herner)

A95-90340* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

EFFECT OF IODINE DISINFECTANT SOURCE AND WATER QUALITY PARAMETERS ON SOLUBLE IODINE SPECIATION

JOANN SILVERSTEIN NSCORT, University of Colorado, US, CHARLES HURST NSCORT, University of Colorado, US, ROBERT BARKLEY NSCORT, University of Colorado, US, and ANDREW DUNHAM NSCORT, University of Colorado, US (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932096; HTN-95-20963) Copyright

Investigations of iodine species distribution of various aqueous solutions of iodine disinfectants and water from equilibrated suspensions of triiodide and penta iodide resins were done at the University of Colorado for the Center for Space Environmental Health during 1992 and 1993. Direct measurements of three individual iodine species: I(-), I₂ and I₃(-), were made. In addition three measures of total titratable iodine species were used. It has been found that I₂ and I₃(-) solutions produce a significant fraction of the non-disinfecting species iodine I(-), ranging from 50 to 80% of added iodine, respectively, at pH values of approximately 5. Correspondingly, I₂ solutions produce more than twice the concentration of disinfecting iodine species per mass iodine dose than I₃(-) solutions. Both I(-) and I₂ species were found in aqueous extracts of penta iodide resin, although no soluble species were detected with triiodide resin. Author (Herner)

A95-90341

IODINE DISINFECTION BY-PRODUCTS GENERATED IN WATER FROM SELECTED ORGANIC PRECURSOR COMPOUNDS

ROBERT BARKLEY NSCORT, University of Colorado, US, ANDREW DUNHAM NSCORT, University of Colorado, US, CHARLES HURST NSCORT, University of Colorado, US, and JOANN SILVERSTEIN NSCORT, University of Colorado, US (ISSN 0148-7191) 1993 4 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932097; HTN-95-20964) Copyright

The reaction of iodine, a potential disinfectant for use in the treatment of recycled water during long-duration manned space missions, and several organic substrates that are expected chemi-

cal constituents in a closed-loop recycle water system, yields iodinated disinfection by-products. The reactions were studied using procedures analogous to those developed by the U.S. Environmental Protection Agency (EPA) for evaluation of chlorinated disinfection by-products in water. The iodinated products formed in these studies were identified using gas chromatography with both electron capture and mass spectrometric detection. Aqueous solutions of acetic acid and of dextran produce iodinated alkyi-compounds when treated with iodine, as triiodide ion, at neutral pH. Similar treatment of phenol yields iodine-substituted phenols at appreciable concentrations. Author (Herner)

A95-90342

PERFORMANCE OF EVA SUIT MOBILITY JOINTS INFLUENCE OF DRIVING PARAMETERS

VALENTIN MENENDEZ Zodiac Espanola, Spain, XAVIER LABOURDETTE Dassault Aviation, France, and JOSE MANUEL BAEZ CDTI, Spain (ISSN 0148-7191) 1993 9 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932098; HTN-95-20965) Copyright

This paper is based on the European Space Suit soft joints development and gives a study about the soft joints performances and working behavior, which is the most important parameter limiting the Suit Enclosure inner pressure and the Zero Prebreath Suits feasibility. It starts with the identification of design drivers, pointed out in accordance with the top level functional and performance requirements. Such drivers strongly influenced conceptual choices, which were reviewed by test campaigns, thus enabling parametric studies of the most important ones (e.g. torque versus range of motion). The second part of the paper analyses the torque performance of soft joints as a function of the inner pressure and mobility range for different types of joints, in order to give an assessment about the soft joints used for manufacturing a suit enclosure with an internal overpressure up to 600 hPa. The third part of the paper analyses the joint behavior function of the joint diameter, joint type, etc. and provides an assessment of the historical background, mass and level of available technology. In the end the paper makes reference to application (PACHA) of the technology developed for Extravehicular Activity (EVA) Space Suits to the terrestrial human protection against a hostile environment. Author (revised by Herner)

A95-90343

EUROPEAN EVA SPACE SUIT: FULL SCALE EVALUATIONS AND ANALYSIS FOR THE LOWER TORSO CONCEPTUAL DESIGN

D. HORNET Dassault Aviation, France and Y OLLIVIER Dassault Aviation, France (ISSN 0148-7191) 1993 14 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932099; HTN-95-20966) Copyright

In the frame of the development of the European Extravehicular Activity (EVA) Suit, a complete trade-off was conducted to select the lower torso architecture. This study, performed under an ESA contract, included a formal trade-off dealing with all cost and programmatic impacts together with a technical assessment based on man rated underwater evaluations and analysis. The results of this campaign were the selection of a lower torso including calf bearings only, as the new European/Russian baseline and the refinement of the ergonomical/kinematic methodology allowing to theoretically predict the performances of a given EVA architecture. Author (revised by Herner)

A95-90344

REDESIGN OF THE SHUTTLE EXTRAVEHICULAR MOBILITY UNIT (EMU) HARD UPPER TORSO TO IMPROVE OVERALL SYSTEM SAFETY AND REDUCE COMPONENT COST

TOM STANKIEWICZ Hamilton Standard Division of United Technologies Corp, US, STEVE DIONNE Hamilton Standard Division of

United Technologies Corp, US, BRADFORD R. PROUTY Hamilton Standard Division of United Technologies Corp, US, and MEL CASE ICL Dover, US (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932100; HTN-95-20967) Copyright

The original Shuttle Extravehicular Mobility Unit (EMU) Hard Upper Torso (HUT) configuration developed in 1978 by Hamilton Standard and ILC, Dover had the arm attached in such a way that the shoulder bearing outer race was integral with the HUT. This paper which describes the completed and planned activity associated with the planar HUT program, begins by describing the methods employed by Hamilton Standard and ILC to investigate the following variables: shoulder diameter, arm opening placement (relative to the constraints defined by the helmet neck ring), Display and Control Module (DCM) and Primary Life Support System (PLSS) relative to the different HUT sizes (from small to extra-large). The paper continues by describing the additional participation of several NASA/JSC personnel (including astronaut crewmembers) in a coordinated effort to evaluate the don/doff and mobility characteristics of the new HUT. Conclusions are presented along with future plans for completing the development and incorporating the changes into the flight hardware. Author (revised by Herner)

A95-90345

DEVELOPMENT OF A FABRIC FOR THE EXTERNAL PROTECTION OF A SPACE SUIT

U. RIECK, W. FISCHER, G. KLEEN, D. MUELLER-WIESNER, K. H. STECHER, J. WALTER, J. WITT, and L. FANCHI (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932101; HTN-95-20968) Copyright

During Extravehicular Activities (EVA) an astronaut has to be protected against various external factors ranging from mechanical hazards to solar radiation and micrometeoroids. An important element in this external protection is the outermost fabric layer. It has to ensure the mechanical protection of the pressure retention bladder and at the same time - by its thermo-optical properties - plays an important role in the thermal control of the space suit. This paper describes the different fabric concepts and their corresponding property profiles, including coating systems for the fabric surfaces. Test results are presented. Author (revised by Herner)

A95-90347

MICROBIAL CONTROL OF THE SPACE SUIT ASSEMBLY FOR SPACE STATION FREEDOM

M. JAMES CLOUGHERTY ILC Dover, Inc., US and JOHN L. SLOYER, JR. (ISSN 0148-7191) 1993 8 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932103; HTN-95-20970) Copyright

The construction and operation of the Space Station Freedom will require longer stays in space and extended re-use of the Liquid Cooling and Ventilation Garment (LCVG) and the Space Suit Assembly (SSA) bladder. Since these conditions require redefinition of microbial control procedures, a program was undertaken to identify an undergarment, an antimicrobial finish, and cleaning protocols for various space suit components. Using standard microbiological techniques and researching earlier American space program experience, a baseline microbial control procedure was established and a series of manned SSA tests undertaken to determine the validity of the procedure. The results suggest that the use of an undergarment with an antimicrobial finish improved the hygiene of the LCVG, and the use of a disinfectant effectively kills bacterial on the SSA bladder. In addition, forced air focused on selected areas of the suit significantly reduces microbial viability. Author (Herner)

A95-90348

MPLM FIRE DETECTION AND SUPPRESSION: ARCHITECTURE AND ANALYSIS

PAOLO BALOCCO Alenia Spazio S.p.A., Italy, FRANCESCO

POTENZA Alenia Spazio S.p.A., Italy, and EMILIO CAFERO Politecnico di Torino, Italy (ISSN 0148-7191) 1993 12 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932104; HTN-95-20971) Copyright

The Mini Pressurized Logistics Module (MPLM) is a servicer of the Space Station Freedom (SSF), whose purpose is to provide location for both subsystems and payload racks (active racks i.e. namely a freezer and a freezer/refrigerator, is to be serviced, and passive racks). The MPLM will be used to supply and return a pressurized cargo to and from the SSF via the National Space Transportation System (NSTS), optimizing the NSTS cargo capabilities. Being a pressurized module, the MPLM is characterized by an Environmental Control System that consists of two sections: The Environmental Control and Life Support System (ECLSS) and the Internal Thermal Control System (ITCS). The ECLSS is constituted by other subsections, among which is the Fire Detection and Suppression (FDS) Subsystem. The fire suppression method, selected at SSF level, is the CO₂ discharge and diffusion in the affected enclosed areas. As far as the mathematical simulation of the FDS aspects is concerned, a big effort has been made and is still on-going. The related mathematical modelization is quite complex, involving two-phase phenomena, choked flow and gas diffusion: this means the implementation and running of dedicated Computational Fluid Dynamics (CFD) models. The diffusion analysis is particularly time-consuming, due to the complexity of the geometry with respect to modelization capability. Author (revised by Herner)

A95-90350

CONDENSING HEAT EXCHANGER MICROBIAL GROWTH AND CONTROL STUDY-PHASE 2

ROBERT W. MARSH Hamilton Standard Division of United Technologies Cor, US, MARK E. CARON Hamilton Standard Division of United Technologies Cor, US, CAROL METSELAAR Hamilton Standard Division of United Technologies Cor, US, and JOHN STEELE Hamilton Standard Division of United Technologies Cor, US (ISSN 0148-7191) 1993 6 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932107; HTN-95-20973) Copyright

The Space Station Temperature and Humidity Control Condensing Heat Exchangers will be utilized to collect and remove atmospheric water vapor generated by the metabolic and hygienic activity of crew members. The porous hydrophilic coating within the heat exchangers will always be wet. Cabin air will continuously flow through the heat exchangers during system operation which makes them a potential site for microbial colonization. This paper summarizes the findings from an ongoing study which evaluates biofilm formation on wet hydrophilic coated panels compared to panels to which microbial control measures have been applied. The control measures evaluated are an antimicrobial agent within the coating and periodic drying. Author (Herner)

A95-90351

SPACE STATION FREEDOM CARBON DIOXIDE REMOVAL FLIGHT DESIGN

GREGORY J. GENTRY Boeing Defense and Space Group, US and ROBERT KAY Allied Signal Aerospace Systems & Equipment, US (ISSN 0148-7191) 1993 16 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932108; HTN-95-20974) Copyright

Boeing is responsible for Space Station Freedom (Work Package (WP) 01) which includes the Habitat and U.S. Laboratory modules, which includes the integration of the Environmental Control and Life Support System (ECLSS). Included as part of the ECLSS is the Atmosphere Revitalization (AR) subsystem. The AR subsystem provides for the removal of metabolic carbon dioxide, removal of trace contaminants, and continuous monitoring of the cabin atmosphere major constituent composition during the Manned Tended Configuration (MTC) phase of station operations. The focus

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

of this paper is on the Carbon Dioxide Removal Assembly (CDRA) flight design aspects of the Space Station Freedom (SSF) AR subsystem. Author (revised by Herner)

A95-90353* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

INVESTIGATION OF LUNAR BASE THERMAL CONTROL SYSTEM OPTIONS

MICHAEL K. EWART NASA JSC, US (ISSN 0148-7191) 1993 12 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932112; HTN-95-20976) Copyright

Long duration human exploration missions to the Moon will require active thermal control systems which have not previously been used in space. The two technologies which are most promising for long term lunar base thermal control are heat pumps and radiator shades. Recent trade-off studies at the Johnson Space Center have focused development efforts on the most promising heat pump and radiator shade technologies. Since these technologies are in the early stages of development and many parameters used in the study are not well defined, a parametric study was done to test the sensitivity to each assumption. The primary comparison factor in these studies was the total mass system, with power requirements included in the form of a mass penalty for power. Heat pump technologies considered were thermally driven heat pumps such as metal hydride, complex compound, absorption and zeolite. Also considered were electrically driven Stirling and vapor compression heat pumps. Radiator shade concepts considered included step shaped, V-shaped and parabolic (or catenary) shades and ground covers. A further trade study compared the masses of heat pump and radiator shade systems. Author (revised by Herner)

A95-90354 HIGH-TEMPERATURE WASTE HEAT DRIVEN COOLING USING SORPTION MEDIA

UWE ROCKENFELLER Rocky Research, US, LANCE KIROL Rocky Research, US, and KAVEH KHALILI Rocky Research, US (ISSN 0148-7191) 1993 6 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932113; HTN-95-20977) Copyright

This paper describes the ongoing development of a solid-vapor complex-compound prototype heat pump suitable for lunar base operation. Working conditions are 4-15 C cooling and 82-94 C heat rejection. Work to meet this objective involves thermodynamic characterization of the media selected and principally tested, complex-compound stability determination, optimization of physical parameters, such as salt packing density and heat exchangers with various construction materials, and proof-of-concept prototype development. Author (revised by Herner)

A95-90355* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

MODERATE TEMPERATURE CONTROL TECHNOLOGY FOR A LUNAR BASE

THEODORE D. SWANSON NASA Goddard Space Flight Center, US, K. R. SRIDHAR University of Arizona, US, and MATTHIAS GOTTMANN University of Arizona, US (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932114; HTN-95-20978) Copyright

A parametric analysis is performed to compare different heat pump based thermal control systems for a Lunar Base. Rankine cycle and absorption cycle heat pumps are compared and optimized for a 100 kW cooling load. Variables include the use or lack of an interface heat exchanger, and different operating fluids. Optimization of system mass to radiator rejection temperature is performed. The results indicate a relatively small sensitivity of Rankine cycle system mass to these variables, with optimized system masses of about 6000 kg for the 100 kW thermal load. It is quantitatively demonstrated that absorp-

tion based systems are not mass competitive with Rankine systems. Author (Herner)

A95-90356* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THERMAL, MASS, AND POWER INTERACTIONS FOR LUNAR BASE LIFE SUPPORT AND POWER SYSTEMS

DARRELL L. JAN JPL California Institute of Technology, Pasadena, CA, US, NARESH ROHATGI JPL California Institute of Technology, Pasadena, CA, US, GERALD VOECKS JPL California Institute of Technology, Pasadena, CA, US, and AUL PROKOPIIUS NASA Lewis Research Center, Cleveland, OH, US (ISSN 0148-7191) 1993 15 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932115; HTN-95-20979) Copyright

A model has been developed for quantitative examination of the integrated operation of the lunar base power system, employing regenerative fuel cell technology, which would lead to incorporation into a lunar base life support system. The model employs methods developed for technology and system trade studies of the Life Support System configuration for the National Aeronautics and Space Administration (NASA). This paper describes the power system and its influence on life support while comparing various technologies, including pressurized gas storage and cryogenic storage, and different operation conditions. Based on preliminary assumptions, the mass, power, and thermal requirement estimates are made at the level of major components. The relative mass contribution and energy requirements of the components in various configurations are presented. The described interactions between power and life support include direct influence, such as water and oxygen storage, and indirect influence, through reliability and maintenance considerations. Author (Herner)

A95-90365* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DESIGN CONSIDERATIONS FOR THE CELSS TEST FACILITY ENGINEERING DEVELOPMENT UNIT

M. KLISS NASA Ames Research Center (ARC), US, B. BORCHERS The Bionetics Corp., US, and M. DREWS The Bionetics Corp., US (ISSN 0148-7191) 1993 9 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932124; HTN-95-20988) Copyright

The NASA Controlled Ecological Life Support System (CELSS) Program has the goal of developing life support systems for humans in space based on the use of higher plants. The program has supported research at universities with a primary focus of increasing the productivity of candidate crop plants. To understand the effects of the space environment on plant productivity, the CELSS Test Facility (CTF) has been developed as an instrument that will permit the evaluation of plant productivity on Space Station Freedom. The CTF will maintain specific environmental conditions and collect data on gas exchange rates and biomass accumulation over the growth period of several crop plants grown sequentially from seed to harvest. To better understand the systems needed to support plants and maintain the environmental conditions required by CTF, an Engineering Development Unit (EDU) is being constructed at NASA Ames Research Center (ARC) in the Advanced Life Support Division. The EDU will provide the means of testing and evaluating hardware solutions to CTF requirements. This paper reviews the CTF science and functional requirements, and provides a description of the EDU objectives, design approach, subsystem descriptions, and some of the technology tools employed in accomplishing the design. Author (Herner)

A95-90366 SIMULATION OF MASS FLUXES IN THE MELISSA MICROORGANISM BASED ECOSYSTEM

C.-G. DUSSAP Universite Blaise Pascal, France, J.-F. CORNET Universite Blaise Pascal, France, and J.-B. GROS Universite Blaise Pascal, France (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colo-

rado, July 12-July 15, 1993

(SAE PAPER 932125; HTN-95-20989) Copyright

The MELISSA (Microbial Ecological Life Support System Alternative) project, conceived as a microorganism based ecosystem, is an early simplified model for the future biological life support system for manned space missions. The driving element is the recovery of edible biomass from the waste, CO₂ and minerals with direct use of light as a source of energy for photosynthesis. MELISSA is composed of four axenic compartments colonized by microorganisms and of a fifth compartment that is the crew on board the craft. This paper reports on the solution of mass balances over the entire MELISSA loop. Author (revised by Herner)

A95-90367

MELISSA: CURRENT STATUS AND FUTURE DEVELOPMENT PROGRAM

CH. LASSEUR, C. TAMPONNET, and C. SAVAGE (ISSN 0148-7191) 1993 10 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932126; HTN-95-20990) Copyright

The MELISSA (Microbial Ecological Life Support System Alternative) project has been set up to be a model for the studies on ecological life support systems for the long term space missions. The compartmentalization of the loop, the choice of the micro-organisms and the axenic conditions have been selected in order to simplify the behavior of this artificial ecosystem and allow a deterministic and engineering approach. In this framework the MELISSA project has now been running since beginning 1989. In this paper we present the general approach of the study, the scientific results obtained on each independent compartment (mass balance, growth kinetics, limitations, compound conversions,...), the tests of toxicity already performed between some compartments and their effect on the growth kinetics. The technical results on instrumentation and control aspects, and the current status of the ESA/SETEC hardware are also reviewed. Finally, based on this first balance of results, we propose our main axis of research for the next coming years. Author (Herner)

A95-90368

PRELIMINARY STUDY ON MICROALGAE CULTURING REACTOR FOR CARBON DIOXIDE ELIMINATION AND OXYGEN RECOVERY SYSTEM

AKIKO MIYA, TADASHI ADACHI, and ITARU UMEDA (ISSN 0148-7191) 1993 8 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932127; HTN-95-20991) Copyright

Prototype bioreactor using internal lighting mechanism was manufactured for biological CO₂/O₂ conversion system. Microalgae culturing experiments were carried out on *Chlorella ellipsoidea* C-27 to estimate the effect of light intensity on photosynthetic activity in the reactor. The light energy source used was a Xe(xenon) lamp, from which light is transferred through optical fibers and diffused from the surface of rods made of acrylic resin. Total surface area of the rods was 0.12 sq m. Tests under the continuous lighting (600w) condition indicated a highest specific growth rate of 8.54/h, a highest cell density of 1.3 X 10⁸ (cells/ml), and a maximum overall photosynthetic rate (CO₂ absorption rate) of 171.84(mg-CO₂ absorption/lr-medium/day). In contrast, the maximum CO₂ absorption per chlorophyll content (mg-CO₂ absorption/mg-chl/h) was reached under the alternating lighting condition. Comparison on the photosynthetic rate under several conditions suggested that the most suitable condition for the synthetic rate did not coincide with the best condition for the photosynthesis of the intact cell. Relationships were also investigated, under various growing conditions, between the ratios of chlorophyll a and chlorophyll b versus the CO₂ absorption per chlorophyll content. Results of the studies suggest the importance of measuring chlorophyll a and b monitoring photosynthetic abilities of growing cells in a vessel. Author (Herner)

A95-90369* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

GENERATION OF A MODELING AND SIMULATION SYSTEM

FOR A SEMI-CLOSED PLANT GROWTH CHAMBER

A. L. BLACKWELL NASA Ames Research Center, US, S. MAA NASA Ames Research Center, US, M. KLISS NASA Ames Research Center, US, and C. C. BLACKWELL The Bionetics Corp., US (ISSN 0148-7191) 1993 11 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932128; HTN-95-20992) Copyright

The fluid and thermal dynamics of the environment of plants in a small controlled-environment system have been modeled. The results of the simulation under two scenarios have been compared to measurements taken during tests on the actual system. The motivation for the modeling effort and the status of the modeling exercise and system scenario studies are described. An evaluation of the model and a discussion of future studies are included. Author (Herner)

A95-90370

ADVANCED LIFE SUPPORT SYSTEM ANALYSIS: METHODOLOGICAL FRAMEWORK AND APPLICATION STUDIES

GARRY ZOOKIN (ISSN 0148-7191) 1993 8 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932129; HTN-95-20993) Copyright

This paper is intended to address the process of System Analysis in the area of Advanced Life-Support Systems (ALSS). Particular attention is given to Controlled Ecological Life Support Systems (CELSS) architectures. The process of System Analysis is an iterative one in which trade-offs of various system elements are executed to evaluate system functionality and structure. In the process, consideration is given to factors such as system requirements, potential architectures and design concepts, integration issues and system operations. The emphasis of the paper is on developing a consistent framework for the analysis process. It is anticipated that by developing a formal framework, particularly for the systems analysis of a CELSS, comparisons of approaches and of quantitative assessments will be made easier. Author (Herner)

A95-90371* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

CELSS ENGINEERING PARAMETERS

ALAN DRYSDALE McDonnell Douglas Space Systems, US, JOHN SAGER NASA Kennedy Space Center, US, RAY WHEELER NASA Kennedy Space Center, US, RUSS FORTSON, and PETER CHETIRKIN (ISSN 0148-7191) 1993 12 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932130; HTN-95-20994) Copyright

The most important Controlled Ecological Life Support System (CELSS) engineering parameters are, in order of decreasing importance, manpower, mass, and energy. The plant component is a significant contributor to the total system equivalent mass. In this report, a generic plant component is described and the relative equivalent mass and productivity are derived for a number of instances taken from the KSC CELSS Breadboard Project data and literature. Typical specific productivities (edible biomass produced over 10 years divided by system equivalent mass) for closed systems are of the order of 0.2.

A95-90384* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

DEVELOPMENT OF AN INFRARED ABSORPTION TRANSDUCER TO MONITOR PARTIAL PRESSURE OF CARBON DIOXIDE FOR SPACE APPLICATIONS

GLENN LUTZ NASA Lyndon B. Johnson Space Center, US, VICTORIA MARGIOTT, SEAN MURRAY, and JAMES SCHAFF (ISSN 0148-7191) 1993 12 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932145; HTN-95-21007) Copyright

An infrared (IR) carbon dioxide (CO₂) transducers has been

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

designed, developed, and produced for space applications. The transducer provides measurement of partial pressure of CO₂ in life support applications, including the Extravehicular Mobility Unit (EMU), Space Shuttle Orbiter and Spacehab. The electrochemical sensor presently used for these applications has a slow response time and has reliability concerns due to the electrolyte. The new microprocessor based unit has a fast response time and can be tailored to other space applications. Author (Herner)

A95-90386

AN ASSESSMENT OF PRESSURE/OXYGEN RATIOS FOR A MARS BASE

TED G. BARRETT University of Colorado, US, GEORGE W. MORGANTHALER University of Colorado, US, and SARAH L. YOFFE University of Colorado, US (ISSN 0148-7191) 1993 7 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932147; HTN-95-21009) Copyright

It is well known that selection of the pressure/oxygen ratio for a human space habitat is a critical decision for the well-being and mission performance of astronauts. It has also been noted how this ratio affects the requirement for pre- and post-breathing and the type and flexibility of extravehicular activity/extrahabitat activity (EVA/EHA) astronaut suits. However, little attention has been paid to how these issues interact with various mission design strategies. Using the first manned mission to Mars as a baseline mission, we have separated the mission into its component parts as it relates to habitat type (i.e., the Earth-Mars interplanetary vehicle, the ascent/descent vehicle, the base, human rover vehicles, etc.) and have determined the oxygen resupply requirements for each part as they reflect a mission design strategy. These component parts form a matrix where duration of stay, loss of oxygen due to leakage and usage, and oxygen resupply needs are calculated. The matrix is then used as part of an evaluation model to compare several strategies which are aimed at reducing the oxygen resupply problem while maintaining astronaut safety and productivity. Author (Herner)

A95-90396* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PERMEABLE MEMBRANE EXPERIMENT

THOMAS J. SLAVIN, TUAN Q. CAO, and MARK H. KLISS NASA Ames Research Center, US (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932161; HTN-95-21019) Copyright

The purpose of the Permeable Membrane Experiment is to gather flight data on three areas of membrane performance that are influenced by the presence of gravity. These areas are: (1) Liquid/gas phase separation, (2) gas bubble interference with diffusion through porous membranes and (3) wetting characteristics of hydrophilic membrane surfaces. These data are important in understanding the behavior of membrane/liquid/gas interfaces where surface tension forces predominate. The data will be compared with 1-g data already obtained and with predicted microgravity behavior. The data will be used to develop designs for phase separation and plant nutrient delivery systems and will be available to the life support community for use in developing technologies which employ membranes. A conceptual design has been developed to conduct three membrane experiments, in sequence, aboard a single Complex Autonomous Payload (CAP) carrier to be carried in the Shuttle Orbiter payload bay. One experiment is conducted for each of the three membrane performance areas under study. These experiments are discussed in this paper. Author (Herner)

A95-90397

DUAL-MEMBRANE GAS TRAP FOR THE SPACE STATION FREEDOM INTERNAL THERMAL CONTROL SYSTEM

MICHAEL B. FAUST, S. JAMES ZHOU, and INARA M. BRUBAKER (ISSN 0148-7191) 1993 10 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932162; HTN-95-21020) Copyright

A gas trap is being developed for use in the internal thermal control system (ITCS) of Space Station Freedom (SSF). The function of the gas trap is to remove and vent noncondensed gases (NCG) that may be entrained in the ITCS water loop. Noncondensed gas bubbles in excessive concentrations can cause the performance of the centrifugal pump to degrade, block coolant flow in remote components, and cause inaccuracies in instrumentation readings. This paper describes the pump sensitivity tests, gas trap trade study, membrane selection process, development testing, and evolution of the gas trap membrane module. The final gas trap design is nearing completion, and the latest test results are presented in this paper. Author (revised by Herner)

A95-90398

EVALUATION OF A TWO-MEMBRANE FILTER FOR GAS-WATER SEPARATION IN MICROGRAVITY

J. WITT, G. POPA, and M. SAEFKOW (ISSN 0148-7191) 1993 6 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPER 932163; HTN-95-21021) Copyright

The separation of gases and liquids under microgravity conditions is a common task to be accomplished in Life Support Systems of Spacecraft. Separation has to be achieved in two main domains: (1) water separators separate water from an air stream coming e.g. from the slurper holes of a condensing heat exchanger; and (2) gas traps have to safeguard sensitive devices in water loops, like e.g. centrifugal pumps or passages with small inner diameter, against blockage by gas bubbles. This paper describes the evaluation of a two-membrane concept for use in microgravity. The concept originally had been developed for medical applications and features a hydrophilic screen for retaining gas bubbles in a water stream; the bubbles are then vented via a hydrophobic membrane to the ambient. Author (revised by Herner)

A95-90399* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CAPILLARY MOVEMENT OF LIQUID IN GRANULAR BEDS

BORIS YENDLER National Research Council (NRC), US and BRUCE WEBBON NASA Ames Research Center (ARC), US (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

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Knowledge of capillary migration of liquids in granular beds in microgravity is essential for the development of a substrate based nutrient delivery system for the growth of plants in space. This problem is also interesting from the theoretical as well as the practical point of view. The purpose of this study was to model capillary water propagation through a granular bed in microgravity. In our ground experiments, water propagation is driven primarily by capillary force. Data for spherical particle sizes in the range from 0.46 to 2 mm have been obtained. It was shown that the velocity of water propagation is very sensitive to particle size. Theoretical consideration is also provided. Actual space flight experiments are planned for the future to confirm our results. Author (Herner)

A95-90400* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

APPLICATION OF CAPILLARY FLUID MANAGEMENT TECHNIQUES TO THE DESIGN OF A PHASE SEPARATING MICROGRAVITY BIOREACTOR

BARRY W. FINGER, GALE E. NEVILLE, JR. University of Florida, US, and JOHN C. SAGER NASA, Kennedy Space Center, US (ISSN 0148-7191) 1993 21 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993

(SAE PAPERS 932165; HTN-95-21023) Copyright

Manned space missions require the development of compact, efficient, and reliable life support systems. A number of aqueous biological conversion processes are associated with bioregenerative life support systems. Vessels, or bioreactors, capable of supporting

these processes in microgravity must be developed. An annular flow bioreactor has been conceived. It has the potential to incorporate containment, phase separation, gas exchange, and illumination into a single vessel. The bioreactor utilizes capillary fluid management techniques and is configured as a cylindrical tube in which a two-phase liquid-gas flow is maintained. Vanes placed around the inner perimeter enhance capillary forces and cause the liquid phase to attach and flow along the interior surface of the tube. No physical barrier is required to complete phase separation. It is shown analytically that liquid film thickness is limited only by vane geometry and that an annular flow bioreactor capable of managing 284 liters would occupy 0.7 cubic m, less than half the volume of a Spacelab experiment rack.

Author (Herner)

A95-90402

MODELING, SIMULATION, AND ANALYSIS OF THE THERMAL AND PRESSURE CONTROL SYSTEM FOR A CLOSED CROP GROWTH CHAMBER

KENNETH C. TSAI and CHARLES C. BLACKWELL (ISSN 0148-7191) 1993 5 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932167; HTN-95-21025) Copyright

This paper presents details of the mathematical modeling and simulation of the shoot side subsystem of a closed crop growth chamber. A discussion of the derivation of the mathematical model and the development of the simulation is presented, including a computer simulation with temperature control. The objective is to design a temperature and pressure control system.

Author (Herner)

A95-90403

FOOD STRATEGY IN BIOTECHNICAL LIFE-SUPPORT SYSTEMS

G. M. LISOVSKY Russian Academy of Sciences Siberian Branch, Russia, I. I. GITELSON Russian Academy of Sciences Siberian Branch, Russia, YU. N. OKLADNIKOV Russian Academy of Sciences Siberian Branch, Russia, and I. N. TRUBACHEV Russian Academy of Sciences Siberian Branch, Russia (ISSN 0148-7191) 1993 2 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932168; HTN-95-21026) Copyright

The experience of operating a closed human life support system (BIOS 3) based primarily on plant growth has provided an extensive data base that is potentially useful for future closed system studies. The paper describes some of the physical requirements of the system, discusses some of the issues regarding diet requirements, and suggests possible scenarios for balancing human metabolic requirements with the production of food and oxygen.

Author (Herner)

A95-90404

CONCEPT OF CLAM CULTURING MODULE FOR FOOD SUPPLYING SYSTEM IN CELSS

KIKO MIYA, TADASHI ADACHI, and ITARU UMEDA (ISSN 0148-7191) 1993 8 p. 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 12-July 15, 1993 (SAE PAPER 932169; HTN-95-21027) Copyright

Clam is a kind of bivalve mollusks, having a high nutritive value and good taste. A combination of clams and food plant should provide a balanced diet in a closed life support system (CELSS). The cultivating module mainly consists of a clam cultivating unit, a microalgae cultivating unit and water recycle system including a water reclaiming unit, a solid waste treatment unit like wet oxidation, a water sterilizing unit and a salinity adjusting unit. Recycled water from the water reclaiming unit is supplied to the clam cultivating unit and the microalgae cultivating unit after being sterilized. Concentration of salts in the water must be adjusted by salt supplied from a mineral recovery unit in habitat module. Lost water and nutrient required for microalgae cultivation must be supplied from habitat module or plant cultivation module. Lipid profile and

optimum cultivating condition of several microalgae were investigated. Total fatty acid contents of marine microalgae were higher than those freshwater microalgae. Freshwater microalgae contained scarcely any highly unsaturated fatty acid. On the contrary, marine microalgae, especially Pavlova, sp., contained a great deal of highly unsaturated fatty acid. All marine microalgae examined were able to grow in inorganic medium based sea water.

Author (Herner)

A95-90423

MODEL REFERENCE ADAPTIVE CONTROL FOR ROBOTIC MANIPULATORS WITHOUT VELOCITY MEASUREMENTS

HOWARD M. SCHWARTZ Carlton University, Ottawa, Ont., Canada International Journal of Adaptive Control and Signal Processing (ISSN 0890-6327) vol. 8, no. 3 May-June 1994 p. 279-285 (HTN-95-21046) Copyright

This paper presents a non-linear model reference adaptive controller for robot manipulators. Although the motivating application for this algorithm is in the field of robotics, the algorithm could be applied to non-linear systems that are feedback-linearizable. The algorithm developed does not require the measurement nor the estimation of manipulator joint velocities or accelerations. Simulation results verify the performance of the method. Author (Herner)

A95-90426

ADAPTIVE DEAD-BEAT CONTROL LAW FOR TRAJECTORY TRACKING OF ROBOTIC MANIPULATORS

L. JETTO Università di Ancona, Ancona, Italy, S. LONGHI Università di Ancona, Ancona, Italy, and A. PAPINI Università di Ancona, Ancona, Italy International Journal of Adaptive Control and Signal Processing (ISSN 0890-6327) vol. 8, no. 6 November-December 1994 p. 587-604 Research sponsored by Ministero dell'Università e della Ricerca Scientifica e Tecnologica (HTN-95-21049) Copyright

The purpose of this paper is to propose an adaptive dead-beat controller for the trajectory tracking of a robotic manipulator. The dead-beat compensator is self-tuned to a linearized discretized model whose parameters are identified on-line through a Kalman-like estimator. To improve the convergence of the estimator and to obtain good control performances even in the case of time-varying parameters, the state covariance matrix of the Kalman filter is adapted to the observed statistics of the innovation process. Numerical results have been obtained in a simulation context and refer to various operating conditions. They show that very good control performances in terms of maximum error are really obtainable. A comparison with minimum variance control is also reported.

Author (Herner)

A95-90661* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CASEMIDAS - A REACTIVE PLANNING ARCHITECTURE FOR THE MAN-MACHINE INTEGRATION DESIGN AND ANALYSIS SYSTEM

R. ADAM PEASE NASA. Ames Research Center, Moffett Field, CA, US In AIAA Computing in Aerospace 10, San Antonio, TX, March 28-30, 1995. A95-90629 Washington, DC American Institute of Aeronautics and Astronautics 1995 p. 265-270 (AIAA PAPER 95-0991) Copyright

MIDAS is a set of tools which allow a designer to specify the physical and functional characteristics of a complex system such as an aircraft cockpit, and analyze the system with regard to human performance. MIDAS allows for a number of static analyses such as military standard reach and fit analysis, display legibility analysis, and vision polars. It also supports dynamic simulation of mission segments with 3d visualization. MIDAS development has incorporated several models of human planning behavior. The CaseMIDAS effort has been to provide a simplified and unified approach to modeling task selection behavior. Except for highly practiced, routine procedures, a human operator exhibits a cognitive effort while determining what step to take next in the accomplishment of mission

tasks. Current versions of MIDAS do not model this effort in a consistent and inclusive manner. CaseMIDAS also attempts to address this issue. The CaseMIDAS project has yielded an easy to use software module for case creation and execution which is integrated with existing MIDAS simulation components.

Author (Herner)

A95-91440* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HEAD PERTURBATIONS DURING WALKING WHILE VIEWING A HEAD-FIXED TARGET

VALLABH E. DAS Case Western Reserve University, Cleveland, OH, US, ARI Z. ZIVOTOFSKY Case Western Reserve University, Cleveland, OH, US, ALFRED O. DISCENNA Case Western Reserve University, Cleveland, OH, US, and R. JOHN LEIGH Case Western Reserve University, Cleveland, OH, US Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 8 August 1995 p. 728-732 Research supported by the USPHS and the Department of Veteran Affairs

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(HTN-95-01208) Copyright

Inexpensive, head-fixed computer displays are now available that subjects can wear during locomotion. Our hypothesis is that viewing a head-fixed visual display will change the characteristics of rotational head perturbations during natural walking. Using a 3-axis angular rate sensor, we measured head rotations during natural or treadmill walking, in 10 normal subjects and 2 patients with deficient vestibular function, as they attempted to view (1) a stationary target at optical infinity; and (2) a target at a distance of 20 cm rigidly attached to the head. Normal subjects and patients showed no significant change in the predominant frequency of head rotations in any plane (ranging 0.7-5.7 Hz) during the two different viewing tasks. Mean peak head velocities also showed no difference during the two viewing conditions except in the yaw plane, in which values were greater while viewing the near target. Predominant frequencies of head rotations were similar in the pitch plane during natural or treadmill walking; however, peak velocities of pitch head rotations were substantially greater during natural walking. One vestibular patient showed modest increases of head velocity during natural walking compared with normal subjects. Rotational head perturbations that occur during natural walking are largely unaffected when subjects view a head-fixed target. There is need to study how such perturbations, which induce vestibular eye movements, affect vision of head-fixed displays.

Author (Herner)

A95-91631

STATUS OF THE COLUMBUS ATTACHED PRESSURIZED MODULE ESC DESIGN

G. SARRI, H. P. LEISEIFER, U. LAUX, R. VENERI, and K.-O. HIENERWADEL (ISSN 0148-7191) 1993 12 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932050; HTN-95-21062) Copyright

The design of the Environmental Control System (ECS) of the Attached Pressurized Module (APM) has lately undergone a series of major modifications. The implementation of a similar design for the fire detection and suppression function insures a unified approach for the safety management of the Space Station under emergency conditions related to these particular hazards. The evolution experienced in the Thermal Control System (TCS) part of the ECS was driven by design maturity and the need of resources management. The water loop architecture has grown from a single loop configuration to a double loop configuration. By this the availability of the thermal resources to the Space Station and therefore each partner are optimized. The purpose of this paper is to present the status of the APM ECS design after the first major program milestone, i.e. the System Requirement Review (SRR), to highlight those areas of the ECS design where fundamental changes have been introduced and to identify the rationale/main drivers for them.

Author (Herner)

A95-91639

EXPERT SYSTEM BASED TOOL FOR ADVANCED LIFE SUPPORT SYSTEM OPTIMIZATION- A MISSION ANALYSIS PERSPECTIVE

ROBERT C. DALEE and THOMAS C. LEE (ISSN 0148-7191) 1993 6 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993
(SAE PAPER 932060; HTN-95-21070) Copyright

An expert system based Environmental Control and Life Support System (ECLSS) trade study tool is under development which calculates resource requirements and penalties for a given system configurations and mission definition parameters. The user friendly, graphical software application allows important ECLSS resources such as power, mass, volume, resupply mass (consumable and expendable), heat rejection and ultimately cost to be analyzed in an efficient hierarchical manner. Hardware resources are calculated using scaling algorithms specific to each technology, based on the existing hardware where possible. Fluid mass balances are tracked and summarized as fluids input into the system and waste output leaving the system. This tool will aid in technology selection and optimization of transportation vehicle or surface habitat designs.

Author (Herner)

A95-91640

USING SECOND LAW ANALYSIS TO PREDICT THE EFFICIENCY OF ECLSS SUBSYSTEMS

SHARMISTA CHATTERJEE Iowa State University, US and R. C. SEAGRAVE Iowa State University, US (ISSN 0148-7191) 1993 11 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932061; HTN-95-21071) Copyright

The objective of this paper is to present an estimate of the second law of thermodynamic efficiencies of the various units comprising an Environmental Control and Life Support Systems (ECLSS). The technique adopted here is based on an evaluation of the lost work within each functional unit of the subsystem. Pertinent information for our analysis is obtained from a user inactive integrated model of an ECLSS. The model was developed using a chemical process simulator called ASPEN (Advanced System for Process Engineering). A potential benefit of this analysis is the identification of subsystems with high entropy generation as the most likely candidates for engineering improvements.

Author (Herner)

A95-91641* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

ENGINEERING STRATEGIES AND IMPLICATIONS OF USING HIGHER PLANTS FOR THROTTLING GAS AND WATER EXCHANGE IN A CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM

DENNIS CHAMBERLAND NASA Kennedy Space Center, US, RAYMOND M. WHEELER NASA Kennedy Space Center, US, and KENNETH A. COREY University of Massachusetts, US (ISSN 0148-7191) 1993 8 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932062; HTN-95-21072) Copyright

Engineering strategies for advanced life support systems to be used on Lunar and Mars bases involve a wide spectrum of approaches. These range from purely physical-chemical life support strategies to purely biological approaches. Within the context of biological based systems, a bioengineered system can be devised that would utilize the metabolic mechanisms of plants to control the rates of CO₂ uptake and O₂ evolution (photosynthesis) and water production (transpiration). Such a mechanism of external engineering control has become known as throttling. Research conducted at the John F. Kennedy Space Center's Controlled Ecological Life Support System Breadboard Project has demonstrated the potential of throttling these fluxes by changing environmental parameters affecting the plant processes. Among the more effective environmental throttles are: light and CO₂ concentration for controlling the rate of photosynthesis and humidity and CO₂ concentration for

controlling transpiration. Such a bioengineered strategy implies control mechanisms that in the past have not been widely attributed to life support systems involving biological components and suggests a broad range of applications in advanced life support system design.

Author (Herner)

A95-91642* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LIFE SUPPORT TECHNOLOGY INVESTMENT STRATEGIES FOR FLIGHT PROGRAMS: AN APPLICATION OF DECISION ANALYSIS

NELSON J. SCHLATER, CHARLES H. SIMONDS, and MARK G. BALLIN NASA Ames Research Center, US (ISSN 0148-7191) 1993 16 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 (SAE PAPER 932064; HTN-95-21073) Copyright

Applied research and technology development (R&TD) is often characterized by uncertainty, risk, and significant delays before tangible returns are obtained. Given the increased awareness of limitations in resources, effective R&TD today needs a method for up-front assessment of competing technologies to help guide technology investment decisions. Such an assessment approach must account for uncertainties in system performance parameters, mission requirements and architectures, and internal and external events influencing a development program. The methodology known as decision analysis has the potential to address these issues. It was evaluated by performing a case study assessment of alternative carbon dioxide removal technologies for NASA's proposed First Lunar Outpost program. An approach was developed that accounts for the uncertainties in each technology's cost and performance parameters as well as programmatic uncertainties such as mission architecture. Life cycle cost savings relative to a baseline, adjusted for the cost of money, was used as a figure of merit to evaluate each of the alternative carbon dioxide removal technology candidates. The methodology was found to provide a consistent decision-making strategy for the development of new life support technology. The case study results provided insight that was not possible from more traditional analysis approaches.

Author (Herner)

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ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM SELECTION FOR THE FIRST LUNAR OUTPOST HABITAT

ALAN ADAMS NASA George C. Marshall Space Flight Center, US (ISSN 0148-7191) 1993 8 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 (SAE PAPER 932065; HTN-95-21074) Copyright

The planning for and feasibility study of an early human return mission to the lunar surface has been undertaken. The First Lunar Outpost (FLO) Mission philosophy is to use existing or near-term technology to achieve a human landing on the lunar surface in the year 2000. To support the crew the lunar habitat for the FLO mission incorporates an environmental control/life support system (ECLSS) design which meets the mission requirements and balances fixed mass and consumable mass. This tradeoff becomes one of regenerable life support systems versus open-loop systems.

Author (Herner)

A95-91644

FUNCTIONS EFFECTIVENESS MODEL FOR DESIGN OF INTEGRATED REGENERATIVE LIFE SUPPORT SYSTEM

EDWARD A. KURMAZENKO Moscow Aviation Institute, Moscow, Russia (ISSN 0148-7191) 1993 13 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 (SAE PAPER 932066; HTN-95-21075) Copyright

This paper deals with the Functions Effectiveness Model (FEM) for Design of the Integrated Regenerative Life Support Systems (IRLSS) based on the physico-chemical methods of the crew metabolic-waste products transformation to controlled components of human environment and intended for the initial problem solution of the

IRLSS technology synthesis. The Functions Effectiveness Model of the IRLSS is utterly based on the conceptual model of the Manned Orbital Station Ecologic-Technical System, which includes the IRLSS and links of the environment: the Space Station Design, the Space-ship crew (CREW), the Space Cabin Atmosphere (SCA), the Thermal Control System (ThCS), the Energetic-Support System (ESS) and the Auxiliary Systems (AS). The approach under consideration is based on the application the global criterion of the IRLSS effectiveness in the form of the optimization thermal-economic goal function, metric criteria for the preliminary contraction of technology alternative variants set, and effectiveness model application for the solution of the design different problems as well as for the solution of the rational utilization energy problem are discussed.

Author (Herner)

A95-91645

NUTRITIONAL BEHAVIOR OF PEOPLE DURING A TWO MONTH DURATION ISOLATION AND CONFINEMENT SIMULATION

E. KIHM, G. DEVIDTS, H. MILON, B. DECARLI, AM. ADINE, MC. CAMBRAY, V. POLYAKOV, and A. AGUREEV (ISSN 0148-7191) 1993 6 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 (Contract(s)/Grant(s): ESA-7581/88/F/HEW(SC); ESA-8687/89/SC/BZ(SC))

(SAE PAPER 932067; HTN-95-21076) Copyright

A simulation campaign, EXEMSI, organized by the ESA Long Term Program Office was held from Sept. 7th to Nov. 6th 1992 in Germany. The crew- three men and one woman- was placed in confined and isolated living conditions in a hyperbaric chamber, thus simulating a space environment. During this two-month period, a nutritional investigation was conducted with a twofold objective: From an operational standpoint, to define and setup the food system; from a scientific standpoint, to collect data on the spontaneous nutritional behavior of the crew. In this scope, a well-defined food system was implemented. For food management and on line nutritional data collection, dedicated software has been developed. This software based on using barcodes permitted accurate recording of food consumption for each crew member. Nutritional assessments were then performed daily for each crewmember-or EMSInaut-by summing the nutritional values of all the foods consumed. This paper presents the main features of the food system for EXEMSI as well as the results of the nutritional investigation conducted.

Author (Herner)

A95-91649

WATER SUPPLY ASSEMBLY FOR HERMES ECLSS

MARC DUBOIS, BERNARD MULLENDER, GUY BEKAERT, REINHARD SCHNEIDER, and ROLF STRITTMATTER (ISSN 0148-7191) 1993 8 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993 (SAE PAPER 932071; HTN-95-21080) Copyright

The Water Supply Assembly (WSA) is part of the Liquid Management Section (LMS) of the Hermes Environmental Control and Life Support Subsystem (ECLSS). The WSA has to provide pure water for drinking and food preparation (rehydration of dry food and beverage powder) and to provide pure water for hygiene purposes (oral hygiene and towel wetting). To obtain different desired temperatures (as well as different quantities of water to be dispensed), a heating device, using electrical foils, and a cooling device, using a water/water heat exchanger have been designed with regard to the critical mass and power requirements. Two dispensers are used to fill food/beverage or hygiene (towels) containers. As part of the Hermes C1 phase, breadboard models of the heating device (heater) and of the cooling device (chiller) have been manufactured and functionally tested.

Author (Herner)

A95-91650

WATER CONDITIONING ASSEMBLY FOR HERMES ECLSS

MARC DUBOIS, PAUL VANDERSTRAETEN, GUY BEKAERT, REINHARD SCHNEIDER, ROLF STRITTMATTER, CHRIS VANDERPOORTEN, PHILIPPE GEORIS, OLIVIER ROUSSELLE,

and JEAN-CLAUDE LEGROS (ISSN 0148-7191) 1993 10 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993
(SAE PAPER 932072; HTN-95-21081) Copyright

This paper presents results of new development work carried out in the context of the Water Conditioning Assembly (WCA) which is part of the Liquid Management Section (LMS) of the Hermes Environmental Control and Life Support Subsystem (ECLSS). Its task is to condition and monitor the quality of highly pure water which has been produced in two fuel-cell stacks by the oxidation of hydrogen. This water will be used for different cooling elements (e.g. water evaporator, watersublimator) and as potable water for drinking and food purposes. The assembly consists mainly of a hydrogen separator, a monitoring and measurement device, a water disinfection device using iodine and a gas trap. This paper presents the selected design concepts of the main constituents. Based on these concepts breadboard models of the H2 separator and of the water quality monitoring device are described. The results of several test series, namely for functional efficiency, hydraulics, matrix expansion, contamination by KOH, influence of temperature, and the relation between conductivity and pH value are presented. The conclusions and the analysis for further development work are then explained.
Author (Herner)

A95-91651*

PERFORMANCE OF HIGH-RECOVERY RECYCLING REVERSE OSMOSIS WITH WASH WATER

CAL C. HERRMANN University of California, Berkeley, CA, US (ISSN 0148-7191) 1993 5 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(Contract(s)/Grant(s): NAS2-13273)

(SAE PAPER 932073; HTN-95-21082) Copyright

Inclusion of a recycling loop for partially-desalted water from second-stage reverse-osmosis permeate has been shown useful for achieving high-recovery at moderate applied pressures. This approach has now been applied to simulated wash waters, to obtain data on retention by the membranes of solutes in a mixture comparable to anticipated spacecraft hygiene wastewaters, and to generate an estimate of the maximum concentration that can be expected without causing membrane fouling. A first experiment set provides selectivity information from a single membrane and an Igepon detergent, as a function of final concentration. A reject concentration of 3.1% Total Organic Carbon has been reached, at a pressure of 1.4 Mega Pascals, without membrane fouling. Further experiments have generated selectivity values for the recycle configuration from two washwater simulations, as a function of applied pump pressure. Reverse osmosis removal has also been tested for washwater containing detergent formulated for plant growth compatibility (containing nitrogen, phosphorous and potassium functional groups.)
Author (Herner)

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ELECTRODIALYSIS SIMULATION TO ACHIEVE OPTIMUM CURRENT DENSITY

CAL C. HERRMANN University of California, Berkeley, CA, US (ISSN 0148-7191) 1993 4 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(Contract(s)/Grant(s): NAS2-13273)

(SAE PAPER 932074; HTN-95-21083) Copyright

Electrodialysis is used to remove salts from waste or other water streams, to yield a concentrated brine and a substantially deionized product water. During the electrodialysis process, the boundary layer adjacent to the ion selective membrane can become depleted of ions, resulting in severe pH changes sometimes accompanied by precipitation, and power losses, by a process known as water splitting. In order to optimize the applied electric current density, to achieve maximum deionization without exceeding the limiting current at any point along the path, a simulation program has

been created to plot ion concentrations and fluxes, and cell current densities and voltages along the electro dialysis path. A means for tapering the current density along the path is recommended.

Author (Herner)

A95-91653

HYDRODYNAMIC AND HEAT-AND-MASS TRANSFER PROCESSES IN SPACE STATION WATER RECOVERY SYSTEMS

N. M. SAMSONOV NPO NIICHIMMASH, Russia, L. S. BOBE NPO NIICHIMMASH, Russia, V. M. NOVIKOV NPO NIICHIMMASH, Russia, G. H. ABRAMOV NPO NIICHIMMASH, Russia, V. B. ASTAFIEV NPO NIICHIMMASH, Russia, B. JA. PINSKI NPO NIICHIMMASH, Russia, and N. N. PROTASOV NPO Energia, Russia (ISSN 0148-7191) 1993 10 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932075; HTN-95-21084) Copyright

This paper systematizes typical hydrodynamic and heat-and-mass transfer chemical engineering processes realized in water recovery systems. The impact of microgravity on the process is analyzed and general principles of the process organization in gas/liquid fluids are described. As examples, some typical separation processes in a cocurrent flow channel with liquid suction through a porous wall, liquid evaporation into a vapor/gas fluid and a vapor condensation from the vapor/gas mixture are considered for water recovery systems. A versatile approach based on an extended analogy between friction, heat transfer and mass transfer and on limited relative laws of a boundary layer at the permeable surface is suggested for an analysis and calculation of the friction resistance of a two-phase flow, heat transfer and mass transfer on evaporation and condensation. Recommendations for an analysis of the influence of free convection are made. The results obtained may be used for new system designs for future space stations.

Author (Conwal)

A95-91654

A PHYSICO/CHEMICAL SYSTEM FOR HYGIENE WASTE WATER RECOVERY

N. M. SAMSONOV NPO NIICHIMMASH, Russia, N. S. FARAFONOV NPO NIICHIMMASH, Russia, S. S. BOCHAROV NPO NIICHIMMASH, Russia, G. H. ABRAMOV NPO NIICHIMMASH, Russia, V. V. KOMOLOV NPO Energia, Russia, A. A. BERLIN IMBP, Russia, N. N. PROTASOV NPO Energia, Russia, and V. B. FILONENKO NPO VNIIGIDROMASH, Russia (ISSN 0148-7191) 1993 4 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932076; HTN-95-21085) Copyright

This paper deals with some aspects and results of research in major processes and hardware of a system for hygiene waste water recovery and its architecture concepts. A principal system schematic and its functions on the MIR space station are presented. It is shown that physico-chemical means ensure cost-effective recovery with minimum energy demand and resupply which is particularly important for long-duration space missions.
Author (Herner)

A95-91655

A PHYSICAL/CHEMICAL SYSTEM FOR WATER AND ATMOSPHERE RECOVERY ABOARD A SPACE STATION

N. M. SAMSONOV NPO NIICHIMMASH, Russia, N. S. FARAFONOV NPO NIICHIMMASH, Russia, V. M. NOVIKOV NPO NIICHIMMASH, Russia, G. H. ABRAMOV NPO NIICHIMMASH, Russia, L. S. BOBE NPO NIICHIMMASH, Russia, A. JA. PODRUGIN NPO NIICHIMMASH, Russia, L. I. GAVRILOV NPO NIICHIMMASH, Russia, JU. E. SINJAK IMBP, Russia, E. I. GRIGOROV NPO Energia, Russia, and E. N. ZAITSEV NPO Energia, Russia (ISSN 0148-7191) 1993 10 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(SAE PAPER 932077; HTN-95-21086) Copyright

The paper deals with the problems of development of physico-

chemical systems for water recovery and atmosphere revitalization for long-duration space stations. Schematics of regenerative life support systems featuring a high degree of closure and biotechnological components are presented. A year-long experiment has proved the possibility for man to stay in a closed artificial environment for a long time by consuming substances regenerated by physico-chemical means from end products of life. A complex of the life support systems (LSS) on Mir space station allowing for oxygen and 90% water recovery as well as its future updating is considered.

Author (Herner)

A95-91662* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PRELIMINARY ANALYSIS OF A MEMBRANE-BASED ATMOSPHERE-CONTROL SUBSYSTEM

SCOTT B. MCCRAY, DAVID D. NEWBOLD, ROD RAY, and KATHRYN OGLE NASA Marshall Space Flight Center, US (ISSN 0148-7191) 1993 9 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(Contract(s)/Grant(s): NAS8-38902; NAS8-39361) (SAE PAPER 932088; HTN-95-21093) Copyright

Controlled ecological life support systems will require subsystems for maintaining the concentrations of atmospheric gases within acceptable ranges in human habitat chambers and plant growth chambers. The goal of this work was to develop a membrane-based atmosphere control (MBAC) subsystem that allows the controlled exchange of atmospheric components (e.g., oxygen, carbon dioxide, and water vapor) between these chambers. The MBAC subsystem promises to offer a simple, nonenergy intensive method to separate, store and exchange atmospheric components, producing optimal concentrations of components in each chamber. In this paper, the results of a preliminary analysis of the MBAC subsystem for control of oxygen and nitrogen are presented. Additionally, the MBAC subsystem and its operation are described.

Author (Herner)

A95-91663* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALYSIS OF A MEMBRANE-BASED CONDENSATE RECOVERY HEAT EXCHANGER (CRX)

D.D. NEWBOLD (ISSN 0148-7191) 1993 7 p. SAE, International Conference on Environmental Systems, 23rd, Colorado Springs, CO, July 12-15, 1993

(Contract(s)/Grant(s): NAS2-13612; NAS2-13345) (SAE PAPER 932089; HTN-95-21094) Copyright

The development of a temperature and humidity control system that can remove heat and recover water vapor is key to the development of an Environmental Control and Life Support System (ECLSS). Large quantities of water vapor must be removed from air, and this operation has proven difficult in the absence of gravity. This paper presents the modeling results from a program to develop a novel membrane-based heat exchanger known as the condensate recovery heat exchanger (CRX). This device cools and dehumidifies humid air and simultaneously recovers water-vapor condensate. In this paper, the CRX is described and the results of an analysis of the heat- and mass-transfer characteristics of the device are given.

Author (Herner)

A95-91707

OWNERSHIP AND ACCOUNTABILITY - THEY'RE NOT JUST BUZZWORDS

P. HOBBS and I. M. RUSSELL 1991 7 p. AeroTech 92: The Aerospace & Airport Technology Exhibition & Congress, UK, 1992, (Seminar 14: Design of Competitive Manufacturing Systems 1) (CONGRESS PAPER C428-14-201; HTN-95-21138) Copyright

It is widely recognized that people and their attitudes are the key to the success of any organization. In these days of ever increasing competition, traditional reactive approaches and attitudes result in the closure of many companies. A change in attitude is required. People at all levels need to be committed and willing to participate in pursuing the goals of the organization. This paper looks at the way in which a 'traditional' manufacturing company is begin-

ning to change the attitudes of its workforce by increasing ownership and accountability.

Author (Herner)

A95-91708

CELLULAR MANUFACTURING - DESIGN AND IMPLEMENTATION

I. K. STRANGWARD HDA Forgings Ltd, Redditch, UK 1991 14 p. AeroTech 92: The Aerospace & Airport Technology Exhibition & Congress, UK, 1992, (Seminar 14: Design of Competitive Manufacturing Systems 1)

(CONGRESS PAPER C428-14-202; HTN-95-21139) Copyright

H. D. A. Forgings Ltd embarked on a Manufacturing Redesign Program in 1989. The company has achieved major changes in plant layout, working practices, etc. by the design and implementation methodologies utilized and shows the significant benefits achieved.

Author (Herner)

A95-91709

BLENDING PEOPLE AND TECHNOLOGY

M. G. FRANCIS Lucas Aerospace Ltd, Burnley, UK 1991 6 p. AeroTech 92: The Aerospace & Airport Technology Exhibition & Congress, UK, 1992, (Seminar 14: Design of Competitive Manufacturing Systems 1)

(CONGRESS PAPER C428-14-203; HTN-95-21140) Copyright

The drive to produce world class standards of competitive performance has put even greater emphasis on how companies effectively employ all their people resources. In 'Blending People and Technology' one of the Lucas Aerospace Businesses, the Defence Fabrications Division which is based in Burnley, Lancashire, UK, is taken as a case study to show how by combining major changes in traditional UK work practices with focus capital investment a quite dramatic improvement in business performance can be achieved.

Author (Herner)

A95-91850

EFFECTS OF LAGS ON HUMAN OPERATOR TRANSFER FUNCTIONS WITH HEAD-COUPLED SYSTEMS

RICHARD H. Y. SO University of Southampton, England, UK and MICHAEL J. GRIFFIN University of Southampton, England, UK Aviation, Space, and Environmental Medicine (ISSN 0095-6562) vol. 66, no. 6 June 1995 p. 550-556 Research sponsored by the European Office of Aerospace Research and Development (HTN-95-92912) Copyright

The effects of operator learning and target velocity on head tracking performance with and without lags has been studied. Five lags (0, 40, 80, 120, 160 ms) between head movement and target image movement, and three target velocities (2, 3.5, 5 deg/s r.m.s.) were investigated with eight male subjects and band-limited random target motions. Head tracking transfer functions, tracking error spectra, mean radical tracking error, and subjective difficulty ratings were obtained. Head tracking performance was significantly degraded by lags greater than, or equal to, 40 ms (in addition to a system lag of 40 ms). Both the input-correlated tracking error and the uncorrelated tracking error increased with increasing lag. No significant improvement in head tracking performance was found through practice with an 80-ms lag. As the lag increased, operators increased their gains at frequencies above about 0.5 Hz and reduced their phase lags at low frequencies (about 0.1 Hz) but failed to fully compensate for the increased display lag. The increased human operator gain was associated with increased operator phase lag at higher frequencies (above 0.5 Hz). To improve head tracking performance in the presence of lags, a lag compensation technique is needed to prevent undesirable changes in tracking strategy.

Author (Herner)

N95-28683 Systems Research Labs., Inc., Dayton, OH.

GENERATOR OF BODY DATA (GEBOD) MANUAL Final Report, Apr. 1991 - Mar. 1994

HUAINING CHENG, LOUISE OBERGEFELL, and ANNETTE RIZER Mar. 1994 71 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A289721; AL/CF-TE-1994-0051) Avail: Issuing Activity (De-

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

fense Technical Information Center (DTIC))

The Generator of Body Data (GEBOD) program is an interactive computer program that produces the human and dummy body description data used by the Articulated Total Body (ATB) model. GEBOD computes the body segments' geometric and mass properties, and the joints' locations and mechanical properties. These data may be computed for children, adult human males, adult human females, or anthropomorphic dummies. This report is a comprehensive manual that covers the applicable material from earlier reports and the most recent upgrades to the GEBOD program, including improved height calculations. The user's guide section of the report describes how to run the program and what options are available. A more detailed description of how the data is generated and on what studies the calculations are based is included in the program description section. Also included are a brief history of GEBOD's development, a detailed description of GEBOD program subroutines, and example output files. DTIC

N95-28792# Armstrong Lab., Brooks AFB, TX. Crew Systems Directorate.

TEST AND EVALUATION OF THE IMPACT INSTRUMENTATIONS, INC. UNI-VENT MODEL 750M VENTILATOR Interim Report, Oct. 1993 - Jun. 1994

MARY L. THOMAS Nov. 1994 23 p
(Contract(s)/Grant(s): DA PROJ. 793-0)
(AD-A292321; AL/CF-TR-1994-0112) Avail: CASI HC A03/MF A01

The Aeromedical Research Function tested and evaluated the Uni-Vent 750M ventilator for use on aeromedical evacuation aircraft in response to a request from the Director, Aeromedical Evacuation and Medical Plans and Requirements, Human Systems Center at Brooks AFB. A collaborative evaluation was conducted with the U.S. Army Aeromedical Research Laboratory, Ft. Rucker, Alabama. The Impact Instrumentations, Inc. Uni-Vent Model 750M ventilator was found acceptable for use on cargo aircraft used for USAF aeromedical evacuation. DTIC

N95-28794# Army Natick Research and Development Command, MA.

AN ANALYSIS OF ANTHROPOMETRIC DIFFERENCES AMONG OCCUPATIONAL GROUPS IN THE US ARMY Final Report, Dec. 1991 - Jul. 1992

THOMAS M. GREINER, CLAIRE C. GORDON, and ELIZABETH A. CARSON Jan. 1995 73 p
(AD-A292326; NATICK/TR-95/016) Avail: CASI HC A04/MF A01

This report addresses the design relevance of anthropometric differences among occupation groups in the U.S. Army. The analysis is based upon the examination of 15 body dimensions of Army enlisted men and women within 10 broadly defined occupation groups (Career Management Fields or CMF's). The membership of each occupation group comprises unique age, race, and sex proportions. Statistical analyses (ANOVA) show that observed differences among CMF's were most strongly associated with these demographic proportions. Still, observable anthropometric differences among groups were very small. Clothing and equipment designs would have to be extremely sensitive to be influenced by these differences. These findings suggest that the anthropometric relationships among CMF's may change as the demographic proportions of the Army population change. Thus, it appears that clothing and equipment designers should be more concerned with the impact of anthropometric differences due to race and sex than to the differences among occupation groups. DTIC

N95-28935 Naval Biodynamics Lab., New Orleans, LA. **OPERATING PROCEDURES FOR ANTHROPOMETRY AND INITIAL CONDITIONS PHOTOGRAMMETRIC PROGRAM Final Report**

DOROTHY A. FRANCIS Mar. 1994 188 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(Contract(s)/Grant(s): MR00-97)
(AD-A291553; NBDL-93R010) Avail: Issuing Activity (Defense

Technical Information Center (DTIC))

This publication provides documentation of the Anthropometry and Initial Conditions Photogrammetric Program used on an IBM-compatible 486 personal computer at the Naval Biodynamics Laboratory in New Orleans, LA. DTIC

N95-28969# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

TASK-DEPENDENT EFFECTS OF AUTOMATION: THE ROLE OF INTERNAL MODELS IN PERFORMANCE, WORKLOAD, AND SITUATIONAL AWARENESS IN A SEMI-AUTOMATED COCKPIT Final Report, Dec. 1991 - Dec. 1993

MEGHAN A. CARMODY 1 Mar. 1994 462 p
(AD-A292538; NAWCADWAR-94140-60) Avail: CASI HC A20/MF A04

The present study investigated the effects of automating different aviation tasks on a pilot's ability to regain manual control following automation failure. The investigation employed a version of the Multi-Attribute Task (MAT) battery (Comstock and Arnegard, 1990) which presents subjects three aviation-relevant tasks: A Tracking task, a System Monitoring task, and a Fuel Management task. Specifically, this study examined task-specific effects on performance, workload, and situational awareness of removing the human operator from the control loop for long periods of time and then requiring him/her to suddenly reenter that loop. A hypothesized task distinction was formulated on the basis of the dynamic versus stable qualities of the internal cognitive model guiding the decision-making process within a particular task. This distinction is presented within the context of a theoretical model of human decision-making in complex, semi-automated cockpits. Results indicated task-specific effects of automation on human performance. Furthermore, data regarding task-specific effects of automation on situational awareness were strongly indicative of the hypothesized distinctions. DTIC

N95-28970# Naval Air Warfare Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.

CURRENT ISSUES IN THE MEASUREMENT OF MILITARY AIRCREW PERFORMANCE: A CONSIDERATION OF THE RELATIONSHIP BETWEEN AVAILABLE METRICS AND OPERATIONAL CONCERNS Final Report, Oct. - Dec. 1993

MEGHAN A. CARMODY 1 Mar. 1994 67 p
(AD-A292539; NAWCADWAR-94139-60) Avail: CASI HC A04/MF A01

This report discusses the primary categories of metrics used by DoD researchers to assess human performance in the aviation domain. In addition to outlining the categories and several representative metrics, various approaches are evaluated on the basis of pre-defined measurement criteria as well as the specific considerations and limitations of the particular testing environment. DTIC

N95-29020# Boeing Defense and Space Group, Seattle, WA. **INTERACTIVE MULTIMEDIA PRESENTATION FOR APPLIED COMPUTER TOMOGRAPHY: IMPACT Interim Report, 1 Jan. 1993 - 1 Jun. 1994**

RICHARD H. BOSSI and ROBERT J. KRUSE Jun. 1994 29 p
(Contract(s)/Grant(s): F33615-88-C-5404)
(AD-A291955; WL-TR-94-4099) Avail: CASI HC A03/MF A01

An interactive multimedia presentation has been developed for viewing on a Macintosh workstation that summarizes the results of the 'Advanced Development of X-ray Computed Tomography Applications' demonstration (CTAD) program. The Interactive Multimedia Presentation for Applied Computed Tomography (IMPACT) package includes the following areas: (1) conclusions and recommendations; (2) X-ray computed tomography; (3) CT application stories; (4) interactive imaging program; and (5) for more information. The 'Advanced Development of X-ray Computed Tomography Applications' demonstration (CTAD) program, sponsored by Wright Laboratory, generated significant amounts of data and conclusions on the application of X-ray computed tomography (CT) to aircraft structures, materials and components. Over 18 formal technical reports

have been written for WL publication. The approach for summarizing the data has been to create a presentation package for use on a Macintosh computer containing the major conclusions of the CTAD program with a number of specific examples. The package can be used by an individual to review information or can be used by a presenter to an audience with an LCD screen and overhead projector. The interactive multimedia allows the users to move through the material at their pace, entering deeper levels of detail as desired. The presentation contains the summary conclusions of the CTAD program, background material on basic X Ray CT, examples of the applications of computed tomography that were demonstrated in the CTAD program, an image processing program for demonstrating CT image analysis, and references for more information. The CD presentation package is available from Wright Laboratory. DTIC

N95-29180* Lockheed Engineering and Sciences Co., Washington, DC.

LOCKHEED STABILIZER SYSTEM FOR SPACE EXERCISE EQUIPMENT (Videotape)

25 Feb. 1992 Sponsored by NASA, Washington Videotape: 5 min. playing time, in color, without sound (NASA-CR-197657; HQ-91-03N; NONP-NASA-VT-95-46004) Avail: CASI VHS A02/BETA A22

Through the use of computer animation, the Lockheed Stabilizer System for spaceborne exercise equipment is shown. A bicycle mounted onto a shuttle floor demonstrates the range of vibrations that occur without the Lockheed Stabilizer. There is animation of the stabilizer system's tests and normal protein crystal growth in microgravity environments. Actual short clips of astronauts exercising in space are also presented. CASI

N95-29359# Naval Command, Control and Ocean Surveillance Center, San Diego, CA.

IMPROVED OPERATOR AWARENESS OF TELEOPERATED LAND VEHICLE ATTITUDE Final Report, Jun. 1990 - Jun. 1992

TRACY HEATH PASTORE Jun. 1994 34 p (AD-A290443; NRAD-TR-1659) Avail: CASI HC A03/MF A01

The operator of a teleoperated land vehicle must have a sufficient understanding of the attitude of a remote vehicle to successfully operate it in an unstructured outdoor environment. The goal of this effort was to develop a human-machine interface that provides sufficient remote vehicle attitude information while minimally impacting operator workload. Referencing the remote video sensors to the earth's gravitational field was proposed as a means of providing vehicle attitude information to the operator. The hood of the remote vehicle appeared in the video image and served as a two-dimensional artificial horizon, providing the operator with vehicle pitch and roll information in a natural, nonintrusive manner. The effectiveness of gravity-referencing the sensors was experimentally tested and compared with vehicle-referencing the sensors on the same teleoperator system. Experimental results confirmed that gravity-referencing the sensors provided the operator with improved vehicle attitude information. In addition, results showed a significantly higher level of operator confidence in vehicle attitude awareness with the gravity-referencing method. A minimal increase in operator workload was also documented for the method of gravity-referencing. DTIC

N95-29365# Federal Aviation Administration, Oklahoma City, OK. Human Resources Research Div.

A HUMAN FACTORS EVALUATION OF THE OPERATIONAL DEMONSTRATION FLIGHT INSPECTION AIRCRAFT Final Report

M. D. RODGERS, ed. May 1995 25 p (DOT/FAA/AM-95/18) Avail: CASI HC A03/MF A01

These reports describe the data collection and analysis efforts performed by the Civil Aeromedical Institute's Human Factors Research Laboratory to assist the Office of Aviation System Standards (AVN) in the human factors evaluation of the Operational Demonstration (Ops Demo) candidate flight inspection aircraft (FIA).

Although there was not sufficient time to conduct an exhaustive human factors evaluation of the Ops Demo FIA, several efforts were undertaken to assist in the determination of the suitability of the proposed aircraft for integration of flight inspection equipment and performance of the flight inspection mission. These efforts included an evaluation of flight inspection pilot and technician preferences for certain aircraft characteristics, an evaluation of aircraft cabin noise levels, an anthropometric familiarization for flight inspection pilots and technicians participating in the Ops Demo, and an evaluation of the proposed flight inspection workstation design for the medium-size, medium-range (MSR) aircraft. Author

N95-29378# Army Tank-Automotive Command, Warren, MI.
RIDE MOTION SIMULATOR (RMS) TESTING USING HUMAN OCCUPANTS Final Report, 17 Oct. - 4 Nov. 1994

ANNMARIE BERGER Dec. 1994 16 p (AD-A292641; TARDEC-TR-13660) Avail: CASI HC A03/MF A01

The objective of this report is to summarize the results of using human occupants in the RMS during the Crewmans Associate Job. This report does not address the subjective data obtained on the helmet mounted displays and controllers preferability and usability. This report will be submitted to the Human Use Committee and describes the tests conducted. DTIC

N95-29600 Office of Naval Research, Arlington, VA.

INFLATABLE LIFE VEST Patent Application

CLEVELAND A. HEATH, inventor (to Navy) and MAURICE W. ROY, inventor (to Navy) 30 Sep. 1994 17 p Filed 30 Sep. 1994 Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-D017273; NAVY-CASE-75646; US-PATENT-APPL-SN-316709) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

An inflatable life vest comprises two sheets of polymeric material. The edges of these sheets are sealed to form an inner cavity with a plurality of discrete, inflatable chambers disposed in a U-shaped pattern to define collar and chest portions of the life vest. A manifold connects to an inflation source and has a plurality of openings. A check valve connects each manifold opening with one of the chambers to permit inflation medium flow into the chamber and to block inflation medium flow outwardly from a chamber into the manifold. This construction isolates the chambers from one another so the rupture of one chamber does not affect the ability of the other chambers to be buoyant. DTIC

N95-29624# Department of the Air Force, Brooks AFB, TX. Armstrong Lab.

AEROMEDICAL IMPACT OF THE TRANSPORTABLE PRESSURE VENTILATOR IN WARTIME AEROMEDICAL EVACUATION

L. RICHARDSON and R. MUNSON *In* AGARD, Recent Issues and Advances in Aeromedical Evacuation (MEDEVAC) 5 p Feb. 1995 Copyright Avail: CASI HC A01/MF A02

Mechanical ventilation permits the early air transport of patients in respiratory failure. Ventilator-dependent patients have been successfully air transported since the 1970's in the United States Air Force (U.S.A.F.) peacetime aeromedical evacuation system. The selection of suitable ventilation equipment, patient management and related safety issues, such as ventilator performance characteristics during rapid decompression, have been previously reviewed. During peacetime aeromedical operations, space is not usually an issue and volume ventilators are generally used. During wartime operations the bulky volume ventilator and the 100 volt AC (VAC) at 60 Hz electrical power converter are not readily available and take up too much space to be used on the C-130 and C-141 aircraft opportunely diverted from cargo missions to perform aeromedical evacuation. Each litter station in these cargo aircraft can hold up to ten litter patients. When a volume ventilator-dependent patient requires air transport, the litter station is typically reduced to only one or two litters. Recent conflicts such as Operations Just Cause and Desert Storm have refocused the need to provide acute care while enroute to definitive care. The projected large numbers of litter

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

casualties and the potential increased demand for ventilator support for biological chemical or burn injuries during Desert Storm resulted in the distribution of the TXP ventilator to U.S.A.F. Aeromedical Staging Facilities. Use of the TXP ventilator has the potential of reclaiming the eight or nine litter positions lost during the air transport of a volume ventilator-dependent patient due to its ability to be attached to the patient's litter. Derived from text

N95-29626# Department of the Air Force, Scott AFB, IL.
CARE IN THE AIR: A SYSTEM ANALYSIS OF CLINICAL OUTCOMES IN AEROMEDICAL EVACUATION

ARLEEN M. SAENGER In AGARD, Recent Issues and Advances in Aeromedical Evacuation (MEDEVAC) 7 p Feb. 1995
Copyright Avail: CASI HC A02/MF A02

In 1993 a clinical outcomes study of the Continental United States (CONUS) Aeromedical Evacuation (AE) system was undertaken. Between 15 Feb. and 31 Oct. 1993, AE patients were screened for a series of adverse clinical outcome indicators and process discrepancy indicators. Rates were determined for each of the indicators. Defense Medical Regulating Information System (DMRIS) records were reviewed to obtain patients' demographic data. Correlations between diagnoses and adverse clinical outcomes were evaluated. During AE missions the adverse clinical outcome rate was 0.9 per 1000 patients. Unanticipated need for O₂ and development of chest pain in flight accounted for 73 percent of the in-flight adverse outcomes and occurred primarily in cardiac patients. The process discrepancy rate was 10 per 1000 patients - 10 times the adverse outcome rate. For patients remaining over night in Aeromedical Staging Facilities the adverse outcome rate was 2.9 per 1000 patients. ENT barotrauma accounted for 66 percent of these patients. The adverse clinical outcome rate for peacetime AE patients is very low. Patients with limited cardiopulmonary reserve are at higher risk during AE. During wartime and military operations other than war, AE patients are more likely to have limited cardiopulmonary reserve and be at higher risk due to injuries, malnutrition, or limited medical care prior to flight. Special attention to oxygen requirements, altitude restrictions, complete documentation of care required en route, and proper selection of medical attendants are crucial for good outcomes in AE. Author

N95-29908# Computer Technology Associates, Inc., McKee City, NJ.

VISUAL AND AUDITORY SYMBOLS: A LITERATURE REVIEW

JAMES P. DUNCANSON Oct. 1994 69 p
(AD-A290222; DOT/FAA/CT-TN-94/37) Avail: CASI HC A04/MF A01

This report is a review of the human factors literature on visual and auditory symbols. The review is the first step in an effort to develop a set of standard symbols for use throughout Airway Facilities. The topics included in the review are: general principles, experimental findings, and standard guidelines. The report also includes an annotated bibliography and a list of possible research topics suggested by gaps in the experimental findings. DTIC

N95-29943# Dayton Univ., OH. Research Inst.
DISTANCE ESTIMATION TRAINING WITH NIGHT VISION GOGGLES UNDER LOW ILLUMINATION Interim Report, Oct. - Dec. 1993

JACK D. REISING and ELIZABETH L. MARTIN Jan. 1995 27 p
(Contract(s)/Grant(s): F33615-90-C-0005)
(AD-A291338; AL/HR-TR-1994-0138) Avail: CASI HC A03/MF A01

Aircrews have reported significant problems in depth perception and distance estimation with night vision goggles (NVG's). The purpose of this experiment was to examine the value of a simple training procedure as a means of reducing errors. A pre/post-test design was used in which distance estimates for a training group and control group were compared. The results revealed significant reductions in errors and variability following exposure to the training

procedure. No significant reduction in errors and variability occurred with the control group. These results are consistent with a preliminary experiment using NVG's and earlier research using unaided vision. Issues for future research are also addressed. DTIC

N95-30267*# United Technologies Corp., Windsor Locks, CT. Hamilton Standard Div.

SPE(R)-OBOGS: ON-BOARD OXYGEN GENERATING SUSTEM Abstract Only

J. MCELROY and W. SMITH In NASA. Lewis Research Center, Space Electrochemical Research and Technology. Abstracts p 33 Apr. 1995

Avail: CASI HC A01/MF A01

Regulations require oxygen usage by commercial airline flight crews during check out and during certain aircraft configurations. This oxygen is drawn from a high pressure onboard pressure cylinder storage system. In a typical aircraft oxygen cylinder removal for oxygen ground servicing is conducted every 4 to 6 weeks. An on board oxygen generating system has been developed to eliminate the need for oxygen ground servicing. The SPE-OBOGS supplies oxygen during flight in a 'trickle charge' mode to replenish the consumed oxygen at pressures up to 1850 psi. The Electrochemical cell stack is the fundamental SPE-OBOGS system component. The same basic proton exchange membrane technology, previously used for the Gemini program fuel cells and currently used in nuclear submarines as oxygen generators, is used in the SPE-OBOGS. An in-service evaluation of the SPE-OBOGS is in the planning stage and a zero gravity version is being promoted for on orbit space suit oxygen system recharge. Summary results of the SPE-OBOGS development will be addressed. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A95-89205* National Aeronautics and Space Administration, Washington, DC.

PREBIOTIC CHEMISTRY IN SPACE; PROCEEDINGS OF SYMPOSIA B1.4 AND F3.3 OF THE COSPAR SCIENTIFIC ASSEMBLY, 30TH, HAMBURG, GERMANY, JULY 11-21,

1994 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 119 p.

(ISBN 0-08-042622-0; HTN-95-B0261) Copyright

A two-part symposium was held concerning topics in Solar System chemistry. The first part covered the organic chemistry of small bodies of the interplanetary medium. It produced papers on the evolution, spectral properties and composition of organic matter in comets, interplanetary dust and asteroids. The second part covered cryochemistry and exobiology in planetary atmospheres (gas giant planets and their satellites) and in various astronomical ices. For individual titles, see A95-89206 through A95-89220.

Herner

A95-89206* National Aeronautics and Space Administration, Washington, DC.

ORIGIN OF ORGANIC MATTER IN THE PROTOSOLAR NEBULA AND IN COMETS

J. M. GREENBERG Sterrewacht Leiden, Leiden, The Netherlands, O. M. SHALABIEA Sterrewacht Leiden, Leiden, The Netherlands, C. X. MENDOZA-GOMEZ Sterrewacht Leiden, Leiden, The Netherlands, W. SCHUTTE Sterrewacht Leiden, Leiden, The Netherlands, and P. A. GERAKINES Sterrewacht Leiden, Leiden, The Netherlands Prebiotic chemistry in space; Proceedings of Symposia B1.4 and F3.3 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-89205 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 p. (2)9-(2)16 (Contract(s)/Grant(s): NGR-33-018-148)

Copyright

Comet organics are traced to their origin in interstellar space. Possible sources of comet organics from solar nebula chemistry are briefly discussed. The infrared spectra of interstellar dust are compared with spectra of solar (space) irradiated laboratory organic residues and with meteorites. The spectra compare very favorably. The atomic composition of first generation laboratory organic residues compares favorably with that of comet Halley organics if divided into appropriate 'volatile' (less refractory) and 'refractory' (more refractory) complex organics. Author (Herner)

A95-89208
FORMATIONS OF AMINO ACID PRECURSORS IN
COMETARY ICE ENVIRONMENTS BY COSMIC RADIATION

K. KOBAYASHI Yokohama National University, Hodogaya-ku, Yokohama, Japan, T. KASAMATSU Yokohama National University, Hodogaya-ku, Yokohama, Japan, T. KANEKO Yokohama National University, Hodogaya-ku, Yokohama, Japan, J. KOIKE Tokyo Institute of Technology, Yokohama, Japan, T. OSHIMA Tokyo Institute of Technology, Yokohama, Japan, T. SAITO University of Tokyo, Tanashi, Tokyo, Japan, T. YAMAMOTO Institute for Space and Astronautical Science, Sagami-hara, Japan, and H. YANAGAWA Mitsubishi Kasei Institute of Life Sciences, Machida, Tokyo, Japan Prebiotic chemistry in space; Proceedings of Symposia B1.4 and F3.3 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-89205 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 p. (2)21-(2)26 (Contract(s)/Grant(s): MOESC-05833007; MOESC-05833011) Copyright

Cometary ices are believed to contain water, carbon monoxide, methane and ammonia, and are possible sites for the formation and preservation of organic compounds relating to the origin of life. Cosmic rays, together with ultraviolet light, are among the most effective energy sources for the formation of organic compounds in space. In order to study the possibility of the formation of amino acids in comets or their precursory bodies (interstellar dust grains), several types of ice mixtures made in a cryostat at 10 K ('simulated cometary ices') were irradiated with high energy protons. These results suggest the possible formation of 'amino acid precursors' (compounds yielding amino acids after hydrolysis) in interstellar dust grains by cosmic radiation. We previously reported that amino acid precursors were formed when simulated primitive planetary atmospheres were irradiated with cosmic ray particles. It will be of great interest to compare the amount of bioorganic compounds that were formed in the primitive earth and that brought by comets to the earth. Author (revised by Herner)

A95-89216
PHOTOLYSIS OF PHOSPHINE IN THE PRESENCE OF
ACETYLENE AND PROPYNE, GAS MIXTURES OF
PLANETARY INTEREST

J.-C. GUILLEMIN Universite de Rennes, Rennes Cedex, France, T. JANATI Universite de Rennes, Rennes Cedex, France, and L. LASALLE Universite de Rennes, Rennes Cedex, France Prebiotic chemistry in space; Proceedings of Symposia B1.4 and F3.3 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-89205 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 p. (2)85-(2)92 Research sponsored by the Programme Nationale de Planetologie Copyright

Phosphine (PH₃) has been observed in the atmospheres of Jupiter and Saturn. We have studied the photochemical reactions of this compound with acetylene (C₂H₂), an alkyne also detected in these atmospheres. The volatile products formed in these reactions were characterized by H-1, P-31 and C-13 NMR. The ethenylphosphine is the first product formed in the photolysis of PH₃ in the presence of C₂H₂. Photolysis of PH₃ in the presence of propyne (C₃H₄) led to the formation of the Z- and E- prop-1-enylphosphines and traces of 1-methylethenylphosphine. A reaction pathway is proposed. The initial step is the dissociation of PH₃

to hydrogen and PH₂ radicals. Addition of the phosphinyl radical on alkyne occurs as the next step. Vinylphosphines are then formed by radical combination. This proposed reaction pathway takes into account the nature of the products and studies devoted to the photolysis of germane (GeH₄) or hydrogen sulfide (H₂S) in the presence of alkyne. Attempts to detect methylidynephosphine in the photolysis products of PH₃-C₂H₂ mixtures were unsuccessful. The application of these findings to Jovian and Saturn atmospheric chemistry is discussed. Author (revised by Herner)

A95-89217
ORGANIC CHEMISTRY IN TITAN'S ATMOSPHERE: NEW
DATA FROM LABORATORY SIMULATIONS AT LOW
TEMPERATURE

P. COLL Universites Paris 12 and 7, Creteil Cedex, France, D. COSCIA Universites Paris 12 and 7, Creteil Cedex, France, M. C. GAZEAU Universites Paris 12 and 7, Creteil Cedex, France, E. DE VANNASAY Universites Paris 12 and 7, Creteil Cedex, France, J. C. GUILLEMIN Universite de Rennes, Rennes, France, and F. RAULIN Universites Paris 12 and 7, Creteil Cedex, France Prebiotic chemistry in space; Proceedings of Symposia B1.4 and F3.3 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-89205 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 p. (2)93-(2)103 Research sponsored by the French Space Agency Copyright

Many experiments have already been carried out to simulate organic chemistry on Titan, the largest satellite of Saturn. They can provide fruitful information on the nature of minor organic constituents likely to be present in Titan's atmosphere, both in gas and aerosol phases. Indeed, all the organic compounds but one already detected in Titan's atmosphere have been identified in simulation experiments. The exception, C₄N₂, as well as other compounds expected in Titan from theoretical modeling, such as other N-organics, and polyynes, first of all C₆H₂, have never been detected in experimental simulation thus far. All these compounds are thermally unstable, and the temperature conditions used during the simulation experiments were not appropriate. We have recently started a new program of simulation experiments with temperature conditions close to that of Titan's environment. It also uses dedicated analytical techniques and procedures compatible with the analysis of organics only stable at low temperatures, as well as solid products of low stability in the presence of O₂ and H₂O. Spark discharge of N₂-CH₄ gas mixtures was carried out at low temperature in the range 100-150 K. Products were analyzed by FTIR, GC and GC-MS techniques. GC-peaks were identified by their mass spectrum, and, in most cases, by comparison of the retention time and mass spectrum with standard ones. We report here the first detection in Titan simulation experiments of C₆H₂ and HC₅N. Their abundance is a few percent relative to C₄H₂ and HC₃N, respectively. Preliminary data on the solid products indicate an elemental composition corresponding to (H₁₁C₁₁N)(sub n). These results open new prospects in the modeling of Titan's haze making. Author (revised by Herner)

A95-89219* National Aeronautics and Space Administration, Washington, DC.

INFRARED SPECTROSCOPY OF ORGANICS OF
PLANETOLOGICAL INTEREST AT LOW TEMPERATURES

R. K. KHANNA University of Maryland, College Park, College Park, Maryland, US Prebiotic chemistry in space; Proceedings of Symposia B1.4 and F3.3 of COSPAR Scientific Assembly, 30th, Hamburg, Germany, July 11-21, 1994. A95-89205 Advances in Space Research (ISSN 0273-1177) vol. 16, no. 2 July 11, 1994 p. (2)109-(2)118 Copyright

In the context of prebiotic chemistry in space, some of the outer planetary objects display H, C, N and O rich chemistry similar to the one in the biosphere of Earth. Of particular interest are Saturn's moon, Titan; Neptune's moon, Triton; and Pluto where extreme cold

55 SPACE BIOLOGY

conditions prevail. Identifications of chemical species on these objects (surfaces and atmospheres) is essential to a better understanding of the radiation induced chemical reactions occurring thereon. There have been several ground based observations of these planetary objects in the infrared windows from 1 to 2.5 micrometers. Voyager also provided spectra in the thermal infrared (6 to 50 micrometers) region. Interpretation of these data require laboratory infrared spectra of relevant species under the temperature conditions appropriate to these objects. The results of some of these studies carried out in our laboratory and elsewhere and their impact on the analyses of the observed data will be summarized.

Author (revised by Herner)

A95-90727

ABSORPTION COEFFICIENT OF PROPYENITRILE IN THE MID-UV RANGE FOR THE STUDY OF TITAN'S

ATMOSPHERE: SOLUTION TO SAMPLE CONTAMINATIONS
DOMINIQUE ANDRIEUX CNRS, France, YVES BENILAN CNRS, France, ETIENNE DE VANSAY CNRS, France, PIERRE PAILLOUS CNRS, France, MOHAMED KHLIFI CNRS, France, FRANCOIS RAULIN CNRS, France, PAUL BRUSTON CNRS, France, and JEAN-CLAUDE GUILLEMIN CNRS, France Journal of Geophysical Research (ISSN 0148-0227) vol. 100, no. E5 May 25, 1995 p. 9455-9460 Research sponsored by the Programme National de Planetologie of the Institut National des Sciences de l'Univers (HTN-95-92809) Copyright

UV spectroscopy is a powerful diagnostic tool in the study of organic composition and chemical processes in planetary atmospheres such as that of Titan. The Spectroscopie UV d'Interet Prebiologique dans l'Atmosphere de Titan (SIPAT) laboratory experiment has been developed in order to systematically determine at high resolution the absorption coefficients of expected molecular absorbers in Titan's atmosphere, with the goal of interpreting mid-UV albedo spectra. We have studied the mid-UV absorption coefficient of propynenitrile (cyanoacetylene), which is a key compound in prebiotic chemistry. In spite of all the precautions taken during the synthesis of this compound, the samples studied contain impurities. Using complementary techniques, we have been able to characterize the impurities (mainly acetone and acetonitrile) in the propynenitrile gas sample. Thus, we present new absorption coefficients of propynenitrile determined at 298 K and at 0.02 nm resolution between 185 and 200 nm (the wavelength range where acetone presents strong absorption features). A precise determination of impurity mixing ratios affecting previously published spectra leads to a reevaluation and the establishment of associated uncertainty values for HC3N absorption coefficients in the 185- to 230-nm range. Finally, these data have been corrected for an erroneous wavelength calibration implying a 3 Å shift.

Author (Herner)

N95-28722*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EXPERIMENT KITS FOR PROCESSING BIOLOGICAL SAMPLES INFLIGHT ON SLS-2

P. D. SAVAGE, W. E. HINDS, R. JAQUEZ (Lockheed Engineering and Sciences Co., Moffett Field, CA.), J. EVANS (Lockheed Engineering and Sciences Co., Moffett Field, CA.), and L. DUBROVIN (Lockheed Engineering and Sciences Co., Moffett Field, CA.) May 1995 9 p

(Contract(s)/Grant(s): RTOP 106-30-02)

(NASA-TM-4685; A-950016; NAS 1.15:4685) Avail: CASI HC A02/MF A01

This paper describes development of an innovative, modular approach to packaging the instruments used to obtain and preserve the inflight rodent tissue and blood samples associated with hematology experiments on the Spacelab Life Sciences-2 (SLS-2) mission. The design approach organized the multitude of instruments into twelve 5- x 6- x 1-in. kits which were each used for a particular experiment. Each kit contained the syringes, vials, microscope slides, etc., necessary for processing and storing blood and tissue samples for one rat on a particular day. A total of 1245 components,

packaged into 128 kits and stowed in 17 Zero(registered trademark) boxes, were required. Crewmembers found the design easy to use and laid out in a logical, simple configuration which minimized chances for error during the complex procedures in flight. This paper also summarizes inflight performance of the kits on SLS-2.

Author

N95-28818*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN INFLIGHT REFILL UNIT FOR REPLENISHING RESEARCH ANIMAL DRINKING WATER

P. D. SAVAGE, M. L. HINES, and R. BARNES (Lockheed Engineering and Sciences Co., Moffett Field, CA.) May 1995 11 p
(Contract(s)/Grant(s): RTOP 106-30-02)
(NASA-TM-4684; A-950015; NAS 1.15:4684) Avail: CASI HC A03/MF A01

This paper presents the design process and development approach for a method of maintaining sufficient quantities of water for research animals during a Shuttle mission of long duration. An inflight refill unit (IRU) consisting of two major subsystems, a fluid pumping unit (FPU) and a collapsible water reservoir (CWR), were developed. The FPU provides the system measurement and controls, pump, water lines, and plumbing necessary to collect water coming into the unit from the potable water system and pump it out into the RAHF drinking water tanks. The CWR is a Kevlar (TM) reinforced storage bladder connected to the FPU, which has a capacity of 6 liters in its expanded volume and functions to store the water collected from the potable water system, allowing for transport of the water back to the Spacelab where it is pumped into each of two research animal holding facilities. Additional components of the IRU system include the inlet and outlet fluid hoses, a power cable for providing 29V direct current spacecraft electrical power to the pump within the FPU, a tether system for the unit when in use in Spacelab, and an adapter for mating the unit to the orbiter waste collection system in order to dump excess water after use in Spacelab.

Author

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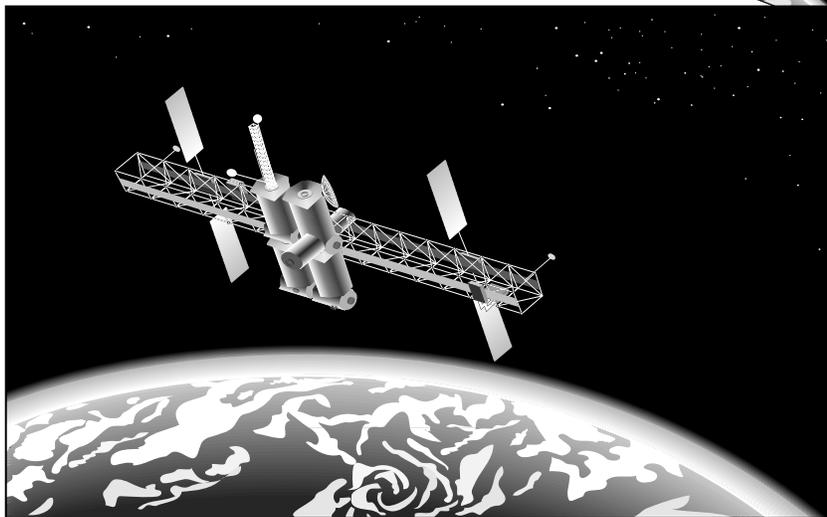
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