

AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 318)

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

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



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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 223 reports, articles and other documents announced during December 1988 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

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

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

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

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

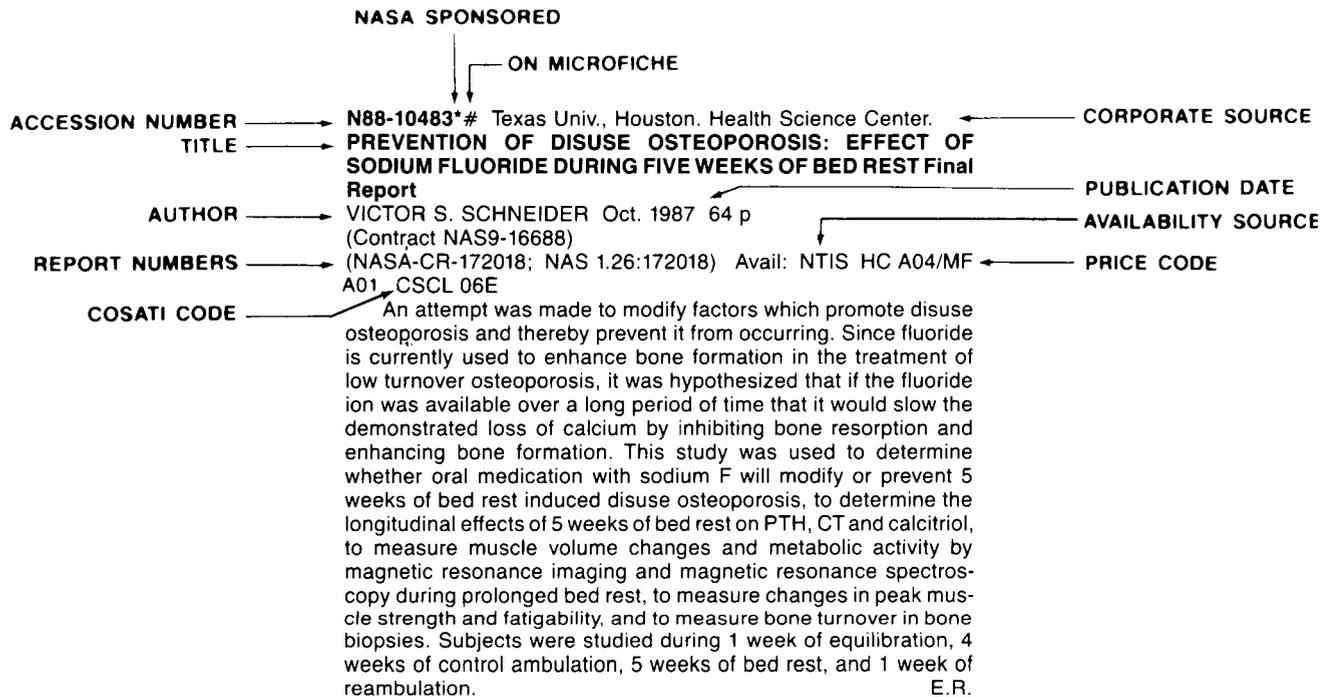
Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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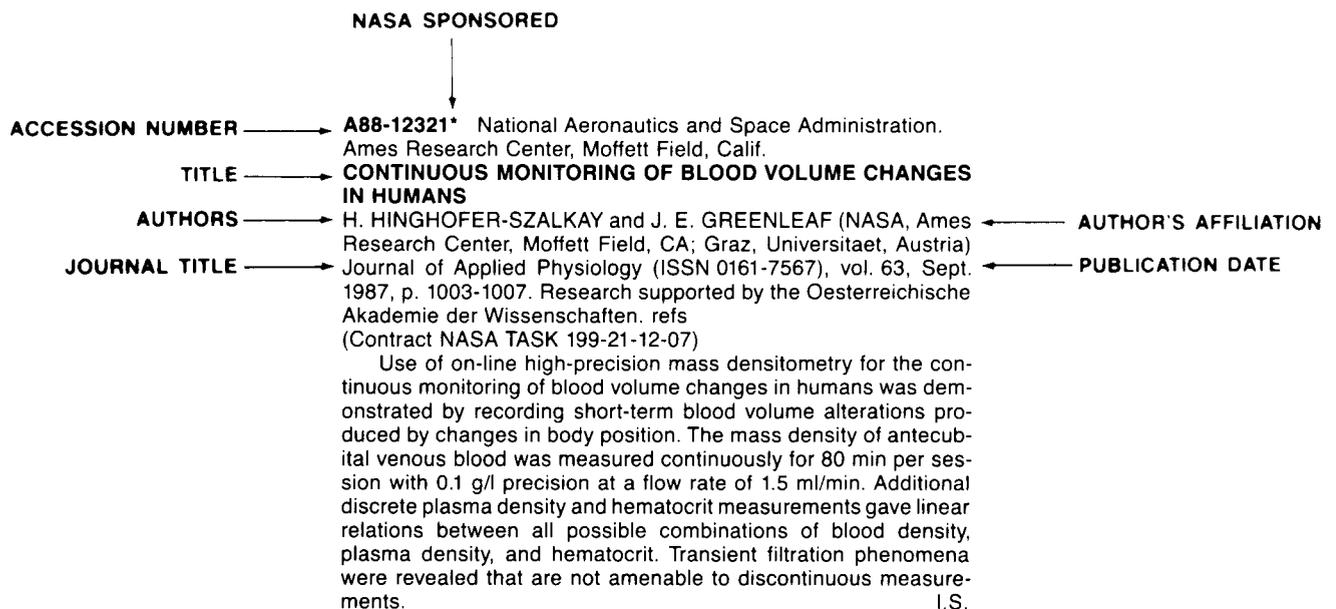
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TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 318)

JANUARY 1989

51

LIFE SCIENCES (GENERAL)

A88-52590

ANAEROBIC MAGNETITE PRODUCTION BY MARINE, MAGNETOTACTIC BACTERIUM

DENNIS A. BAZYLINSKI, HOLGER W. JANNASCH (Woods Hole Oceanographic Institution, MA), and RICHARD B. FRANKEL (MIT, Cambridge, MA) *Nature* (ISSN 0028-0836), vol. 334, Aug. 11, 1988, p. 518, 519. NSF-Navy-supported research. refs

The first isolation and axenic culture of a marine, magnetotactic bacterium that can synthesize intracellular, single-domain magnetite crystals under strictly anaerobic conditions is reported. It is concluded that magnetotactic bacteria do not necessarily require molecular oxygen for magnetite synthesis, and it is suggested that they as well as dissimilatory iron-reducing bacteria can contribute to the natural remanent magnetism of even long-term anaerobic sediments. C.D.

A88-52596* California Univ., San Diego, La Jolla.

SUBMARINE HOT SPRINGS AND THE ORIGIN OF LIFE

STANLEY L. MILLER and JEFFREY L. BADA (California, University, La Jolla) *Nature* (ISSN 0028-0836), vol. 334, Aug. 18, 1988, p. 609-611. Research supported by the University of California and NASA. refs

The popular hypothesis that life originally arose in hydrothermal vents at oceanic ridge crests is examined. It is shown that the high temperatures in the vents would not allow synthesis of organic compounds, but would decompose them, unless the exposure time at vent temperature was short. Even if the essential organic molecules were available in the hot hydrothermal waters, the subsequent steps of polymerization and the conversion of these polymers into the first organisms would not occur as the vent waters were quenched to the colder temperatures of the primitive oceans. C.D.

A88-52597

LONG-RANGE MOLECULAR ORDER AS AN EFFICIENT STRATEGY FOR LIGHT HARVESTING IN PHOTOSYNTHESIS

ZOIA G. FETISOVA (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR), ARVI M. FREIBERG, and KIU E. TIMPMANN (AN ESSR, Institut Fiziki, Tartu, Estonian SSR) *Nature* (ISSN 0028-0836), vol. 334, Aug. 18, 1988, p. 633, 634. refs

The picosecond polarized fluorescence kinetics has been directly measured for bacteriochlorophyll emissions upon selective polarized light excitation of the long-wave transition of bacteriochlorophyll c in the bacteria Chlorobiaceae and Chloroflexaceae. The measured fluorescence polarization value was found to be constant during the lifetime of the bacteriochlorophyll c excited state, reaching a limiting value for monomeric bacteriochlorophyll of 0.42. These results demonstrate that in living cells of green bacteria, excitation energy transfer within the bacteriochlorophyll c antenna occurs between chromophores with parallel transition moments. C.D.

A88-52721

GENETIC INFORMATION COULD BE INTEGRATED EXTRINSICALLY FOR SIMPLEST LIFE FORMS

GORDON ALLEN *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 289-298. refs

This paper discusses possibilities, other than DNA mutations, of acquiring new genetic information by early life forms. It is argued that new genetic information can be obtained from sources extrinsic to the central reproductive apparatus or even to the organism and that, if nucleic acids are removed from the DNA-based model of genetic apparatus and substituted by a hypothetical hereditary unit incapable of mutation, there remain enough mechanisms within and among organisms to accumulate genetic information and to integrate it by means of natural selection. A model of a hereditary unit based on self-reproducing catalysts is discussed. I.S.

A88-52722

THE RELATIONSHIP BETWEEN RNA CATALYTIC PROCESSES

ROBERT CEDERGREN, B. FRANZ LANG, and DENIS GRAVEL (Montreal, Universite, Montreal, Canada) *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 299-305. Research supported by the Medical Research Council of Canada, Ministere de l'Education du Quebec, DFG, and NSERC. refs

This paper analyzes the validity of recent proposals that an RNA-based genetic system preceded DNA, by tracing the evolution of RNA mechanisms. It is concluded that modern examples of catalytic RNA are related to two intrinsic chemical mechanisms which probably existed in primordial times: the conjunct nucleophile mechanism, typified by the nucleophilic attack of a 2-prime-OH on the adjacent phosphodiester bond, and the disjunct nucleophile mechanism, an example of which would be the self-splicing of Tetrahymena ribosomal RNA. Comparisons of present data indicate that modern RNase P processing and tRNA splicing are the most ancient of the reactions discussed, since only these reactions have a seemingly continuous series of relatives in more than one primary kingdom. I.S.

A88-52855

POSSIBLE MECHANISM FOR SPECIFIC EFFECTS OF PULSED MICROWAVE FIELDS [VOZMOZHNYI MEKHANIZM SPETSIFICHESKOGO DEISTVIA IMPUL'SNYKH SVCH-POLEI]

R. E. TIGRANIAN (AN SSSR, Institut Biofiziki, Pushchino, USSR) *Biofizika* (ISSN 0006-3029), vol. 33, July-Aug. 1988, p. 698-702. In Russian. refs

Mechanisms responsible for biological effects of pulsed microwave radiation were examined using experimental data obtained on the excitation of various types of mechanical oscillations in model liquids subjected to pulsed microwave fields. Calculations show that shear waves excited by microwaves may have biological effects, suggesting that the mechanism responsible for the specific effects of pulsed microwaves might be of acoustic nature and that the effects are due to the generation of shear waves in biological media. I.S.

51 LIFE SCIENCES (GENERAL)

A88-53993

SPACE BIOLOGY AND AEROSPACE MEDICINE; ALL-UNION CONFERENCE, 8TH, KALUGA, USSR, JUNE 25-27, 1986, REPORTS [KOSMICHESKAIA BIOLOGIIA I AVIAKOSMICHESKAIA MEDITSINA; VSESIOUZNAIA KONFERENTSIIA, 8TH, KALUGA, USSR, JUNE 25-27, 1986, TEZISY DOKLADOV]

O. G. GAZENKO, ED. Moscow, Izdatel'stvo Nauka, 1986, 392 p. In Russian. No individual items are abstracted in this volume.

This book discusses topics on clinical, physiological, and psychophysiological aspects of aerospace medicine, the problems of spacecraft habitability and hygiene, the biological effects of space flight, the effects of cosmic rays, and the regulation of metabolism in space. Papers are presented on a mathematical analysis of heart rhythm in predicting the functional state during EVA, the effects of weightlessness on the vestibular and vestibulo-oculomotor reactions, hypodynamia as the leading factor in the development of atherosclerosis, the psychophysiological aspects of motivation for activity, and the work efficiency of operators of different age under short-term hypercapnia. Other papers are on the house-fly larva as a user of life-support system wastes, the role of unicellular algae in the life-supporting system for humans, the levels of catecholamines and adrenergic receptors in rats after flights on Cosmos satellites, and the erythrocyte metabolism under conditions of prolonged hypokinesia. I.S.

A88-54005

SPACE BIOLOGY AND MEDICINE [KOSMICHESKAIA BIOLOGIIA I MEDITSINA]

O. G. GAZENKO, ED. Moscow, Izdatel'stvo Nauka, 1987, 320 p. In Russian. No individual items are abstracted in this volume.

This book examines the reactions of the human organism to the adverse conditions of space flight, the functioning of life support systems, and the means of maintaining the health and work capacity of cosmonauts. Topics discussed include the effects on humans of the space-flight dynamics; the mechanism of the weightlessness effect and the protective measures; the psychological reliability of the cosmonaut during a space flight and the psychological preparation and support; the habitability of the spacecraft cabin; the physiological-hygienic and ergonomic aspects of the spacesuit design and the medical and biological results of EVA activity; protection against cosmic rays; and the preparation of a cosmonaut for survival after a nonscheduled landing in such areas as the Arctic, taiga, desert, or jungles, or on the ocean. Special attention is given to the medical support of cosmonauts, the methods used for their selection and preparation, and medical assistance during a spaceflight. Various aspects of biological experimentation in space are discussed, including the selection of animals and microorganisms for experiments, and the maintenance of these organisms in space. Results on biological studies in space are included. I.S.

A88-54006

INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES COMMISSION ON GRAVITATIONAL PHYSIOLOGY, ANNUAL MEETING, 9TH, NITRA, CZECHOSLOVAKIA, SEPT. 28-OCT. 2, 1987, PROCEEDINGS

ORR E. REYNOLDS, ED. Meeting sponsored by the International Union of Physiological Sciences. *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, 166 p. For individual items see A88-54007 to A88-54067.

The physiological effects of gravitational changes in humans, animals, and plants are discussed in reviews and reports of recent experimental investigations. Topics addressed include gravitational effects on cardiovascular and respiratory function, muscle and bone, thermoregulation, cellular function, hormones and metabolism, the vestibular visual and proprioceptive systems, plant and cell organisms, animal development, chronobiology, and bird organisms. Particular attention is given to recent space experiments, advanced concepts, and novel methods and projects. T.K.

A88-54008#

BIOMECHANICAL CHARACTERISTICS OF BONE STRUCTURE CHANGES FOLLOWING REAL AND SIMULATED WEIGHTLESSNESS

GURII P. STUPAKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-4 to S-7. refs

The effects of 18.5-19.5 days of weightlessness (during the Soviet Cosmos missions 782, 936, and 1129) on the mechanical characteristics of rat femur heads are described. Data on ultimate stress, elastic modulus, elastic energy, limit strength, Ca content, and density are presented in tables and compared with similar data on vertebrae from 22-45-year-old human subjects who were bedridden for 20-45 days prior to death. Similar degradation of mechanical properties and decreases in Ca content are observed. In the case of human vertebrae, evidence is also found for a mechanism resisting bone-structure resorption. T.K.

A88-54009#

NEURONAL ACTIVITY OF NUCLEUS VESTIBULARIS DURING COORDINATED MOVEMENT OF EYES AND HEAD IN MICROGRAVITATION

M. G. BIROTA, B. M. BABAIEV, I. N. BELOOZEROVA, A. N. NYROVA, S. B. IAKUSHIN (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-8, S-9.

On Cosmos mission 1667, the activity of neurons in the vestibular nuclei of monkeys was monitored using implanted electrodes. The present paper describes the adaptation to monkeys of the method developed by Girman (1973), Pigarev (1977), and Beloozerova et al. (1986) for implanting the electrodes. The electrodes, preamplifiers, transducers, and connectors are mounted rigidly onto a plastic cap molded to fit the skull and attached with screws; this cap also provides for fixation of the head in a special chair while the positions of the microelectrodes in the brain are adjusted. A drawing of the instrumentation and a sample activity tracing are shown. T.K.

A88-54010*# Arizona Univ., Tucson.

PROBLEMS IN ANALYSIS OF DATA FROM MUSCLES OF RATS FLOW IN SPACE

MARC E. TISCHLER, ERIK HENRIKSEN, STEPHAN JACOB, SOISUNGWAN SATARUG, and PAUL COOK (Arizona, University, Tucson) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-10 to S-13. refs (Contract NAGW-227)

Comparison of hind-limb muscles of rats flown on Spacelab-3 or tail-traction-suspended showed that 11-17 h reloading postflight might have altered the results. Soleus atrophied; plantaris, gastrocnemius, and extensor digitorum longus grew slower; and tibialis anterior grew normally. In both flight and simulated soleus and plantaris, higher tyrosine and greater glutamine/glutamate ratio indicated negative protein balance and increased glutamine production, respectively, relative to controls. Aspartate was lower in these muscles. Reloading generally decreased tyrosine, but increased aspartate and glutamine/glutamate. These data showed that 12 h of reloading after flight is characterized by reversal, to varying extents, of the effects of unloading. Author

A88-54018*# Louisville Univ., Ky.

COMPARATIVE MORPHOMETRY OF FIBERS AND CAPILLARIES IN SOLEUS FOLLOWING WEIGHTLESSNESS (SL-3) AND SUSPENSION

X. J. MUSACCHIA, JOSEPH M. STEFFEN, R. D. FELL, and M. J. DOMBROWSKI (Louisville, University, KY) (International Union of Physiological Sciences Commission on Gravitational Physiology,

Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-28, S-29. refs

(Contract NAG2-386; NASA ORDER A-21996-C)

This work is a continuation of efforts to assess responses of rat skeletal muscle to weightlessness (W) and earthside laboratory experiments with unloading of hind limbs. The soleus is a slow-twitch, load-bearing (antigravity) muscle. Both exposure to W and to the hypokinesia/hypodynamia of whole-body suspension (WBS) results in soleus atrophy. Cross-sectional areas of both slow- and fast-twitch fibers decrease during 7 days of W or 7 or 14 days of WBS. Density and area changes tended to reverse to control levels during 7 days of recovery (R) following WBS. Capillary density was increased with 7 days of W or 7 or 14 days of WBS. During 7 days of R the capillary density returned toward control levels. In summary, the reduction in fiber cross-sectional areas and the increase in fiber and capillary densities support the hypothesis that in both W and WBS there is a loss in soleus muscle cell mass and not in fiber numbers. Author

A88-54020#

EFFECT OF SPACEFLIGHT ON COLLAGEN PEPSIN SOLUBILITY AND COLLAGEN TYPE DISTRIBUTION IN FEMORAL BONE AND SKIN OF RATS

J. POSPISILOVA (Brno, Universita, Czechoslovakia), M. POSPISIL (Ceskoslovenska Akademie Ved, Biofyzikalni Ustav, Brno, Czechoslovakia), and L. V. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-32, S-33.

Samples of femoral bone and skin of male Wistar rats, subjected to a 7-day spaceflight on the biosatellite Cosmos-1667, were analyzed to reveal possible effects of weightlessness on collagen pepsin solubility and collagen type distribution. The analysis has shown the following effects of spaceflight as compared with controls: in bones - the increase of collagen solubility and the presence of collagen type III; in skin - the decrease of collagen solubility and a higher percentage of collagen type III. Author

A88-54021#

THE INFLUENCE OF A ONE-WEEK SPACE FLIGHT ON TEETH AND JAW BONES OF WISTAR-RATS (COSMOS 1514 AND COSMOS 1667)

H. WEINGART, M. KLEBER, H. GEISSLER, E. WACHTEL, K. HECHT (Berlin, Humboldt-Universitaet, German Democratic Republic) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-34, S-35. refs

The effects of weightlessness on the growth processes in bones and teeth were investigated experimentally in groups of 10 male and pregnant female Wistar rats on two 1-week Cosmos missions. The results of carbonate-apatite (CA) determinations in cement and dentin from molars and incisors and in jaw bone are presented in a table and briefly characterized. The CA concentrations in pregnant females were found to be lower than those in males and to be unaffected by weightlessness; CA concentration in males was significantly reduced under weightlessness. T.K.

A88-54024#

STABILITY OF CELL POLARITY UNDER VARIOUS GRAVITATIONAL FORCES

DIETER VOLKMANN, INGE CZAJA, and ANDREAS SIEVERS (Bonn, Universitaet, Federal Republic of Germany) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-40 to S-43. refs

The effects of hypergravity (1000 g in a centrifuge) and hypogravity (less than 0.001 g in space) on the establishment of polarity in root cells of cress (*Lepidium sativum* L.) are investigated

experimentally. The development of seeds activated and grown under these gravitational conditions is studied by means of electron microscopy; sample micrographs are presented and discussed in detail. Hypergravity is found to cause a loss of polarity in statocytes (SCs), but cell division is unaffected in either SCs or meristematic cells (MCs); on return to 1-g conditions, normal structure is restored in several minutes in SCs and after several hours in MCs. Division and polarity in SCs and MCs are unaffected by hypogravity, despite changes in lipid droplets, protein vacuoles, starch grains, and endoplasmic reticular membranes. T.K.

A88-54025#

GROUND-BORNE METHODS AND RESULTS IN GRAVITATIONAL CELL BIOLOGY

W. BRIEGLEB (DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-44 to S-47. refs

The mechanisms by which gravitational fields affect the development and function of cells are discussed, and techniques for studying these effects in ground-based laboratories are reviewed. The analysis is based on the heuristic concept of smallest functional units, introduced by Briegleb et al. (1982) and refined by Briegleb (1984) and Briegleb and Block (1986). Topics addressed include observations of cells lying or hanging on free surfaces, freely swimming cells, and correlated gravitaxis and phototaxis. Particular attention is given to experiments on freely rotating platforms, especially high-speed clinostats. It is concluded that such devices can effectively simulate space microgravity conditions in many biological and nonbiological experiments. T.K.

A88-54026*# Arizona Univ., Tucson.

DOES VECTOR-FREE GRAVITY SIMULATE MICROGRAVITY? FUNCTIONAL AND MORPHOLOGIC ATTRIBUTES OF CLINOROTATED NERVE AND MUSCLE GROWN IN CELL CULTURE

RAPHAEL GRUENER and GLENN HOEGER (Arizona, University, Tucson) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-48, S-49. refs (Contract NAG2-326)

Contracted *Xenopus* neurons and myocytes were subjected to nonvectorial gravity by clinostat rotation to determine the effects of microgravity on cell development and communications. Observed effects included increases in the myocyte and its nuclear area, fragmentation of nucleoli, the appearance of neuritic aneurysms, decreased growth in the presence of trophic factors, and decreased yolk utilization. These effects were most notable at 1-10 rpm and depended on the onset and duration of rotation. It is found that, in microgravity, cell differentiation is altered by interference with cytoskeleton-related mechanisms. It is suggested that the alteration of the distribution of acetylcholine receptor aggregates on myocytes which occurs might indicate that microgravity affects brain development. R.B.

A88-54028*# Pennsylvania State Univ., University Park.

CELL BIOPROCESSING IN SPACE - APPLICATIONS OF ANALYTICAL CYTOLOGY

P. TODD, W. C. HYMER, C. L. GOOLSBY, J. M. HATFIELD (Pennsylvania State University, University Park), D. R. MORRISON (NASA, Johnson Space Center, Houston, TX) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-52 to S-55. refs (Contract NAS9-15584; NAS9-17431; NAGW-694; NAGW-1196)

Cell bioprocessing experiments in space are reviewed and the development of on-board cell analytical cytology techniques that can serve such experiments is discussed. Methods and results of

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experiments involving the cultivation and separation of eukaryotic cells in space are presented. It is suggested that an advanced cytometer should be developed for the quantitative analysis of large numbers of specimens of suspended eukaryotic cells and bioparticles in experiments on the Space Station. R.B.

A88-54029#

THE INFLUENCE OF WEIGHTLESSNESS ON CELL SKELETON

B. B. EGOROV, N. L. DELONE, and V. V. ANTIPOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-56 to S-60. refs

The influence of microgravity on the cytoskeleton of microspores of *Tradescantia paludosa* was studied aboard several Soviet spacecraft. The effects of microgravity include changes in cell form and size, and redispersion of the nucleus and vacuoles leading to disturbance of genome activity and cell differentiation. The direct and indirect effects of weightlessness on the genetic apparatus of the cells are discussed. It was found that the quantity of abnormal cells increased with increased flight duration, probably due to a change in genome activity. R.B.

A88-54030#

EFFECT OF SPACE FLIGHT AND HYPOKINESIA ON PLASMA HORMONE LEVELS AND LIPID METABOLISM IN RATS

L. MACHO, M. FICKOVA, S. ZORAD (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia), R. A. TIGRANIAN, and L. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-61, S-62. refs

Changes in plasma hormone levels and lipid metabolism in adult male rats due to space flight (aboard the Cosmos biosatellites) and hypokinesia are experimentally investigated. Increased plasma levels of hormones were found in rats exposed to space flight. Hypercorticoesteronaemia is shown to be followed by activation of several enzymes involved in liver aminoacid metabolism. Changes in the stimulatory action of catecholamines on lipolysis and of insulin on lipogenesis were noted in hypokinetic rats, indicating that both space flight and hypokinesia have important effects on hormonal regulation and lipid metabolism in adipose tissue. R.R.

A88-54031#

EFFECTS OF HYPOKINESIA ON HORMONAL REGULATION OF INSULIN RECEPTORS IN RAT ADIPOCYTES

M. FICKOVA, L. MACHO, and S. ZORAD (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-63, S-64. refs

This paper investigates the effect of 24-hr-long hypokinesia on the control of rat fat-cell insulin receptors by catecholamines and corticosterone, using intact and medullectomized rats treated with guanethidine (Medex + Guan) and adrenalectomized rats, respectively, with control animals (intact and operated) allowed to move freely in standard cages. Isolated adipocytes were prepared from epididymal fat pads and used in binding studies using I-125-labeled insulin. No changes in insulin binding were observed in adrenalectomized rats after hypokinesia. On the other hand, the (Medex + Guan) rats in the hypokinesia group displayed a decrease of binding compared with the freely moving controls. I.S.

A88-54032#

ADAPTATION TO RESTRAINT IN THE RAT

VOJIN POPOVIC (Emory University, Atlanta, GA) (International Union of Physiological Sciences Commission on Gravitational

Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-65, S-66. refs

Experiments were performed to determine whether there is an adaptation in rats to restraint (as evidenced by a decrease toward normal of plasma stress hormones), with application to microcirculatory studies performed in space. Repeatedly stressed rats were shown to grow at a slower rate than the control animals. The results show that after 18 repeated exposures to a semirestraint device, the plasma stress hormones (ACTH and corticosterone) in the rats were elevated, suggesting that adaptation to restraint stress does not exist. R.R.

A88-54033#

EFFECT OF SPACE FLIGHT ON PLASMA LEVELS OF GROWTH HORMONE, PROLACTIN, CORTICOSTERONE AND INSULIN IN PREGNANT RATS AND THEIR OFFSPRINGS DURING ONTOGENESIS

J. JURCOVICOVA, D. JEZOVA, M. VIGAS, and L. SEROVA (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-67, S-68. refs

The effect of spaceflight on the hormonal balance of pregnant rats and their offspring was investigated using rats flown aboard Cosmos 1514 between days 13 and 18 of pregnancy and measuring the postflight plasma levels of growth hormone (GH), prolactin (P), corticosterone (C), insulin, and glucose in the pregnant rats and in their offspring when these were aged 15, 30, and 100 days. The same protocol was used for synchronous controls, i.e., animals kept under simulated flight conditions, and for intact controls. It was found that space flight resulted in lower levels of GH in plasma of pregnant rats and in that of 30- and 100-day-old offspring of flown mothers. No difference in C levels was observed between the offspring of controls and flown (and synchronous control) rats, indicating that the prenatal flight was not a severe stressor. Plasma insulin and glucose levels were decreased in flown rats, and plasma P was substantially enhanced, indicating the synergistic effect of flight and circulating estrogens. I.S.

A88-54034#

THE SYNTHESIS AND CONCENTRATION OF THYROID HORMONES IN RATS AFTER SPACE FLIGHT

J. KNOPP, L. MACHO, V. STRBAK (Slovenska Akademia Vied, Ustav Experimentalnej Endokrinologie, Bratislava, Czechoslovakia), R. A. TIGRANIAN, and N. T. KALITA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-69, S-70.

The effect of space flight on the synthesis of thyroid hormones in the thyroid gland and their concentrations in serum in adult rats and pregnant rats which delivered babies after flight was studied. It was found that the percentage of T3 and T4 in the thyroid glands of adult rats and pregnant females after space flight was unchanged, and no difference was noted in the T3 and T4 concentrations of mothers and babies. The concentration of thyroxine in rat serum was also not changed in the groups considered, and the results indicate that space flight does not significantly affect thyroid activity in rats. R.R.

A88-54035#

EARLY PLASMA ATRIAL NATRIURETIC FACTOR CHANGES IN THE RAT DURING ANTIORTHOSTATIC HYPOKINETIC SUSPENSION

C. KAZEK, G. GAUQUELIN, R. GARCIN, D. DESPLANCHES (Lyon I, Universite, Lyons, France), J. BONNOD (IFFA CREDO, L'Arbresle, France) et al. (International Union of Physiological Sciences

Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-71, S-72. refs

To investigate the releasing mechanisms of atrial natriuretic factor (ANF) during weightlessness simulation, rats were suspended of 1, 2, 6 and 24 hours. At the same time, plasma and atrial immunoreactive ANF (IR-ANF) were measured using a radioimmunoassay. Plasma and atrial IR-ANF increased after two hours of suspension, and returned rapidly to the basal levels at 6 h. These results suggest that ANF may contribute to the natriuresis reported in weightlessness. Author

A88-54036#

SPECIFIC BINDING OF ATRIAL NATRIURETIC FACTOR TO RENAL GLOMERULI DURING DAY OR NIGHT ANTIORTHOSTATIC-HYPOKINETIC SUSPENSION (AOH)

G. GAUQUELIN, C. GHARIB (Lyon I, Universite, Lyons, France), E. L. SCHIFFRIN, R. GARCIA, and M. CANTIN (Montreal, Institut de Recherches Cliniques, Montreal, Canada) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-73, S-74. refs

Rat experiments were performed to compare the day and night atrial natriuretic factor (ANF) response to AOH. A significant increase was found in plasma ANF in AOH rats after two hours of day or night suspension. During night, ANF receptors were shown to be significantly reduced in AOH rats as compared to attached horizontal rats. It is concluded that the attenuation of the natriuretic and diuretic response during night is related to elevated plasma ANF levels and decreased ANF receptor density. R.R.

A88-54037#

EFFECT OF HYPERGRAVITY (2G) ON THE REGENERATION OF RAT LIVER

K. KROPACOVA, E. MISUROVA (Univerzita Pavla Josefa Safarika, Kosice, Czechoslovakia), and L. V. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-75, S-76. refs

The effect of hypergravity (2G) on liver regeneration of rats within the first three days after partial hepatectomy is investigated. During liver regeneration, the nucleic acid concentration was increased at 24-30 h in comparison with nonexposed rats. The increment in total contents of DNA and RNA was lower mainly at 72 h. Inhibition of mitotic activity was noted at 30 h. Hypergravity exposure did not affect the ratio of prophase to metaphase counts and chromosomal abnormalities. R.R.

A88-54038#

THE EFFECT OF SUPPORT UNLOADING INDUCED BY MICROGRAVITY IMITATION

A. M. GENIN, N. G. LACOTA, IU. V. KREIDICH, G. S. AIZIKOV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), and R. A. GRIGORIAN (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-77 to S-83. refs

The effects of support unloading during microgravity simulation by costume immersion are studied. These effects are compared with those observed during real weightlessness and with pathological disturbances of proprioception and cerebellar control. It is found that most microgravitational changes connected with the labyrinth are pseudovestibular in nature. They result from the loss of contact with the support and from a proprioceptive afferentation deficit. K.K.

A88-54041#

CELL MORPHOLOGY AND ULTRASTRUCTURE OF MAIZE ROOT MERISTEM IN MICROGRAVITY

V. G. GRIF, M. G. TAIRBEKOV, and E. M. BARMICHEVA (AN SSSR, Botanicheskii Institut, Leningrad; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-88 to S-91.

Cytomorphological and ultrastructural studies of maize roots grown in flight aboard Cosmos-1667 in June 1985 revealed differences in their organization as compared with controls. Parameters considered include the root cap size, the meristem zone size, the cell numbers in these parts along the root axis, the periblem cell size, the size of periblem cell nuclei, and the nucleoplasmic ratio. Ultrathin sections of the root cap cells were used in the EM studies. A mitotic index was determined for the periblem cells of the root meristem. R.R.

A88-54042#

DEVELOPMENT OF CARDIOVASCULAR SYSTEM AND THE GRAVITY

IURI E. MOSKALENKO (AN SSSR, Institut Evoliutsionnoi Fiziologii i Biokhimii, Leningrad, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-91A to S-91C. refs

The stages in the evolution of the cardiovascular system from the open system of invertebrates to the four-chamber heart system in mammals are examined together with the role of gravity in the adaptation of man's cardiovascular system to vertical body posture. It is emphasized that the development of vertical posture in man was preceded by the conversion from the multiheart invertebrate systems to the two-, three-, and four-chambered hearts of the vertebrates, due to changed environment and increased respiratory and muscular activities in vertebrates. The effect of gravitational force on the heart caused (in addition to a limited increase in myocardial mass) the development of special autoregulatory mechanisms, based on neurohumoral mechanisms involving pressure receptors, which guarantee the independence of organ blood flow during changes of body axis with respect to gravitational vector. I.S.

A88-54044#

EVOLUTION OF GRAVITATIONAL TOLERANCE IN THE SEA

A. B. DUBOIS (John B. Pierce Foundation Laboratory, New Haven, CT) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-98 to S-101. refs

It is shown that bluefish have the body strength and circulatory responses necessary to accelerate 3G in water, withstand large transmural pressures during swimming, compensate for hemorrhage, and tolerate head-up tilting in air to 30 or even 60 deg for 30 minutes. It is found that sympathectomy attenuates the vascular responses. It is suggested that cross-tolerance for gravity may have evolved before or simultaneously with emergence from the sea. K.K.

A88-54048*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TISSUE ADAPTATIONS TO GRAVITATIONAL STRESS - NEWBORN VERSUS ADULT GIRAFFES

ALAN R HARGENS (NASA, Ames Research Center, Moffett Field, CA), DAVID H. GERSHUNI, LARRY A. DANZIG (California, University; USVA, Medical Center, San Diego, CA), RONALD W. MILLARD (Cincinnati, University, OH), and KNUT PETTERSSON (AB Hassle, Molndal, Sweden) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-110 to

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S-113. Research supported by the National Geographic Society, USVA, and NASA. refs
(Contract NSF DCB-84-09253; NIH-HL-32703)

Preliminary results on developmental alterations in load-bearing tissues of newborn and adult giraffes are presented. Attention is focused on vascular wall thickness in relation to local blood pressure, and on meniscal adaptations to increased load bearing in the developing giraffe. It is believed that the developing giraffe provides an excellent model for investigations of adaptive mechanisms of increased weight bearing. K.K.

A88-54049#

SPACE FLIGHT EFFECTS ON TISSUE LIPIDS IN GRAVID RATS AND IN THEIR OFFSPRING

I. AHLERS, E. AHLERSOVA (Univerzita Pavla Jozefa Safarika, Kosice, Czechoslovakia), and L. V. SEROVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-114, S-115.

The effect of space flight on pregnant rats and their offspring is determined. It is found that the patterns of tissue lipid changes in pregnant rats flown for 5 days onboard Cosmos 1514 are similar to those seen in male rats after longer and short-term flights. There was an increase in nonesterified fatty acids in white and brown adipose tissue and an increase in TG concentration in the liver. It was found that the use of artificial gravity onboard Cosmos 936 did not prevent changes in thymus lipid composition. K.K.

A88-54050#

HEMOPOIETIC STEM CELL (CFUS) MEASUREMENTS IN PREGNANT RATS FLOWN ON COSMOS-1514 BIOSATELLITE

A. VACEK, D. ROTKOVSKA, A. BARTONICKOVA, L. V. SEROVA, T. V. MICHURINA (Ceskoslovenska Akademia Vied, Biofyzikalni Ustav, Brno Czechoslovakia; Institut Mediko-Biologicheskikh Problem; AN SSSR, Institut Biologii Razvitiia, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-116, S-117. refs

Changes in the number of hemopoietic stem cells (CFUs) were studied in pregnant rats during the recovery day and in their offspring during selected days after a 5-day flight on the biosatellite Cosmos-1514. A statistically significant decrease was found in the CFUs number in bone marrow and spleens of pregnant rats. Different changes in the number of CFUs/10 to the 6th nucleated cells in the bone marrow and spleen of flight and synchronous model control rats indicate that the extent of the decrease in CFUs pool in the spleen was influenced by the action of nonspecific flight factors. In the offspring no significant changes were found in the bone marrow and spleen pools of CFUs during their ontogenesis. Author

A88-54051#

CHANGES OF DEOXYRIBONUCLEOPROTEIN AND NUCLEIC ACID CONTENT IN TISSUES OF PREGNANT RATS AND THEIR OFFSPRING AFTER 5 DAYS OF SPACE FLIGHT

E. MISUROVA, K. KROPACOVA, and J. GABOR (Univerzita Pavla Jozefa Safarika, Kosice, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-118, S-119. refs

A88-54052#

EFFECT OF CHRONIC CENTRIFUGATION ON MOUSE BREEDING PAIRS AND THEIR OFFSPRING

JENNIFER MOORE and JACKIE DUKE (Texas, University, Houston, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-120, S-121. refs

The exposure of chronically centrifuged female mice to male bedding 48 hours before mating induced estrus; these females were then paired with males on the centrifuge or at 1 G, and were sacrificed at 18 days' gestation in order to study the fetuses. No pregnancies occurred at 3.5 G centrifuging; the weights and lengths of centrifuged fetuses were significantly lower than those of controls at 2.6 and 2.9 G, even though there was no effect on litter size or male/female ratio. Centrifuged fetuses' bones were smaller and differently shaped than those of the control fetuses. These effects were mitigated by matings with 1-G males. O.C.

A88-54053#

ADAPTATION OF IMMATURE BRAIN TO POSITIVE RADIAL ACCELERATION OF 10 G AND 5 G

S. TROJAN and J. KOUDELOVA (Univerzita Karlova, Prague, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-122, S-123.

Radial acceleration inhibits venous return and causes stagnant hypoxia (oligaemia) or anoxia (ischaemia) of the organism. Circulatory arrest, i.e., general stagnant anoxia, including the central nervous system (CNS), develops in rats at an acceleration of 10 g. It leads to changes in metabolism, structure, and function of the CNS, the final outcome depending on the degree of developmental maturity of the CNS. Nervous tissue reacts to different degrees of oxygen deficiency in different ways. In young rats, positive acceleration of 5 g causes stagnant hypoxia of the CNS which is not lethal until it has acted a relatively long time. Resistance to this treatment diminishes with age. Author

A88-54055#

BIOLOGICAL MINUTE RHYTHMS OF SENSORIAL AND MOTORIAL FUNCTIONS OF PRIMATES IN THE ADAPTATION ON HYPOGRAVITATION

J. DRESCHER, K. HECHT, K. JEVGENOV, G. G. JEVSTRATOV, G. G. SHLYK (Berlin, Humboldt-Universitaet, German Democratic Republic; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-126, S-127. refs

Reflex data obtained on rhesus monkeys during the Cosmos 1667 experiment were used to study the influence of hypogravitation on the biological minute rhythms of sensorial and motorial functions in primates. While during preflight experiments the maximum of the significant reaction-time rhythms was found to be in the 1-2-minute range, under hypogravitation, minute rhythms demonstrate significant variability of frequencies and becomes stabilized in the period range from 2-4 minutes. The results confirm the importance of psychophysiological minute rhythms as a criterion to describe stress reactions under extreme conditions. R.R.

A88-54056#

REM CYCLES - A CRITERION FOR VERIFICATION OF SLEEP REGULATION, SLEEP DISTURBANCE AND THE EFFECTS OF SLEEP REGULATED PEPTIDES

E. WACHTEL, K. HECHT, H.-U. BALZER, R. SIEMS (Berlin, Humboldt-Universitaet, German Democratic Republic), and P. OEHME (Academy of Sciences, Institute of Drug Research, Berlin, German Democratic Republic) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-128, S-129. refs

REM sleep cycles in unstressed and stressed rats were monitored by somnopolygraphical recording during circadian-activity minima over six days. The number of REM cycles and their duration were found to differ significantly in normal sleep and hyposomnia. Hyposomnia treatments with substance-P(I-II) (SP) and Delta-sleep-inducing peptide (DSIP) were shown to induce nearly the same normalizing effects in the distribution and duration of

REM cycles. The results indicate that SP is more efficient than DSIP in regulating the rhythms of stressed rats. R.R.

A88-54058#**METABOLIC AND HORMONAL CHANGES IN RATS IMMOBILIZED AT VARIOUS TIMES OF DAY**

E. AHLERSOVA, I. AHLERS, and A. MOLCANOVA (Univerzita Pavla Jozefa Safarika, Kosice, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-132, S-133. refs

Metabolic and hormonal responses in rats to short-term immobilization at different times of day were investigated using a nocturnal experimental arrangement. The dependence of the results on time of day was demonstrated, despite the interaction of various factors such as immobilization, circadian rhythms, and starvation. Only the evening results showed a pronounced increase of triacylglycerol (TG) in serum, liver, and bone marrow, elevated T3 in serum, and an increase in liver glycogen. The increase in serum corticosterone and liver phospholipid and the decrease in TG content in the thymus noted during the day reflected the response to the stress reaction alone. R.R.

A88-54059#**ORGAN SIZES AND BODY SIZE IN CHRONICALLY ACCELERATED GALLIFORM BIRDS**

A. H. SMITH (California, University, Davis) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-134, S-135.

The influence of chronic acceleration upon organ size in Coturnix birds (with a body mass of 0.1 kg) and Arbor Acre fowl (with a body mass of 4-5 kg) is investigated. The body-size influence was found to be most significant in the animals of greater than 2-kg body mass. Little overall difference was noted in gravity-modified organ and tissue size between the two breeds of fowl considered, despite a two-fold difference in body size. R.R.

A88-54060#**GASTROINTESTINAL TRANSIT AND LYSINE ABSORPTION IN THE JAPANESE QUAIL AT HYPERGRAVITY**

M. OTTO, M. SNEJDARKOVA, M. JURANI, and V. SABO (Slovenska Akademia Vied, Ustav Fyziologie Hospodarskych Zvierat, Ivanka pri Dunaji, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-136, S-137.

The transit of the inert intestinal marker polyethylene glycol 4000 (PEG) and the absorption of lysine in the gastrointestinal tract (GIT) of Japanese quail at normal and elevated gravity was investigated. While at hypergravity PEG is shown to be significantly retained in the upper part of the GIT, total lysine absorption was unaffected. Analysis of the lysine:PEG ratios, however, indicated a shift in the site of lysine absorption. Fractional growth rates in both groups were found to be unaffected. R.R.

A88-54061#**INFLUENCE OF HYPERGRAVITATION, HYPODYNAMY AND THEIR COMBINATION ON JAPANESE QUAIL**

M. GAZO, K. BODA, J. JANKELA, P. VYBOH, M. JURANI (Slovenska Akademia Vied, Ustav Fyziologie Hospodarskych Zvierat, Ivanka pri Dunaji, Czechoslovakia) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-138, S-139. refs

The simultaneous effect of chronic acceleration at 2 G and hypodynamy on the composition of the thigh and breast muscles of Japanese quail is investigated. Plasma corticosterone was used as a stress marker. The hypodynamy tended to increase the DNA

content in thigh muscles but had no effect on the content of myofibrillar proteins in breast muscles. Myofibrillar proteins in breast muscles were influenced negatively by hypergravitation. Previous findings on the ultrastructure of the muscles could not be correlated with the present findings with respect to protein composition. R.R.

A88-54062#**SELECTION OF JAPANESE QUAIL LINE RESISTANT TO HYPODYNAMY**

M. JURANI, K. BODA, L. KOSTAL, E. SOMOGYIOVA, D. LAMOSOVA (Slovenska Akademia Vied, Ustav Fyziologie Hospodarskych Zvierat, Ivanka pri Dunaji, Czechoslovakia) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-140, S-141.

A88-54063*# General Electric Co., Moffett Field, Calif.**THE FRANCO-AMERICAN MACAQUE EXPERIMENT**

LEONARD F. CIPRIANO (General Electric Co., Moffett Field, CA) and RODNEY W. BALLARD (NASA, Ames Research Center, Moffett Field, CA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-142, S-143.

The details of studies to be carried out jointly by French and American teams on two rhesus monkeys prepared for future experiments aboard the Space Shuttle are discussed together with the equipment involved. Seven science discipline teams were formed, which will study the effects of flight and/or weightlessness on the bone and calcium metabolism, the behavior, the cardiovascular system, the fluid balance and electrolytes, the muscle system, the neurovestibular interactions, and the sleep/biorhythm cycles. New behavioral training techniques were developed, in which the animals were trained to respond to behavioral tasks in order to measure the parameters involving eye/hand coordination, the response time to target tracking, visual discrimination, and muscle forces used by the animals. A large data set will be obtained from different animals on the two to three Space Shuttle flights; the hardware technologies developed for these experiments will be applied for primate experiments on the Space Station. I.S.

A88-54064#**GRAVITATIONAL EFFECTS ON MAMMALIAN CELLS**

G. LORENZI, B. BECHLER, M. COGOLI, and A. COGOLI (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-144 to S-147. refs

Gravitational effects on the activation of human lymphocytes were studied. By immunoenzymatic staining and by using concanavalin A coated red blood cells it is shown that the increase of activation measured at 10 g is due to a simultaneous activation of T and B lymphocytes. At 1 g only T cells are stimulated. It is found that activation of T-cells by chemical modification of the membrane with sodium periodate is depressed at 10 g. Centrifuge and hybridoma-cell tests show that each cell line develops its own adaptation to gravitational stress. R.R.

A88-54067#**CHANGES IN METABOLIC ACTIVITY OF THE CENTRAL NERVOUS STRUCTURES DURING HYPODYNAMIC EXPOSURE (BODY SUSPENSION)**

N. MURAKAMI and A. MORIMOTO (Yamaguchi University, Ube, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-152, S-153. refs

The involvement of the brain regions in the central-nervous response to hypokinesia is investigated experimentally in male

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albino Wistar rats, which were suspended horizontally for 90 min and then injected with 2-deoxy-D-(C-14)glucose (2-DG) to permit autoradiographic characterization of glucose utilization in brain sections prepared using a cryostat. Sample autoradiographs are shown, and the optical densities of the different brain regions and structures in suspended and control animals are compared in a table. Suspended animals are found to have significantly increased 2-DG uptake in the anterior cingulate cortex, septal nuclei, lateral preoptic area, and medial and lateral habenula; decreased uptake is found in the sensory-motor cortex and olivary nuclei. T.K.

A88-54538* Rice Univ., Houston, Tex.

OPTIMAL FEEDBACK CONTROL OF A BIOREACTOR WITH A REMOTE SENSOR

S. C. NIRANJAN and K. Y. SAN (Rice University, Houston, TX) IN: 1988 American Control Conference, 7th, Atlanta, GA, June 15-17, 1988, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1988, p. 1106-1111. (Contract NAS9-17403; NSF CBT-87-07928)

Sensors used to monitor bioreactor conditions directly often perform poorly in the face of adverse nonphysiological conditions. One way to circumvent this is to use a remote sensor block. However, such a configuration usually causes a significant time lag between measurements and the actual state values. Here, the problem of implementing feedback control strategies for such systems, described by nonlinear equations, is addressed. The problem is posed as an optimal control problem with a linear quadratic performance index. The linear control law so obtained is used to implement feedback. A global linearization technique as well as an expansion using Taylor series is used to linearize the nonlinear system, and the feedback is subsequently implemented. I.E.

A88-55165

EFFECTS OF ISCHEMIA ON VO₂, TENSION, AND VASCULAR RESISTANCE IN CONTRACTING CANINE SKELETAL MUSCLE

M. W. GORMAN, J. K. BARCLAY, and H. V. SPARKS (Michigan State University, East Lansing; Guelph, University, Canada) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1075-1081. Research supported by the American Heart Association. refs (Contract NIH-HL-25779-07)

Changes in O₂ consumption, vascular resistance, and tension development during skeletal muscle contractions at reduced flow were monitored in 18 mongrel dogs. It is shown that a vasodilator reserve exists under certain ischemic conditions, and that the flow-to-oxygen consumption ratio is similar to that noted during free-flow conditions. Because the release of vasodilator metabolites may be indirectly related to the flow-to-metabolism ratio, the present results could explain the lack of maximal vasodilation during ischemia which is severe enough to reduce tension development. The defect in tension development is found to be long lived, producing a 'stunned' muscle in which excess O₂ supply does not restore function to normal. R.R.

A88-55167

INCREASE IN PULMONARY CAPILLARY PERMEABILITY IN DOGS EXPOSED TO 100 PERCENT O₂

F. ROYER, D. J. MARTIN, G. BENCHETRIT, and F. A. GRIMBERT (Grenoble I, Universite, La Tronche, France) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1140-1146. Research supported by the Institut National de la Sante et de la Recherche Medicale. refs

Changes in pulmonary capillary filtration due to hyperoxia were studied in 15 dogs. An increase in pulmonary capillary filtration was found in comparison to normoxic dogs in similar conditions. The results show an increase in pulmonary capillary permeability, as evidenced by a decrease of the minimal estimate of the protein reflection coefficient from 0.62 + or - 0.05 to 0.42 + or - 0.05. R.R.

A88-55169

EXPERIMENTAL RESPIRATORY DECOMPRESSION SICKNESS IN SHEEP

C. E. ATKINS, C. E. LEHNER, K. A. BECK, R. R. DUBIELZIG, E. V. NORDHEIM (Wisconsin, University, Madison) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1163-1171. Research supported by the University of Wisconsin. refs

(Contract NOAA-NA-84AAD00065)

A previous technique for inducing respiratory decompression sickness (RDCS) is used to investigate this syndrome in sheep, and the usefulness of the 'sheep model' for the study of human RDCS and obstructive pulmonary hypertension is demonstrated. Respiratory signs such as tachypnea, sporadic apnea, and labored breathing were found to be accompanied by marked venous bubble loading, as detected by precordial Doppler ultrasound. The precipitating RDCS event is found to be massive pulmonary embolization by bubbles, and it is shown that the presence of venous bubbles can be used to predict impending RDCS. R.R.

A88-55170

LUNG HYPERINFLATION IN ISOLATED DOG LUNGS DURING HIGH-FREQUENCY OSCILLATION

EUN J. CHA, EDNA CHOW, H. K. CHANG, and STANLEY M. YAMASHIRO (Southern California, University, Los Angeles, CA) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1172-1179. refs

(Contract NIH-RR-01861; NIH-HL-16390; NIH-HL-33274)

Lung volume changes in isolated dog lungs during high-frequency oscillation with air, He, and SF₆ were measured in order to investigate the phenomenon of lung hyperinflation (LHI). In the experiments, mean tracheal pressure was controlled at 2.5, 5.0 and 7.5 cm H₂O. LHI was observed in all the cases considered except for a few of the He trials, and the degree of LHI was found to be inversely related to mean tracheal pressure and to be directly related to gas density. It is suggested that overall expiratory flow limitation did not cause LHI in isolated dog lungs, and that asymmetry of inspiratory and expiratory impedances may be one of the causes of LHI. R.R.

A88-55171* Texas Univ., Dallas.

CHANGES IN FIBER COMPOSITION OF SOLEUS MUSCLE DURING RAT HINDLIMB SUSPENSION

G. H. TEMPLETON, H. L. SWEENEY, B. F. TIMSON, M. PADALINO, and G. A. DUDENHOEFFER (Texas, University, Dallas and Austin; Eastern Illinois University, Charleston, IL; Lincoln University, Jefferson City, MO) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1191-1195. refs (Contract NIH-AR-35661; NAGW-140)

A technique in which the gravitational load in the rear limbs of rats was chronically reduced is used to study soleus muscle atrophy in near-zero-gravity conditions. The results show a decline in the number of fibers in groups that contained the slow isoenzyme of myosin and which were classified as type I. The total number of fibers did not change, and fibers containing the intermediate isoenzyme and those classified as type IIa increased. The results are consistent with either a change in the composition within existing fibers or a simultaneous loss of slow fibers accompanied by de novo synthesis of intermediate and fast fibers. R.R.

A88-55172* California Univ., Los Angeles.

PERIODIC WEIGHT SUPPORT EFFECTS ON RAT SOLEUS FIBERS AFTER HINDLIMB SUSPENSION

EDWARD O. HAUSCHKA, ROLAND R. ROY, and V. REGGIE EDGERTON (California, University, Los Angeles) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1231-1237. refs

(Contract NCA2-IR-390-502)

The morphological and histochemical properties of rat soleus muscles were investigated following one week of hindlimb suspension. Short-duration daily weight support activity is shown to ameliorate, but not prevent, soleus atrophy induced by hindlimb suspension. The results indicate that fiber cross-sectional area is

more responsive to periodic weight support in dark than light ATPas fibers, and that muscle fiber atrophy need not be associated with a loss in succinate dehydrogenase activity. R.R.

A88-55173

ROLE OF BRAIN LACTIC ACIDOSIS IN HYPOXIC DEPRESSION OF RESPIRATION

JUDITH A. NEUBAUER, ARTHUR SIMONE, and NORMAN H. EDELMAN (New Jersey, University of Medicine and Dentistry, New Brunswick) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1324-1331. refs
(Contract NIH-HL-16022; NIH-HL-29855)

Lactate formation was prevented both locally and globally with dichloroacetate in 14 adult male cats in order to evaluate the role of lactic acidosis of progressive brain hypoxia (PBH) as both a central chemoreceptor stimulant and a general respiratory depressant. Phrenic nerve activity and ventral medullary responses to PBH were assessed in cats whose fraction of end-tidal CO₂ and mean arterial blood pressure were maintained constant. While the overwhelming response to central lactic acidosis of PBH is respiratory depression, lactic acidosis near the central chemosensitive regions does produce a small stimulation of respiration during PBH. R.R.

A88-55174

VENTILATORY RESPONSE TO MODERATE AND SEVERE HYPOXIA IN ADULT DOGS - ROLE OF ENDORPHINS

JANIS I. SCHAEFFER and GABRIEL G. HADDAD (Columbia University, New York) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1383-1388. refs
(Contract NIH-HD-15736)

Ventilation was studied in six chronically instrumented awake adult dogs during hypoxia before and after naloxone administration in order to evaluate the role of opioids in modulating the ventilatory response to moderate or severe hypoxia. Endorphins are shown to be released, and although they act to restrain ventilation during severe hypoxia, the relationship between endorphin release and moderate hypoxia is found to be less consistent. The observed increase in ventilation following naloxone administration during severe hypoxia is shown to be accompanied by an increase in metabolic rate, explaining the isocapnic response. R.R.

A88-55432#

EARLY REACTIONS OF PLANT CELLS ON MICROGRAVITY AND POWER-ENERGY CHARGED PARTICLES EFFECTS

S. I. ZHADKO, V. A. BARABOI, IU. A. POLULIAKH, A. I. VASILENKO, and P. G. SIDORENKO (AN USSR, Institut Botaniki; Kievskii Nauchno-Issledovatel'skii Rentgeno-Radiologicheskii i Onkologicheskii Institut, Kiev, Ukrainian SSR) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 5 p. refs
(IAF PAPER 88-498)

Early changes in lipid peroxidation (LPO) and antioxidative activity in plant cells are studied by modeling certain biological effects of weightlessness using clinostating and power-energy charged particles. Pea-root shoots revealed regularities in LPO indices, decreasing kinetics in the logarithmic and stationary growth stages. The induction of LPO differed only slightly in pea cells and cultivated tobacco cells in the early stages of response to proton irradiation. The delayed reaction evidences the inhibition of the free-radical process in biological membranes. C.D.

N88-29263# Centers for Disease Control, Atlanta, Ga.

QUALITY CONTROL IN MICROBIOLOGY: CDC LAB MANUAL

J. M. MILLER Nov. 1987 106 p
(PB88-179890) Avail: NTIS HC A06/MF A01 CSCL 06C

A brief historical background is given for procedural technology in the laboratory. The topic headings are: Quality control in the microbiology laboratory; Introduction; Establishing a quality control policy; Laboratory safety; Equipment; Media, Reagents, Disks, Strips; Products for direct antigen detection; Documentation; Antisera disk/strips, Reagents-Aerobic bacteriology; Quality control

frequency guidelines for antimicrobial susceptibility testing; Media-anaerobic bacteriology; Mycobacteriology. Author

N88-29264# Nebraska Univ., Lincoln. Dept. of Chemistry. **ELECTROCHEMICAL AND OPTICAL STUDIES OF MODEL PHOTOSYNTHETIC SYSTEMS** *Progress Report, 1 Jul. 1987 - 30 Jun. 1988*

T. M. COTTON 15 Feb. 1988 6 p
(Contract DE-FG02-84ER-13261)

(DE88-009291; DOE/ER-13261/2) Avail: NTIS HC A02/MF A01

During the first eight months of this funding period, we have continued our studies of photosynthetic model systems using Langmuir-Blodgett monolayers, self-assembled monolayers, and vesicles. These model systems were characterized by electrochemical and optical methods (resonance Raman, UV-Vis, and surface-enhanced resonance Raman scattering (SERRS) spectroscopy). A number of different redox-active molecules were examined in addition to the natural photosynthetic pigments. A brief summary of the results is discussed. DOE

N88-29265# School of Aerospace Medicine, Brooks AFB, Tex. **USAF HYPERBARIC ANIMAL TRANSFER CHAMBER SYSTEM Final Report, Aug. 1986 - Feb. 1987**

ROCKY D. CALCOTE Jan. 1988 90 p

(AD-A193633; USAFSAM-TR-87-9) Avail: NTIS HC A05/MF A01 CSCL 13G

The Animal Transfer Chamber (ATC) is an especially designed and constructed test system for research use in the study and evaluation of the physiological effects of high barometric pressures on laboratory animals. The purpose of this technical report is to provide the user organization with guidance, procedures, and safety precautions related to the installation and operation of the USAF hyperbaric ATC system. GRA

N88-29266# Army Research Inst. of Environmental Medicine, Natick, Mass.

LOW DOSES OF ATROPINE SULFATE IMPAIR RETENTION OF A WELL-LEARNED SPATIAL TASK

T. M. BAUCH, D. I. WELCH, and L. GALLEGO Apr. 1988 21 p
(AD-A194065) Avail: NTIS HC A03/MF A01 CSCL 05H

Retention of a well-learned spatial task was assessed in rats 10 minutes prior to, and 10, 20, 30, 40 and 50 minutes after treatment with 3, 10 or 30 mg/kg, iv, atropine sulfate or the equivalent volume of saline, iv. There was a variable dose effect for escape latency and choice accuracy measures of spatial retention. A relatively large dose of atropine sulfate (30 mg/kg, iv) significantly impaired choice accuracy and escape latency compared with the control group. Moreover, impairment in choice accuracy was observed with the control group. Moreover, impairment in choice accuracy was observed with smaller doses of atropine sulfate (3, 10 mg/kg, iv) than have previously been shown to disrupt spatial retention. GRA

N88-29267# Dartmouth Coll., Hanover, N.H. Medical School.

EMETIC MECHANISM IN ACUTE RADIATION SICKNESS

Technical Report, 1 Dec. 1982 - 30 Nov. 1986

HERBERT L. BORISON 20 Aug. 1987 58 p

(Contract DNA001-83-C-0010; DNA PROJ. U99-QMXX)

(AD-A194102; DNA-TR-87-159) Avail: NTIS HC A04/MF A01 CSCL 06G

A dose-response relationship was established in normal cats for the evocation of vomiting within 24 h after whole-body exposure to 60 Co radiation with doses ranging from 7.5 to 60 Gy delivered at 1.0 Gy/min. Vomiting was recorded oscillographically. Radiation-induced vomiting was elicited unabatedly at the optimal dose of 45 Gy in chronically postremectomized cats. Radioemetic susceptibility was evaluated in normal cats after each of two doses of radiation, from 7.5 to 60 Gy, given on successive days. Occurrence of radioemetic protection against the second irradiation was manifested in direct relation to the magnitude of the first exposure, and complete protection for 24 h resulted after second radiation exposure at the highest dose level. Postremectomized cats were also fully protected against the radioemetic effect of a

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second exposure at 45 Gy. All normal cats vomited in response to an emetic drug injection during the state of radioemetic refractoriness after the second irradiation at 45 Gy. A neural origin of emetic signal generated by first radiation exposure was examined in postrema-intact cats. GRA

N88-30274*# California State Univ., Northridge.
SEMI-MICRODROPLET ASSAY FOR CELL ADHESION MOLECULES M.S. Thesis

LAWRENCE SHINZO TAWA Aug. 1988 9 p
(Contract NAG2-499)
(NASA-CR-183139; NAS 1.26:183139) Avail: NTIS HC A02/MF A01 CSCL 06C

A new cell-to-cell adhesion assay was devised. Using dissociated embryos of the sea urchin, this procedure involves rotating a 0.100 ml suspension of single cells with 0.100 ml of the solution to be tested in the bulb portion of a transfer pipet with the tip removed. After 1 hour of rotation at 60 rpm at 15 C, the contents of each bulb were transferred into individual wells of a 96 well flat bottom plate. After the plate was incubated for 1 hour at 15 C, black and white photographs were taken with a 35 mm camera attached to an inverted photomicroscope. Examining a proof sheet of the negatives directly allowed a rapid evaluation of suspected cell adhesion promoting factors. A ranking system was used to evaluate all samples. The assay was tested by examining the effect of specific solutions on the aggregation of single cells obtained from dissociated 23 hour embryos. Author

N88-30275*# California State Univ., Northridge.
SCANNING ELECTRON MICROSCOPY STUDY OF ADHESION IN SEA URCHIN BLASTULAE M.S. Thesis

SUSAN D. CROWTHER May 1988 5 p
(Contract NAG2-499)
(NASA-CR-183136; NAS 1.26:183136) Avail: NTIS HC A02/MF A01 CSCL 06C

The dissociation supernatant (DS) isolated by disaggregating *Strongylocentrotus purpuratus* blastulae in calcium- and magnesium-free seawater specifically promotes reaggregation of *S. purpuratus* blastula cells. The purpose of this study was to use scanning electron microscopy to examine the gross morphology of aggregates formed in the presence of DS to see if it resembles adhesion in partially dissociated blastulae. A new reaggregation procedure developed here, using large volumes of cell suspension and a large diameter of rotation, was utilized to obtain sufficient quantities of aggregates for scanning electron microscopy. The results indicate that aggregates formed in the presence of DS resemble partially dissociated embryos in terms of the direct cell-cell adhesion observed. DS did not cause aggregation to form as a result of the entrapment of cells in masses of extracellular material. These studies provide the groundwork for further studies using transmission electron microscopy to more precisely define the adhesive contacts made by cells in the presence of the putative adhesion molecules present in DS. Author

N88-30276*# California State Univ., Northridge.
IMMUNOFLUORESCENCE LOCALIZATION OF DISSOCIATION SUPERNATANT AND EXTRACELLULAR MATRIX COMPONENTS IN LYTECHINUS PICTUS SECTIONED EMBRYOS M.S. Thesis

ANA LETICIA GARCIAFLACK May 1988 5 p
(Contract NAG2-499)
(NASA-CR-183137; NAS 1.26:183137) Avail: NTIS HC A02/MF A01 CSCL 06C

Indirect immunofluorescence was used to localize specific extracellular components in embryos of the sea urchin *Lytechinus pictus*. Hyalin and S2 (a group of components found in the disaggregation supernatant from *Strongylocentrotus purpuratus* blastulae) were uniformly present at all stages (unfertilized up to 32 hr) except hyalin could not be detected at the 12 hour early blastula stage. Laminin was found in 16 cell, 32 cell, 6 hour, 18 hour, 24 hour, and 32 hour stages, with especially bright fluorescence at 18 hours. Collagen I was present at all stages (freshly fertilized up to 32 hour) except little was detected at 12

hours. Fibronectin was uniformly present in blastocoelar fibers stained with anti-collagen I and anti-fibronectin. These results were compared with those for *S. purpuratus* to produce an overview of the localization of specific extracellular matrix components during development of two species of sea urchins. The results set the stage for future studies that will examine the function of these components at the various developmental stages. Author

N88-30277# Kansas Univ., Lawrence. Dept. of Chemistry.
CYTOCHROME ELECTRON TRANSFER AND BIOMOLECULAR ELECTRONICS Annual Report, Nov. 1987 - Jun. 1988

GEORGE S. WILSON and MICHAEL A. CUSANOVICH 22 Jun. 1988 6 p
(Contract N00014-88-K-0055; PROJ. RR0-4108)
(AD-A195482) Avail: NTIS HC A02/MF A01 CSCL 06A

This research pursues the previous observation that films of cytochrome c3 deposited on a gold substrate undergo a change in resistivity of ten orders of magnitude when this tetraheme protein passes from a fully oxidized to a fully reduced state. This unusual behavior appears to be attributable to the ability of the four hemes to communicate through intramolecular as well as intermolecular electron transfer. To understand this phenomenon in more detail, four cytochromes c3 with differing physical properties have been selected: (1) *D. vulgaris* (Miyazaki); (2) *D. vulgaris* (Hildenborough); (3) *D. sulfuricans* (Norway); and (4) *D. gigas*. The macroscopic redox potentials for each of the hemes in the four proteins have been determined. Electrostatic field maps based on the X-ray structures of the Norway and Miyazaki proteins have been prepared to assist in the design of homogeneous and heterogeneous electron transfer experiments. In the next year, the electrical properties of cytochrome films will be evaluated through Hall effect measurements in particular to establish whether the conductivity is ionic or electronic. GRA

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AEROSPACE MEDICINE

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

A88-52854
INTEGRAL PARAMETERS OF THE HEAT CONDUCTIVITY AND ELECTROCONDUCTIVITY OF HUMAN SKIN [INTEGRAL'NYE KHARAKTERISTIKI TEPLO- I ELEKTROPROVODNOSTI KOZHI CHELOVEKA]

A. G. MALENKOV, V. V. POROIKOV, L. M. KOLOTYGINA, and D. A. FILIMONOV (Nauchno-Issledovatel'skii Institut po Biologicheskim Ispytaniyam Khimicheskikh Soedinenii, Kupavna, USSR) *Biofizika* (ISSN 0006-3029), vol. 33, July-Aug. 1988, p. 692-697. In Russian. refs

The age-related changes in the heat conductivity (HC) and electroconductivity (EC) systems of human skin were investigated by determining integral parameters describing the two systems, such as the HC and EC mean values, the lateral asymmetry indices (AIHC and AIEC), and the nonhomogeneity indices (NIHC and NIEC), in 95 women aged from 10 to 63. The HC and EC measurements were performed at 14 skin points on the upper body, and the age-related changes of integral parameters and their rms deviations were computed using cluster analysis. Statistically reliable changes with age were observed for the values of mean EC and NIEC and for rms deviations of AIHC and NIHC, reflecting the physiological state of the organism. In particular, a five-fold increase in AIHC was observed for subjects who were about 55 years old, i.e., at the age coincident with postclimacteric hormonal changes. I.S.

A88-53292#
HIGH SUSTAINED G - AEROMEDICAL ASPECTS

H. MALIK (Indian Air Force, New Delhi, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 53-58. refs

The potentially disabling effects of G forces on aircrew, i.e., gray-out, blackout, and loss of consciousness (LOC), are well known. Aircrew have been exposed to +Gz forces for decades. However, G-induced loss of consciousness (G-LOC) has emerged as a premier human factor challenge to those who fly modern generation aircraft. Besides generating and sustaining G forces far in excess of what the human body can tolerate, new electronic flight control systems allow high Gs to build up so rapidly that aircrew may lapse into unconsciousness without passing through the stages of gray-out or blackout. Author

A88-53293#
G-INDUCED LOSS OF CONSCIOUSNESS AND ITS PREVENTIVE ASPECTS

M. M. DOGRA and J. K. GUPTA (Indian Air Force, Institute of Aviation Medicine, Bangalore, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 59-64. refs

This paper discusses the physiological basis of the G-induced loss of consciousness (LOC), the course of events taking place during a LOC occurrence, situations that might lead to LOC in flight, and the effectiveness of methods designed to enhance tolerance to +Gz. Special attention is given to both the personal-protection methods (such as anti-G straining maneuvers and exercise training) and the protective hardware (such as the anti-G system, anti-G hose and connectors, positive-pressure breathing regulator, tilt-back seat, light-weight helmets, and automatic recovery systems). It is emphasized that no single protective method would provide adequate protection against high-G stress in a modern fighter aircraft, and that a combination of protective techniques provides an additive effect, with no interference among the methods. I.S.

A88-53294#
ROLE OF CENTRIFUGE TRAINING IN COMBATING HIGH SUSTAINED G FORCES

KULDIP RAI (Indian Air Force, Institute of Aviation Medicine, Bangalore, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 65-67. refs

The role of centrifuge training in decreasing the debilitating effect of high sustained G forces is discussed together with the elements of the centrifuge training program conducted by the USAF for pilots flying F-16, F-4, F-15, F-5, AT-10, and AT-38. Special attention is given to the centrifuge-run profiles used for particular phases of high-G training, and to the relative values of various protective methods used to prevent loss of consciousness, such as the straining maneuver and the M-1 and L-1 maneuvers. The performance results obtained by the USAF for a group of 741 pilot trainees are presented. I.S.

A88-53295#
EFFECT OF BIOFEEDBACK AND YOGIC RELAXATION EXERCISE ON THE BLOOD PRESSURE LEVELS OF HYPERTENSIVES - A PRELIMINARY STUDY

A. L. MOGRA (Indian Air Force, New Delhi, India) and GURMUKH SINGH (Indian Air Force, Institute of Aviation Medicine, Bangalore, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 68-75. refs

The effect of yogic relaxation exercise on the blood pressure of hypertensive subjects subjected to biofeedback training was investigated. Eight males aged from 25 to 45, six of them suffering from essential hypertension and two from renal hypertension, were biofeedback-trained for 30 min with respect to blood-pressure and galvanic skin resistance (GSR) and were then asked to practice the yogic exercise Shavasana. Subjects were asked to increase their GSR and decrease their blood pressure by passive volition. At the end of 20 such sessions, mean systolic blood pressure was found to decrease from 144.2 mm Hg to 119.7 mm Hg and mean diastolic pressure from 95.2 mm Hg to 81.2 mm Hg. All subjects displayed good ability to control and increase their GSR as a result of yoga exercises. I.S.

A88-53296#
TYMPANOGRAPHIC STUDY OF NORMAL SUBJECTS DURING HYPOBARIC CHAMBER EXPOSURE - A PRELIMINARY STUDY
A. B. RAO and P. C. CHATTERJEE (Indian Air Force, Institute of Aviation Medicine, Bangalore, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 76-81.

Tympanometry facilitates a more complete evaluation of the auditory apparatus and is particularly useful for aircrew selection and evaluation. This preliminary study presents tympanometric data of 15 healthy adults following exposure to simulated altitudes of 2438 m and 4572 m. Author

A88-53297#
PHYSIOLOGICAL MECHANISMS INVOLVED IN THE CARDIOVASCULAR RESPONSES TO POSTURAL STRESS
M. B. DIKSHIT (Nottingham University, England) *Aviation Medicine*, vol. 30, Dec. 1986, p. 82-91. refs

The intrathoracic blood volume reduces each time a person changes posture from supine to erect, resulting in a temporary fall in blood pressure and pooling of blood in the legs. In this review, current concepts of the physiological processes involved in the various cardiovascular responses to postural stress are discussed with special emphasis on the possible causes of failure of the reflex response in apparently healthy individuals. This understanding has a special bearing on vasovagal syncope in aircrew. Author

A88-53298#
DECOMPRESSION SICKNESS AFTER EXERCISE AT 4,572 M (15,000 FT) - A CASE REPORT

M. AKHTAR, P. TYAGI, RANJIT KUMAR (Indian Air Force, Institute of Aviation Medicine, Bangalore, India), K. V. KUMAR, and N. MADAN *Aviation Medicine*, vol. 30, Dec. 1986, p. 92-95. refs

Decompression sickness in aviation is usually encountered at altitudes above 9144 m. This paper presents a case of bends which occurred at a simulated altitude of 4572 m in a hypobaric chamber following accidental decompression during submaximal treadmill exercise. It is suggested that even moderately severe exercise at low altitudes may predispose healthy subjects breathing air to decompression sickness. Author

A88-53299#
AIRCREW FITNESS FOLLOWING SURGICAL MANAGEMENT OF CONDUCTIVE DEAFNESS
N. S. DE (Armed Forces Medical College, Pune, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 96-99.

Microsurgical techniques supported by antibiotics and increasing expertise in the use of graft material and prosthesis have revolutionized the management of conductive deafness. Most aircrew with this problem may have to be taken off flying duties either due to the disease process itself or due to the effects of surgical treatment. This paper discusses the various surgical procedures in vogue and their possible effects on flying duties. Author

A88-53300#
ANALYSIS OF RENAL DISORDERS AMONG AIRCREW
G. S. NAYAR, M. AKHTAR, and A. B. RAO (Indian Air Force, Institute of Aviation Medicine, Bangalore, India) *Aviation Medicine*, vol. 30, Dec. 1986, p. 100-105. refs

Data on the incidence of renal diseases among Indian military aircrew, obtained at the Indian Air Force (IAF) Institute of Aviation Medicine during the ten years period between 1976 and 1985 were analyzed, with special attention given to the medical standards used by the IAF and other air forces. It was found that, among the 11,740 medical evaluations performed at the institute during this time, only 47 evaluations (0.4 percent) were carried out for the assessment of urinary disorders. Urolithiasis was found in 58.5 percent of the aircrew evaluated for renal disorders. I.S.

A88-54007#
MEDICAL INVESTIGATIONS RESULTS OBTAINED IN 125-DAY FLIGHT ON 'SALYUT-7' AND 'MIR' ORBITAL STATIONS

A. EGOROV, O. ANASHKIN, O. ITSEKHOVSKII, I. ALFEROVA, L. GOLUBCHIKOVA (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-1 to S-3.

The results of medical experiments and monitoring performed on a long-term Soviet space mission in 1986 are summarized. Topics addressed include monitoring during normal operations and EVAs, in-depth medical examinations in the resting state, functional tests, metabolic and regulatory experiments, environmental monitoring, and evaluation of proposed prophylactic measures against the adverse effects of weightlessness. Although the cosmonauts were generally healthy throughout the mission, several significant cardiovascular changes were recorded, including redistribution of fluid and general deconditioning. Numerical data on these changes are presented in tables and briefly characterized. T.K.

A88-54011#
COMPARATIVE STUDY OF THE CARDIOVASCULAR ADAPTATION TO ZERO G DURING 7 DAYS SPACE FLIGHTS

J. M. POTTIER, PH. ARBEILLE, F. PATAT, A. RONCIN, M. BERSON (Tours, Universite, France) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-14, S-15. refs

The effects of microgravity on essential cardiovascular parameters are studied, summarizing the results of experiments using ultrasonic measurement techniques before, during, and after the 7-day space missions Salyut 7 (1982) and STS-51G (1985). Data on left-ventricular systolic and diastolic volume, cardiac output, heart rate, left-ventricular diameter shortening, ejection fraction, carotid and femoral flow, and cerebral and femoral resistance are presented in graphs and briefly characterized. Large individual variations are observed, and it is shown that moderate (30 percent or less) increases in cardiac output and left-ventricular diastolic volume on the first day were correlated with changes in femoral circulation (but not with cerebral circulation) and followed by decreases (to -15 percent or greater) over the following days. T.K.

A88-54012#
EFFECTS OF LEG POSITIVE PRESSURE ON CARDIO-RESPIRATORY ADJUSTMENTS TO DYNAMIC LEG EXERCISE

O. EIKEN and H. BJURSTEDT (Karolinska Institutet, Stockholm, Sweden) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-15A, S-15B.

The effect of reduced blood flow to the leg muscles on the cardiorespiratory response to incremental-load cycling exercise is investigated in eight subjects; the flow-reducing effect of weightlessness in planned space experiments is simulated by applying leg positive pressure (LPP) of 50 mm Hg. Data on heart rate, systolic arterial pressure, inspired minute ventilation, and blood lactate concentration at rest and during supine exercise with and without LPP are presented in graphs and briefly discussed. It is found that exercise performance is significantly impaired by LPP, despite an exaggerated cardiovascular response tending to compensate the change in blood flow. T.K.

A88-54013#
EFFECT OF ACUTELY EXPOSURING TO 40 MM HG LBNP ON CARDIOVASCULAR RESPONSES DURING REST AND MILD EXERCISE AFTER 6 HRS REST IN 5-DEG HEAD DOWN TILTING (HDT)

S. TORIKOSHI, K. YOKOZAWA, M. INAZAWA (Tokyo Woman's Christian University, Japan), K. ITOH (Tsurumi, University, Japan), Y. FUKASE (Rikkyo Saint Marguerite Woman's College, Japan) et al. (International Union of Physiological Sciences Commission

on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-16, S-17.

The restoration of sympathetic control of cardiovascular function after 6 h of 5-deg HDT and acute exposure to 40-mm Hg LBNP was investigated experimentally in six healthy female subjects. Immediately after sympathetic control was broken (after an average time of 10 min), bicycle-ergometer exercise to 40 percent of VO₂(max) was begun and continued for 15 min. The response of the cardiovascular parameters is shown in graphs and discussed. It is found that the mild bicycle exercise was effective in restoring the marked decreases in systolic arterial pressure, heart rate, and pulse pressure observed at the intolerance point. T.K.

A88-54014#
EFFECT OF STATIC HAND-GRIP CONTRACTION (HGC) ON CARDIOVASCULAR RESPONSES TO CHANGING IN HYDROSTATIC PRESSURE IN WOMAN

J. NAGANO (Bunka Woman's University, Tokyo, Japan), S. TORIKOSHI, K. YOKOZAWA, M. INAZAWA (Tokyo Woman's Christian University, Japan), K. ITOH (Tsurumi University, Japan) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-18, S-19.

Results are reported from water-immersion experiments on six healthy female subjects, at rest or performing 5 min of HGC exercise to 15 percent of MVC. The changes in cardiovascular parameters for immersion (standing upright or upright with floating legs) to axillary, diaphragm, os ilium, or patellar depth in water at 31 C are presented in graphs and briefly characterized. It is found that the responses are directly correlated with the hydrostatic pressure, and that heart rate, mean arterial pressure, and forearm blood flow at diaphragm immersion were higher during HGC in the standing position than with floating legs. T.K.

A88-54015#
BODY FLUID SHIFTS IN SPINAL CORD TRANSECTION AND SIMULATED MICROGRAVITY

DAVID CARDUS and WESLEY G. MCTAGGART (Baylor University, Houston, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-20, S-21. refs

It has been suggested that spinal-cord transection could be used as a model for studying the physiological effects of weightlessness. This hypothesis is tested in the present study by comparing the effects of spinal-cord injury (SC1) and head-down tilt (HDT) on body-fluid shifts. A study on healthy men and men suffering from traumatic SCI using a radioisotope technique showed that in the stable phase after SCI there is an increase of the interstitial space. Using an electric impedance technique it was found that the relative size of the interstitial space is increased. In the HDT experiment, measurements by electric impedance indicated a decrease in interstitial space volume. These findings strongly suggest that body-fluid distributions after SCI and HDT change in opposite directions. Author

A88-54016#
THE STUDY OF BARORECEPTOR REFLEX FUNCTION BEFORE AND AFTER BED REST

XIANYUN SHEN, YAZHI SUN, QILU XIANG, JINGRUI MENG, LIHUA XU (Institute of Space Medico-Engineering, Beijing, People's Republic of China) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-22, S-23.

In order to investigate the mechanism of the lowering of orthostatic tolerance (OST) after exposure to weightlessness (WL), the changes of baroreceptor reflex function (BRF) of two groups, one with 2-deg head-down tilt ($n = 7$) and one in seated position ($n = 7$), were studied before and after bed rest (BR). The open-loop gain (G) was calculated during the head-up tilt (HUT) and HUT

plus LBNP (-5333 Pa) before and after BR. The frequency spectrum changes of R-R intervals (RI) were also compared during neck positive pressure and LBNP between the two groups. The result was that the changes of G and RI and lowering of OST were different between the two groups after BR. Thus the decline in BRF, which probably resulted from the change of function state of CNS, was one of the important causes responsible for the lowering of OST after WL or simulated WL. Author

A88-54017#**THE ROLE OF PHYSICAL TRAINING IN INCREASING +GZ ACCELERATION TOLERANCE IN THE INITIAL PHASE OF AVIATION TRAINING**

STANISLAW BARANSKI, LECH MARKIEWICZ, MIECZYSLAW WOJTKOWIAK, and EUGENIUSZ SOKOLOWSKI (Instytut Medycyny Lotniczej, Warsaw, Poland) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-24 to S-27.

The effects of physical training on acceleration tolerance were investigated experimentally in 135 pilot candidates who had always experienced visual disturbances at 5.2 G in centrifuge screening tests. The ten mainly isometric exercises (combined with breathing techniques) making up the training program are described in detail, and results from retesting on the centrifuge are presented in graphs. After 8 weeks, 114 of the candidates passed the test, with tolerances of 5.7-8.0 G (mean of 6.85 G); after 6 more weeks, 13 more candidates surpassed the 5.7-G limit, with a mean of 6.55 G. The results of Flack's test and inspiratory-capacity measurements are shown to be consistent with these findings.

T.K.

A88-54019#**POSTURAL EFFECTS ON MUSCLE SYMPATHETIC NERVE RESPONSIVENESS TO SUSTAINED MUSCLE CONTRACTION**

MITSURU SAITO (Toyota Technological Institute, Nagoya, Japan), TADDAKI MANO, and SATOSHI IWASE (Nagoya University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-30, S-31. refs

To confirm the dominance of the effect between postural change and muscle contraction on muscle sympathetic nerve activity (MSNA), MSNA was recorded before, during and after a sustained handgrip exercise in a lying and in a standing position by means of microneurography. At rest, MSNA was markedly higher in the standing position compared with that in a lying position. However, during handgrip, MSNA did not increase in the standing position, and significantly increased in the lying position, although MSNA was lower during handgrip in the lying than that in the standing position at rest without exercise. It is concluded that the gravity dependent postural effect dominates the MSNA responsiveness to exercise. Author

A88-54022#**A NEW DRUG IN TREATMENT OF OSTEOPOROSIS**

T. SZILAGYI, I. FOLDES, M. RAPCSAK, J. GYARMATI, JR., and A. SZOOR (Debrecen, Orvostudományi Egyetem, Hungary) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-36, S-37. refs

The effectiveness of Ipriflavone (7-isopropoxy-isoflavone) in preventing immobilization-induced osteoporosis is investigated experimentally in 15 albino Wistar rats. Ten of the rats are given 40 mg/kg body weight per day of Ipriflavone for 8 weeks during plaster-cast immobilization of their right hind limbs; the results are presented in tables and micrographs of bone sections. It is found that the drug significantly diminishes the effects of osteoporosis but does not completely prevent its development. T.K.

A88-54027#**IN VITRO INTERFERON PRODUCTION BY HUMAN LYMPHOCYTES DURING SPACEFLIGHT**

L. BATAKAI, M. TALAS, I. STOGER, K. NAGY (Országos Kozegészségügyi Intézet, Budapest, Hungary), L. HIROS (Medicor Works, Budapest, Hungary) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-50, S-51.

Interferon inducers were added to human lymphocytes on the space station Salyut-6 to study the effects of low gravity on cells which modulate interferon production. The lymphocyte suspensions and interferon inducers were kept at 37 C for periods of 6 days and 4 days in two separate experiments. In both experiments, interferon titers from flight samples were 4-8 times higher than those of synchronous ground controls. In addition, the natural killer activity of the lymphocytes after the flight were about 4 times lower than before the flight. R.B.

A88-54039#**VESTIBULAR-VISUAL CONFLICT DURING STANCE CONTROL AS A SIMULATION OF SOME EFFECTS OF MICROGRAVITY**

F. HLAVACKA (Slovenska Akadémia Vied, Ústav Normálnej a Patologickej Fyziológie, Bratislava, Czechoslovakia), W. BLES, and CH. NJOKIKTIJEN (Free University Hospital, Amsterdam, Netherlands) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-84, S-85. refs

A variable phase relationship was used to describe sinusoidal galvanic stimulation of labyrinths and visual stimulation by a sinusoidal tilting room. Consideration is given to the value of the phase between the visual and vestibular stimuli which evokes maximum body sway and the stressful control of upright posture. The vestibular stimulation was found to have a strong postural effect in the lateral direction more often than visual stimulation.

K.K.

A88-54040#**FOLLOW UP OF THE GASTRIC EMPTYING (GE) BY ULTRASOUNDS AFTER A STRESS (ROTATING CHAIR) - INTEREST OF THIS METHOD IN SPACE DURING SPACE MOTION SICKNESS**

PH. ARBEILLE, R. VALMALLE, F. PATAT, J. M. POTTIER, L. PLESKOF (Tours, Université, France) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-86, S-87. refs

Gastric emptying, which can be disturbed before such clinical symptoms of motion sickness as nausea and vomiting arise, can be quantified by ultrasound imaging. This 'echographic' method is presently demonstrated in the course of rotating-chair experiments on eight subjects, whose gastric emptying time significantly increased after rotation and allowed the disturbances induced upon gastric emptying to be quantified. Ultrasound echography is recommended for gastric-emptying studies during spaceflight, when the efficacy of motion sickness-prevention drugs is being evaluated. O.C.

A88-54043#**PHYSIOLOGICAL RESPONSES OF SKELETOMUSCULAR SYSTEM TO MUSCLE EXERCISES UNDER LONG-TERM HYPOKINETIC CONDITIONS**

A. I. GRIGORIEV and I. B. KOZLOVSKAIA (Institut Mediko-Biologicheskikh Problem Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-93 to S-97. refs

Anti-orthostatic bed-rest (ABR) experiments were carried out over a 120-day period with 21 test subjects. Consideration was

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given to the efficiency of various types of physical exercise at the same as well as at different stages of hypokinesia. Long-term ABR was followed by significant changes in calcium balance. In the control group (that group which did not use any preventative measures), the total calcium loss averaged about 20 g. It was found that groups using pharmacological, physical training, and complex countermeasures did not experience strength and velocity deficiencies. K.K.

A88-54045#

THE RELATIONSHIP BETWEEN CARDIOVASCULAR RESPONSES AND STRESS TOLERANCE BEFORE AND AFTER BED REST

XIANGCHANG ZHUANG, YAMING FAN, QILU XIANG, and XIANYUN SHEN (Institute of Space Medico-Engineering, Beijing, People's Republic of China) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-102 to S-105. refs

A joint HUT LBNP test which was carried out on 20 healthy young males is described. On the basis of their cardiovascular responses, the subjects were divided into the following categories: (1) vascular type, (2) mixed type, (3) cardiac type, and (4) less regulating type. An attempt was made to assess the changes in the features of the cardiovascular responses in the subjects of the four types that had taken place during and after exposure to the hypokinetic bed rest. K.K.

A88-54046#

PHYSICAL PERFORMANCE AND GZ TOLERANCE

PER A. TESCH (Karolinska Institutet, Stockholm, Sweden) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-105A, S-105B. refs

Some of the physiological reactions of combat pilots in response to acute exposure to high G(z) forces, which are associated with a substantial increase in sympathetic nervous system activity, are presently discussed in order to evaluate the influence of the state of an individual pilot's training, and of various physical-training programs, on G(z) tolerance. Attention is given to the ways in which G(z) tolerance may be altered in response to specific physical-conditioning programs. It appears that high aerobic power is not a prerequisite for high G(z)-tolerance in pilots. O.C.

A88-54054#

DYNAMICS OF PROCESSES - A POSSIBILITY TO ANALYZE PHYSIOLOGICAL PARAMETERS

H.-U. BALZER, K. HECHT, S. WALTER, and K. JEWGENOW (Berlin, Humboldt-Universitaet, German Democratic Republic) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-124, S-125.

Autocorrelation and Fourier transform methods are presently used to ascertain stable and unstable conditions in biological systems, which are characterized by a hierarchy of biorhythms. The primary component of this analysis is 'double autocorrelation'; attention is given to the alternation of a circaseptan rhythm in sleep-disturbed patients, which has important desynchronical effects, with a stabilization that is influenced by drug abuse or the application of a placebo. O.C.

A88-54057#

RELATIONS BETWEEN REM-CYCLES, SLEEP DISTURBANCES AND SUBSTANCE-P IN MAN

R. SIEMS, K. HECHT, A. DIEDRICH, E. WACHTEL, H. HUELLER (Berlin, Humboldt-Universitaet, German Democratic Republic) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-130, S-131.

Polygraphical sleep recordings of healthy subjects and subjects with sleep disturbances were obtained in order to study the distribution of frequencies of REM-cycle durations. It is found that the sleep-disturbed patients had mean REM-cycle durations of 134 minutes and a reduced number of REM cycles in comparison to the healthy subjects, who had mean REM-cycle durations of 95 minutes. Sleep-disturbed neurotics treated by substance-P had an increased number of REM cycles per night and nearly-normal REM-cycle durations. R.R.

A88-54066#

ELECTROPHOTOGRAPHY AS A TOOL FOR EVALUATION OF CHANGES INDUCED IN HUMAN ORGANISM BY HYPERGRAVITY

J. SYKORA, I. SOLCOVA, B. JAKOUBEK, Z. DRAHOTA (Ceskoslovenska Akademie Ved, Fyziologicky Ustav, Prague, Czechoslovakia), and A. P. NECHAEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist*, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-150, S-151.

Electrophotograms were obtained of eight subjects exposed twice for 1.5 minutes to 3-5 G. Electrophotographs digitized and evaluated by a Leitz Image Analyzer revealed different shapes before and after centrifugation. The results validate the usefulness of the technique as a tool for evaluating integral and complex changes induced in the human organism by hypergravity. R.R.

A88-55166

TEMPERATURE PROFILES WITH RESPECT TO INHOMOGENEITY AND GEOMETRY OF THE HUMAN BODY

JUERGEN WERNER and MONIKA BUSE (Bochum, Ruhr-Universitaet, Federal Republic of Germany) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1110-1118. refs

(Contract DFG-SFB-114; DFG-WE-919/2-1)

Temperature profiles within the human body are highly dependent on the geometry and inhomogeneity of the body. Physical parameters such as density and heat conductivity of the various tissues and variables such as blood flow and metabolic heat production of different organs are spatially distributed and thereby influence the temperature profiles within the human body. Actual physiological knowledge allows one to take into account up to 54 different spatially distributed values for each parameter. An adequate representation of the anatomy of the body requires a spatial three-dimensional grid of at least 0.5-1.0 cm. This is achieved by photogrammetric treatment of three-dimensional anatomic models of the human body. As a first essential result, the simulation system has produced a realistic picture of the topography of temperatures under neutral conditions. Compatibility of reality and simulation was achieved solely on the basis of physical considerations and physiological data base. Therefore the simulation is suited to the extrapolation of temperature profiles that cannot be obtained experimentally. Author

A88-55168

EFFECT OF 100 PERCENT O2 ON HYPOXIC EUCAPNIC VENTILATION

S. G. HOLTBY, D. J. BEREZANSKI, and N. R. ANTHONISEN (Manitoba, University, Winnipeg, Canada) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1157-1162. Research supported by the Medical Research Council of Canada and University of Manitoba. refs

Ventilation was measured in nine young adults while they breathed pure O₂ after breathing room air, and after 5 and 25 minutes of hypoxia. Transient depressions of ventilation were found with O₂ breathing after both 5 and 25 minutes of hyperoxia, while significant depressions were not found when hyperoxia followed room air breathing. The results show that the normal ventilatory response to isocapnic hypoxia has two components: (1) an excitatory one from peripheral chemoreceptors which is turned off

by O₂ breathing; and (2) a slower inhibitory one which is affected less promptly by O₂ breathing. R.R.

A88-55175**RELATIVE STABILITY OF HUMAN RESPIRATION DURING PROGRESSIVE HYPOXIA**

DAVID W. CARLEY and DANIEL C. SHANNON (Massachusetts General Hospital, Boston; Harvard University; MIT, Cambridge, MA) Journal of Applied Physiology (ISSN 0161-7567), vol. 65, Sept. 1988, p. 1389-1399. refs

The relationship between the relative stability (R) of respiration and the loop gain (LG) of the CO₂ control system was investigated in 15 healthy awake adult males during progressive hypoxia. A minimal mathematical model of respiratory control was used to predict R as a function of LG, and confirmed the observed positive correlation between the two. The results suggest that periodic breathing is a quantitative extension of the relative stability continuum and corresponds to unstable operation of the CO₂ control system. R.R.

A88-55334#**MAIN RESULTS OF MEDICAL INVESTIGATIONS DURING LONG-DURATION SPACE FLIGHTS ONBOARD SALYUT-7 - SOYUZ-T**

O. G. GAZENKO, A. I. GRIGOR'EV, and A. D. EGOROV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p. refs (IAF PAPER 88-074)

Medical investigations conducted during six long-term missions (65 to 237 days) and five short-term missions (8 to 12 days) between 1982 and 1986 on the orbital complex Salyut-7-Soyuz-T are discussed. The flight parameters of Salyut-7 are presented including the environmental parameters, diet, water supply, work and rest arrangements, and exercise habits. Results are presented from experiments concerning cosmonauts' health status, nervous responses, sleep, and work capacity. Decreases in body mass and leg volume, and changes in vestibular function, motor activity, and the cardiovascular system are reported. The fluid-electrolyte metabolism and hormonal status of the cosmonauts are given, including an increase in the production of ADH and aldosterone, activation of the sympathoadrenal, cholinergic and histaminergic systems, and inhibition of the serotonergic system. Experiments on bones, immunology, and extravehicular activity are also presented. R.B.

A88-55429#**THE PREVENTIVE EFFECTS OF L.B.N.P. (LOW BODY NEGATIVE PRESSURE) ON ORTHOSTATIC INTOLERANCE AFTER A 30-DAY BEDREST**

ANTONIO GUELL, LAURENT BRAAK (CNES, Centre Spatial de Toulouse, France), JEAN LOUIS MAUROUX, and ANNE PAVY (Centre Hospitalier Universitaire Rangueil, Toulouse, France) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 6 p. refs (IAF PAPER 88-492)

The specific effects of periodic low body negative pressure (LBNP) sessions on the cardiovascular deconditioning syndrome were studied during a one-month antiorthostatic bedrest simulation experiment. Six volunteers took part in the thirty-day experiment. Several LBNP sessions per day were performed on three subjects. Two orthostatic investigations were performed, one five days before bedrest and the other at the end of the 30-day bedrest period. The results showed an identical response to that resulting from the tilt test performed on the LBNP group during the ambulatory period. In control subjects, high orthostatic intolerance was observed. These results appear to indicate the preventive effects of repeated LBNP sessions on orthostatic intolerance. C.D.

A88-55430*# National Aeronautics and Space Administration, Washington, D.C.

NON-LINEAR CHARACTERISTICS OF THE ENDOLYMPH-CUPULA NYSTAGMUS SYSTEM

PERCIVAL D. MCCORMACK (NASA, Life Sciences Div., Washington, DC) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p. refs (IAF PAPER 88-496)

The way a human can detect angular acceleration forces by means of the semicircular canals in the ears is discussed. The anatomy of the canals and the characteristics of the canal fluids are described. The physical implications of variation in cupula stiffness with angular acceleration are examined by analyzing cross-coupled angular acceleration and modeling mathematically the cupula-endolymph system. The system transfer function is obtained and the nonlinear characteristics of the endolymph-cupula-nystagmus system are discussed. C.D.

A88-55431#**BRAIN ACTIVITY DURING PARABOLIC FLIGHTS**

O. QUADENS, PH. DEQUAE (Antwerpen, Rijksuniversitair Centrum, Antwerp, Belgium), and R. FERRI (Oasi Brain Research Institute, Troina, Italy) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 6 p. refs (IAF PAPER 88-497)

The electroencephalogram has been recorded in three subjects during parabolic flights. The power spectrum, calculated by means of the fast Fourier transform, evidenced a 90 sec periodicity, similar to that of the parabolas, in the theta frequency band. The increase in the theta frequency power corresponds to the zero G acrophases. Author

A88-55433*# George Washington Univ., Washington, D.C.

EARTH BENEFITS FROM SPACE LIFE SCIENCES

V. GARSHNEK (George Washington University, Washington, DC), A. E. NICOGLOSSIAN, and L. GRIFFITHS (NASA, Washington, DC) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 5 p. refs (IAF PAPER 88-500)

The applications to medicine of various results from space exploration are examined. Improvements have been made in the management of cardiovascular disease, in particular the use of the ultrasonic scanner to image arteries in three dimensions, the use of excimer lasers to disrupt arterial plaques in coronary blood vessels, and the use of advanced electrodes for cardiac monitoring. A bone stiffness analyzer has helped to diagnose osteoporosis and aid in its treatment. An automated light microscope system is used for chromosome analysis, and an X-ray image intensifier called Lixiscope is used in emergency medical care. An advanced portable defibrillator has been developed for the heart, and an insulin delivery system has been derived from space microminiaturization techniques. C.D.

A88-55434#**SPACE EXPLORATION AND PREVENTIVE MEDICINE**

O. G. GAZENKO, R. M. BAEVSKII, and A. D. EGOROV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p. refs (IAF PAPER 88-502)

The applications of space medicine achievements to medicine in general are considered. A prognostic approach to health assessment has been developed, and automatic systems for large-scale prognostic examinations of various population groups have been designed and developed. These systems help detect prenosological and premorbid states and determine risk factors of different diseases. They recognize that the major risk factor for disease is the deterioration of adaptive capabilities. It is emphasized that advances in preventive medicine can be achieved with the aid of methods developed in space medicine. C.D.

N88-29268# Utah Univ., Salt Lake City.

CURRENTS INDUCED IN A HUMAN BEING FOR ELECTROMAGNETIC FIELDS TO 10 KHZ-50 MHZ Final Report
OM P. GANDHI 15 Jan. 1988 52 p
(Contract N00014-86-K-01014)

(AD-A191977; ETL-88002-TR) Avail: NTIS HC A04/MF A01
CSSL 06J

The two tasks undertaken during the period of this project are: (1) Development of a high resolution thermal model of the human leg and its use to estimate the temperature distribution as a result of the induced high current densities at radio frequencies. (2) Development of a high-resolution, anatomically-realistic, inhomogeneous model of man and its use to calculate the SAR and induced current distributions for frequencies to 100 MHz. We have previously shown (1,2) that vertically polarized incident plane waves are capable of inducing fairly significant RF currents in a free-standing human being. Foot currents were found to be proportional to the frequency of incident radiation for the frequency band 0 to 40 MHz with values as high as 12.7 milli A/(V/m) measured for adult human volunteers at 40 MHz. Recognizing that the induced current is divided equally between the two legs on its way to the ground underneath, fairly high current densities result in the various cross sections of the leg with concomitant high rates of energy deposition (SAR). In particular, due to the predominantly bony nature of the ankle cross section forcing the RF current to flow in an effective 9.5 sq cm cross section of the high conductivity tissues, very high current densities (J) and the resulting SARs are set up. These SARs are almost two orders of magnitude larger than the metabolic rates of the tissues and considerably in excess of the ANSI guideline of 8 W/kg for any 1 g of tissue. Author

N88-29269 Connecticut Univ., Storrs.
HUMAN AUDITORY AND VISUAL CONTINUOUS EVOKED POTENTIALS Ph.D. Thesis

ZVI Z. GOLDMAN 1987 192 p
Avail: Univ. Microfilms Order No. DA8800222

The motivation for this research was to develop an evoked potential methodology for non-invasively monitoring the auditory and visual sensory channel engagement and interaction (A x V) in humans. Sensory interaction was concluded whenever response variations of one sensory channel could be attributed to parameter changes of an additional stimulus, simultaneously presented to another sensory channel. This study adapted the phase-lock technique in characterizing the stimulus parameter-space of the A x V process. Dissert. Abstr.

N88-29270# Army Research Inst. of Environmental Medicine,
Natick, Mass.

HUMAN PERFORMANCE AND ACUTE HYPOXIA, CHAPTER 12
CHARLES S. FULCO and ALLEN CYMERMAN Nov. 1987

52 p
(AD-A192604; USARIEM-M-11/88) Avail: NTIS HC A04/MF A01
CSSL 06E

The effects of a reduction in ambient oxygen pressure occurring within four hours are dependent to a large extent on one principal factor: the degree of hypoxia and the resultant arterial hypoxemia. As the degree of hypoxia increases, a series of compensatory responses occur in various organ systems which are directly proportional to the severity. Above approximately 1500 m, demonstrable changes become evident in ventilation, cardiac output, circulation, blood endocrine levels, and sensory and mental function. With a level of hypoxia equivalent to approximately 4000 m, the changes can become considerable and can be discerned for almost any physiological and psychological function. The problems are further accentuated when exercise is superimposed on the hypoxia. With physical performance, reductions of both maximal and endurance exercise capacity are observed almost immediately due to the reduction in oxygen content of arterial blood despite potentially beneficial changes in alveolar ventilation, distribution of ventilation/perfusion ratios, cardiac output distribution, shifts in the oxygen dissociation curve, increases in sympathetic nervous system activity, and changes in fluid control hormones. GRA

N88-29271# Army Research Inst. of Environmental Medicine,
Natick, Mass.

EFFECTS OF PSYCHOPHYSICAL LIFTING TRAINING ON MAXIMAL REPETITIVE LIFTING CAPACITY Report, Feb.-May 1985

M. A. SHARP and S. J. LEGG Dec. 1987 28 p
(Contract DA PROJ. 3E1-62787-A-879)
(AD-A192605; USARIEM-M-12/88) Avail: NTIS HC A03/MF A01
CSSL 06J

The purpose of this investigation was to determine the effectiveness of psychophysical lifting training on maximal repetitive lifting capacity. Maximal repetitive lifting capacity was defined as the maximum box mass that could be lifted for a full hour to a height of 132 cm at a rate of 6 lifts per minute. Eight male subjects participated in five psychophysical lifting training sessions each week for four weeks. Each day subjects were presented one empty and one heavily loaded box and asked to adjust to the maximum load they felt capable of lifting for one hour. This load was lifted at a rate of 6 lifts per minute to a height of 132 cm for two 15 minute sessions. After four weeks of training, subjects did not select a heavier training load, exhibit a decreased training heart rate, or report a decreased training RPE. The training program produced a significant increase in one hour maximal repetitive lifting capacity. The box mass selected for the maximal repetitive lifting capacity test increased significantly following training, with no concomitant change in VO₂, heart rate or RPE. GRA

N88-29272# Army Research Inst. of Environmental Medicine,
Natick, Mass.

ALTERATIONS IN UPPER EXTREMITY MOTOR FUNCTION IN SOLDIERS DURING ACUTE HIGH ALTITUDE EXPOSURE

ALLAN J. HAMILTON, LAURIE A. TRAD, and ALLEN CYMERMAN Mar. 1988 31 p
(AD-A192676; USARIEM-M-31/88) Avail: NTIS HC A03/MF A01
CSSL 06E

Acute Mountain Sickness (AMS) is a syndrome of inadequate acclimatization to the diminished concentration of oxygen available at high altitude. In its mild form, it is almost solely a symptomatic illness and physical examination is usually unremarkable. We hypothesized that while clinical examination might be insensitive for the detection of quantifiable changes, computerized measures of neurological function could be capable of noninvasively measuring and analyzing decrements in neurological function at high altitude. For this reason, a device was designed and tested called an upper extremity movement analyzer (UEMA) which employs magnetic coil search technology to record movements of a subject's upper extremity. Software programs were developed which analyze the recorded movements of a pen stylus between a common start position and a randomly generated series of target positions on the digitizing tablet. Subjects were first tested at SL and then at 18 hrs and 30 hrs. Clinical assessments, neurological examinations, and environmental symptoms questionnaires (ESQ) were performed serially to compare with UEMA. GRA

N88-29273# Yale Univ., New Haven, Conn. School of
Medicine.

LIMITS OF PATTERN DISCRIMINATION IN HUMAN VISION
Annual Technical Report, 1 Jan. 1987 - 1 Jan. 1988

JOY HIRSCH 1 Jan. 1988 14 p
(Contract AF-AFOSR-0077-86)
(AD-A193449; AFOSR-88-0375TR) Avail: NTIS HC A03/MF A01
CSSL 06D

The three specific aims of this current ongoing project include: (1) the characterization of the human and monkey photoreceptor lattice; (2) the study of new spatial discriminations in two dimensions including circle center, area, and dot density discriminations, and (3) the expansion and generalization of current models of one-dimensional spatial discriminations such as spatial-frequency, line separation, and vernier acuity. GRA

N88-29274# Army Research Inst. of Environmental Medicine, Natick, Mass.

ATTITUDES TOWARDS THE COLD: EFFECTS ON PSYCHOLOGICAL MOOD AND SUBJECTIVE REPORTS OF ILLNESS DURING COLD WEATHER TRAINING

RICHARD F. JOHNSON, LAURENCE G. BRANCH, and DONNA J. MCMENEMY Feb. 1988 33 p
(AD-A194777; USARIEM-T-11/88) Avail: NTIS HC A03/MF A01 CSCL 05H

The present study examined the influence of soldiers' attitudes toward the cold, expectations concerning living and working in the cold, and subjective reports of psychological stress on subsequent symptoms of physical illness and psychological mood during military training in the cold. GRA

N88-29275# New York Univ., New York. Neuromagnetism Lab. **CRYOSQUID: A SQUID-BASED MAGNETIC FIELD SENSOR Final Technical Report No. 3, 15 Aug. 1984 - 30 Nov. 1987**

S. J. WILLIAMSON and LLOYD KAUFMAN 15 Mar. 1988 16 p
(Contract AF-AFOSR-0313-84)
(AD-A194237; AFOSR-88-0461TR) Avail: NTIS HC A03/MF A01 CSCL 14B

A new type of neuromagnetometer has been developed to enhance the capability for measuring the magnetic field of the human brain. This system - known as CryoSQUID - results from the marriage of two advanced technologies: a refrigerator incorporating closed-cycle operation of a pair of cryocoolers and a sensor incorporating the superconducting quantum interference device (SQUID). The apparatus is relatively small and requires no supply of liquid helium for initial cooling or operation. Only a source of electrical power is needed. Each sensor relies on a detection coil wound in the geometry of a second-order gradiometer so as to minimize the effects of ambient magnetic noise found in typical unshielded environments. The intrinsic noise level of CryoSQUID is comparable to a magnetic field sensitivity of 20 femtoTesla within a one-hertz bandwidth. Residual noise at 1.2 Hz and its harmonics, contributed by the displacer in the Gifford-McMahon cooler, is virtually eliminated in real time by an adaptive filter run on a personal computer. GRA

N88-29276# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

IMPROVEMENTS IN TECHNIQUES OF MICROWAVE THERMOGRAPHY Final Report No. 4, 15 Nov. 1982 - 30 Jun. 1985

ALAN H. BARRETT Feb. 1988 19 p
(Contract DAMD17-83-C-3025)
(AD-A193620) Avail: NTIS HC A03/MF A01 CSCL 06G

Research efforts were concentrated in the following areas: (1) The development and testing of a reflection compensating radiometer. (2) A theoretical investigation of the variation of microwave penetration depth in human tissue as a function of the aperture size of the contact antenna. (3) Antenna design to give improved penetration depth. (4) A study of the utility of bistatic measurements to detect embedded tumors and aid microwave thermography and hyperthermia. GRA

N88-29277# South Carolina Univ., Columbia.

CONJUNCTIVE MEASUREMENT THEORY: COGNITIVE RESEARCH PROSPECTS Final Report, 15 Aug. 1986 - 30 Nov. 1987

ROBERT J. JANNARONE 25 Jan. 1988 30 p
(Contract N00014-86-K-0817; PROJ. RR0-4204)
(AD-A193627; USCM-88-12) Avail: NTIS HC A03/MF A01 CSCL 05H

A new psychometric development theory based on conjunctive measurement is introduced with an eye toward cognitive modeling. Conjunctive measures are shown that can reflect persons' abilities to: combine component skills that are individually necessary for solving a given task; learn information at one point and successfully use it at a later point; positively transfer learned material from one setting to another; and improve knowledge in different ways between pretests and posttests. Several theoretical issues are

also introduced to contrast conjunctive testing with traditional testing. The main distinction is that conjunctive measurement violates test theory's local independence axiom, by allowing individuals to change rather than be unaffected during the measurement process. GRA

N88-29278# New York Univ., New York.

METHODS AND INSTRUMENTATION FOR BIOMAGNETISM Report, 1 Jan. 1987 - 28 Feb. 1988

LLOYD KAUFMAN, SAMUEL J. WILLIAMSON, and S. E. ROBINSON 28 Feb. 1988 9 p
(Contract F49620-85-K-0004; SCEE-HER/86-14)
(AD-A193811; AFOSR-88-0344TR) Avail: NTIS HC A02/MF A01 CSCL 06E

Capabilities for biomagnetic measurements have been advanced by the successful development of a Superconducting Quantum Interference Device (SQUID)-based magnetic sensor that does not rely on liquid helium for cooling. This system, known as CryoSQUID, achieves a sensor noise level that is appropriate for high-sensitivity measurements of the magnetic field of the human brain. It employs an external compressor and a two-stage refrigerator within the sensor's dewar to cool a dc-SQUID and associated detection coil. The sensor can be operated in any orientation, including horizontally and upside-down. GRA

N88-29279# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.

ANALYSIS OF THE HOPFIELD NEURAL NETWORKS AND THEIR APPLICATION TO PATTERN RECOGNITION M.S. Thesis

BERNARD F. GERASIMAS, JR. 1988 68 p
(AD-A193827) Avail: NTIS HC A04/MF A01 CSCL 06D

This three-part discussion provides the necessary background in understanding the make-up and operation of the generalized biological neuron and its role in memory and pattern recognition in the brain. There are many specific types of neurons which have adapted to perform specialized operations as part of the central nervous system. Motor neurons deal with the operation of the muscles; optical neurons deal with the operations of the eyes. Although there are differences in physical make-up, their basic operation is similar and is known as the generalized biological neuron. The physical structure and operation of this neuron will be examined. A brief discussion will follow on how the inter-connection and paralleled structure of neural networks in the optical system and cortex of the brain are able to send, store, and recall information dealing with pattern recognition. This will be followed by a brief discussion of the first mathematical model developed of the generalized biological model. Its make-up is the building block for the vast majority of neural network models which followed. GRA

N88-29280# Naval Submarine Medical Research Lab., Groton, Conn.

EFFECT OF HYPOXIA ON SPEECH RECOGNITION IN NOISE Interim Report

LYNNE MARSHALL Jul. 1987 17 p
(AD-A193943; NSMRL-1111) Avail: NTIS HC A03/MF A01 CSCL 06J

Speech-to-babble ratios for 50 percent word recognition were measured in four men, age 30 to 35, while breathing 12 and 21 percent oxygen. There were no differences between the two conditions. Learning effects, however, were seen for the task. As the 12 percent-oxygen level is considerably lower than would be used for routine reduction of fire hazards onboard submarines, reduced oxygen levels at the intermediate levels being considered should not affect speech recognition. GRA

N88-29281# Army Research Inst. of Environmental Medicine, Natick, Mass.

GASTRIC EMPTYING DURING WALKING AND RUNNING: EFFECTS OF VARIED EXERCISE INTENSITY

P. D. NEUFER, ANDREW J. YOUNG, and MICHAEL N. SAWKA

Mar. 1988 21 p

(AD-A194025) Avail: NTIS HC A03/MF A01 CSCL 06D

Gastric emptying is increased during running (50 to 70 pct maximal aerobic uptake, VO(sub 2) max) as compared to rest. Whether this increase varies as a function of mode (i.e., walking vs running) and intensity of treadmill exercise is unknown. To examine the gastric emptying characteristics of water during treadmill exercise performed over a wide range of intensities relative to resting conditions, 10 males ingested 400 ml of water prior to each of six 15 min. exercise bouts or 15 min. of seated rest. Three bouts of walking exercise (1.57 m/sec) were performed at increasing grades eliciting approx. 28, 41 or 56 pct of VO(sub 2) max). On a separate day, three bouts of running (2.60 m/sec) exercise were performed at grades eliciting approx. 57, 65 or 75 pct VO(sub 2) max). Gastric emptying was increased during treadmill exercise at all intensities excluding 75 pct VO(sub 2) max) as compared to rest. Gastric emptying was similar for all intensities during walking and at 57 and 65 pct VO(sub 2) max) during running. However, running at 74 pct VO(sub 2) max) decreased the volume of original drink emptied as compared to all lower exercise intensities. Stomach secretions were markedly less during running as compared to walking and rest. These data demonstrate that gastric emptying is similarly increased during both moderate intensity (approx. 28 to 65 pct VO(sub 2) max) walking or running exercise as compared to resting conditions. GRA

N88-29282# Centre d'Essais en Vol, Istres (France). Lab. de Medecine Aerospatiale.

VARIATION OF CAROTID FLOW UNDER LOAD, STUDIED BY THE DOPPLER ECHO METHOD [VARIATION DU DEBIT DE LA CAROTIDE PRIMITIVE SOUS FACTEUR DE CHARGE ETUDIE PAR METHODE ECHO-DOPPLER]

G. FLORENCE, J. M. CLERE, H. MAROTTE, A. LEGER, and H. VIEILLEFOND Mar. 1988 72 p In FRENCH (REPT-1149; ETN-88-92887) Avail: NTIS HC A04/MF A01

The effects of +Gz acceleration (head to feet of the pilot) were investigated in relation to the constraints created by modern combat aircraft. The carotid artery cross section and the blood flow were measured by echotomography and echo Doppler measurements. The cross section does not seem to change under the acceleration load, but the flow diminishes by 5 percent under upward acceleration. ESA

N88-29283# National Aerospace Medical Centre, Soesterberg (Netherlands).

ACTIVITIES REPORT IN AEROSPACE MEDICINE Annual Report, 1986 [JAARVERSLAG 1986]

1986 46 p In DUTCH (ETN-88-92906) Avail: NTIS HC A03/MF A01

Medical examinations, X-ray recordings, electrocardiograms, and electroencephalograms are tabulated. Military examinations, examinations for the Royal Dutch Airlines, and examinations for the A-licence are summarized. The research and development activities are outlined: general medical research, psychodiagnostic investigation and selection, workloads of helicopter pilots, surgery and audiology, internal medicine, and flight physiology. ESA

N88-30032# International Scientific Radio Union, Brussels (Belgium).

BIOEFFECTS OF ELECTROMAGNETIC WAVES

C. ROMERO-SIERRA *In its* Review of Radio Science, 1984-1986 20 p 1987

Avail: NTIS HC A09/MF A01

The scientific literature of these years, 1984 to 1986, on the bioeffects of electromagnetic (EM) waves includes many articles with not only the finest scientific methodology but also discriminating critical analysis and data interpretation. A better understanding of the basic interactive mechanisms was gained in recognizing that they depend on three groups of variables: the EM field, the living systems and their components, and their coupling efficiency, i.e., dosimetry and window phenomena. Although most areas of this scientific field have developed steadily

during these years, some of them have attracted particular attention, e.g., dosimetry, cellular and subcellular effects, diagnostic and therapeutic applications, and pulsed EM fields. Author

N88-30278# Army Research Inst. of Environmental Medicine, Natick, Mass.

ACCIDENTAL HYPOTHERMIA

DANIEL F. DANZL, ROBERT S. POZOS, and MURRAY P. HAMLET 3 Mar. 1988 113 p

(AD-A194967) Avail: NTIS HC A06/MF A01 CSCL 06E

Hypothermia has played a major role in the medical statistics from many armies deploying in a cold environment. The loss of body heat, either from the decreased heat production, increased heat loss, or alterations in thermoregulation are important in the epidemiology of this injury. Cold appears to protect various portions of the body from the decreasing cardiovascular capability of delivering nutrients and oxygen. Recognition of these patients as they are severely hypothermic is the key to survival. Emergency Department of Management involves fluid resuscitation, respiratory support, active core rewarming and management of electrolytes. Cardiovascular support is critical to long-term management and a successful outcome. Prevention is the key to individuals exposed to a high threat environment. GRA

N88-30279# Naval Submarine Medical Center, Groton, Conn. **VISUAL SENSITIVITIES UNDER REDUCED OXYGEN Interim Report**

S. M. LURIA and NANCY MORRIS 27 Jan. 1988 19 p (AD-A195628; NSMRL-1108) Avail: NTIS HC A03/MF A01 CSCL 06D

Thirteen subjects were confined in a hypobaric chamber for 15 days, and their scotopic sensitivity and field-of-view were measured twice a day. The oxygen concentration in the nitrogen-oxygen atmosphere was changed every three days in this sequence: 21 pct, 17 pct, 21 pct, 13 pct, and 21 pct. The barometric pressure was always equivalent to sea-level, except for the final 7 hours of exposure to 17 pct oxygen when it was reduced to 576 torr. The atmosphere was contaminated with 0.9 pct carbon-dioxide throughout the confinement. Neither visual function was degraded by the lowered oxygen levels. GRA

N88-30280# School of Aerospace Medicine, Brooks AFB, Tex. **CENTRAL SEROUS CHORIORETINOPATHY IN USAF**

AVIATORS: A REVIEW Final Report, Dec. 1986 - Dec. 1987

ROBERT P. GREEN, JR., DEAN W. CARLSON, J. P. DIECKERT, and THOMAS J. TREDICI Mar. 1988 20 p

(AD-A195697; USAFSAM-TR-87-34) Avail: NTIS HC A03/MF A01 CSCL 06E

Iidopathic central serous chorioretinopathy (ICSC) is an uncommon disease with the potential to cause loss of visual acuity, decreased color vision, and decreased depth perception. These visual changes may become permanent and require removal of aviators from flight status. This study reviews 55 eyes of 47 USAF aviators with ICSC examined at the United States Air Force School of Aerospace Medicine (USAFSAM), Brooks Air Force Base, Texas. Clinical and aeromedical findings, both on initial and on follow-up ophthalmic examination were studied. Ninety-seven percent of aviators otherwise medically qualified were ultimately returned to flight status. Overall, 51 percent had recurrent episodes, 17 percent had bilateral disease, and 13 percent underwent laser photocoagulation. Visual acuity correlated with active disease, and there was a trend toward poor stereopsis and diminished color vision with worsening visual acuity. Eighty-six percent attained a final visual acuity of 20/20 or better. On final examination, 90 percent had normal stereopsis, 87 percent had normal color vision, and 49 percent had a normal central visual field. Eyes with recurrent disease tended to have degraded final visual acuity, stereopsis, color vision, and central visual field. GRA

N88-30281* National Aeronautics and Space Administration, Washington, D.C.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 315)

Oct. 1988 71 p
(NASA-SP-7011(315); NAS 1.21:7011(315)) Avail: NTIS HC A04;
NTIS standing order as PB88-912300. \$9.00 domestic, \$18.00
foreign CSCL 06E

This bibliography lists 211 reports, articles and other documents introduced into the NASA scientific and technical information system in September, 1988. Author

N88-30282# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

COMPARISON OF MORNING WITH AFTERNOON NITROGEN ELIMINATION IN RESTING SUBJECTS BREATHING 100 PERCENT OXYGEN M.S. Thesis

GRANT A. BROWN 1988 49 p
(AD-A196191; AFIT/CI/NR-88-23) Avail: NTIS HC A03/MF A01 CSCL 06D

The purpose of this study was to compare morning with afternoon nitrogen elimination rates in subjects breathing 100 percent oxygen. Less nitrogen elimination during the morning could possibly account for the higher incidence of altitude-induced decompression sickness reported during the morning. No difference was noted between the volume of nitrogen eliminated in the morning or afternoon sessions. However, significant correlations were noted between nitrogen elimination and physiological parameters associated with stress (e.g., increased heart rate and increased carbon dioxide elimination) implying that psychological and metabolic factors may influence the rate of nitrogen elimination. These data suggest that there is no diurnal variation in the effectiveness of breathing 100 percent oxygen as a means of denitrogenation. The increased incidence of DCS during the morning hours must therefore be due to other factors. GRA

N88-30283# Technion - Israel Inst. of Tech., Haifa.

MODELS OF CEREBRAL-BODY PERFUSION AND CEREBRAL CHEMICAL TRANSPORT Annual Report, Oct. 1986 - Oct. 1987

S. SOREK, J. BEAR, and M. FEINSOD Mar. 1988 71 p
(Contract AF-AFOSR-0320-86; AF-AFOSR-0233-85)
(AD-A194945; SR-3) Avail: NTIS HC A04/MF A01 CSCL 06D

In this research, a sequence of models is constructed to simulate the movement of fluids and chemicals in the cerebrovascular system. One model simulates the nonsteady response to perfusion in various sections of the brain. In a second model certain relevant parts of the body are added to form a single brain-body model. A third model simulates the transport of selected chemical components through the cerebrovascular system. Predictions derived from the brain model were shown to be well within the range of available clinical observations. The brain-body model describes the interaction between the cerebral, the cardiovascular and the respiration systems. It is excited by expiration/inspiration fluxes and accounts for the effects of hydrostatic, environmental pressures, flight maneuvers with excessive (head to bottom) gravity acceleration and resuscitation procedures. In simulating chemical processes in the brain, the model accounts for carbon dioxide, bicarbonate, and hydrogen, as they are transport by perfusion and diffusion in the presence of chemical reactions. This model also focuses on the flow control between brain arteries and capillaries, due to changes in CO₂ concentration. GRA

N88-30284# Louvain Univ. (Belgium).

CENTRAL ADRENERGIC RECEPTORS AS MEDIATORS OF CENTRAL RESPONSE TO STRESS: STUDY WITH POSITRON EMISSION TOMOGRAPHY (PET) Final Scientific Report, 30 Sep. 1986 - 29 Sep. 1987

ANDRE M. GOFFINET 19 Feb. 1988 9 p
(AD-A194947) Avail: NTIS HC A02/MF A01 CSCL 06D

This report describes initial studies designed to investigate the effects of a high degree of neurological alertness on brain metabolism. Positron emission tomography (PET) was used to quantitate brain metabolism using fluorodeoxyglucose (FDG) as an indicator of glucose uptake during mental stimulation provided by playing a video game (Mooncrash) for 30 minutes. Brain metabolism in 22 regions during neurological alertness was

compared with the resting state. In most subjects there was a marked increase in brain metabolism with stimulation, however there was tremendous variability in brain metabolism in the eight subjects. Consistent patterns of activation were found with maximal activation in primary visual cortex, followed by parieto-occipital cortex, cerebellum and thalamus. GRA

N88-30285# School of Aerospace Medicine, Brooks AFB, Tex.
A FIELD STUDY ON SOFT CONTACT LENS WEAR IN USAF MILITARY TRANSPORT AIRCRAFT Progress Report, May 1985 - Jan. 1987

RICHARD J. DENNIS, WILLIAM J. FLYNN, CAROLYN J. OAKLEY, and THOMAS J. TREDICI Apr. 1988 24 p
(AD-A195962; USAFSAM-TR-88-4) Avail: NTIS HC A03/MF A01 CSCL 06J

Contact lens wear as an alternative to spectacles for the correction of refractive errors in USAF aircrew members remains a controversial issue. Military transport aircrew must contend with reduced oxygen levels (typical cabin pressures of 5,000 to 8,000 ft), low relative humidity (10 to 15 percent), cigarette smoke, and fatigue and stress on long missions. Ten subjects wearing soft contact lenses and 6 control subjects not wearing contact lenses were evaluated visually and with a slit lamp onboard a C-5 aircraft on a routine mission to PACAF. Soft contact lens wearers noted no significant loss of visual acuity or contrast sensitivity during the flights. Some measures of corneal physiological stress (conjunctival injection, tear debris, etc.) were evaluated in both contact lens wearers and controls. Lens dehydration from the low relative humidity may have been the primary cause of the corneal physiological stress in the contact lens wearers. The results indicate that although there are increased physiological stresses on the cornea in the aircraft environment, there was not sufficient degradation in visual performance or lens comfort to preclude soft contact lens wear in military transport aircraft. GRA

N88-30286# North Carolina Univ., Chapel Hill.

EVALUATION OF THE POTENTIAL HEALTH HAZARDS ASSOCIATED WITH THE MACHINING OF CARBON FIBER COMPOSITES M.S. Thesis Final Report

MICHAEL A. ZUSTRA 1987 79 p
(AD-A194835) Avail: NTIS HC A05/MF A01 CSCL 06I

Industrial hygiene surveys were conducted to assess personnel exposures to carbon fibers and carbon/epoxy composite dust during carbon composite airframe sanding operations. The operation is currently performed every two to three weeks for eight hours at a time. The nature and frequency of operation performance is expected to change as more composite aircraft are put into service. The health implications of carbon composite particulate exposure are not well understood. Good industrial hygiene practices, however, suggest that exposure levels be kept to a minimum. Recommendations for reducing personnel exposure have been made. To characterize the composite debris, a particle size distribution and fiber dimension analyses were done. Additionally, several organizational standards relating to carbon composite particulates were evaluated. A recommendation for reducing the applicable Coast Guard standards has been made. Other potential hazards identified were exposure to solvents during lay-up procedures, and to primer dust during sanding work. Both require further evaluation to determine the extent of the exposure. GRA

N88-30287# Ohio Wesleyan Univ., Delaware. Dept. of Psychology.

FUNCTIONAL ASSESSMENT OF LASER IRRADIATION Annual Report, Mar. 1984 - Feb. 1985

DAVID O. ROBBINS Mar. 1988 44 p
(Contract DAMD17-81-C-1065; DA PROJ. 3E1-62777-A-878)
(AD-A195735) Avail: NTIS HC A03/MF A01 CSCL 06G

Exposure of the retina to intense spots of coherent light produces immediate changes in the ability of the animal to perform a visual discrimination task. Relatively large shifts in visual acuity occur during laser irradiation and recovery is somewhat rapid following termination of relatively low-energy, long duration

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exposures. With more intense energies, recovery is slower and permanent shifts in postexposure spectral sensitivity often accompany these types of exposure conditions. GRA

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

A88-53663#

TIME DELAY COMPENSATION USING SUPPLEMENTARY CUES IN AIRCRAFT SIMULATOR SYSTEMS

MICHAEL S. MERRIKEN, WILLIAM V. JOHNSON, JEFFERY D. CRESS (Systems Research Laboratories, Inc., Dayton, OH), and GARY E. RICCIO (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 295-303. refs
(Contract F33615-85-C-0541)
(AIAA PAPER 88-4626)

This study investigated the effects of providing real-world supplementary information to the visual and tactual modalities to reduce the deleterious effects of a delayed primary display on operator control performance. The supplementary visual and motion cues were presented at two different update rates: (1) at the same rate as the primary display and (2) at a rate of 133 ms faster. The results indicate that the conditions with the faster updating secondary cues had better performance in altitude control than the conditions with the cues at the same rate as the delayed primary display. There were no significant effects for heading control. When compared to a control condition with no supplementary cue there were no statistical differences but the trend of the faster updating secondary cue conditions having better performance scores was maintained for both altitude and heading control. Author

A88-53672#

A BROADER VIEW OF IN COCKPIT MOTION AND FORCE CUING

FRANK M. CARDULLO (New York, State University, Binghamton) and JOHN B. SINACORI (John B. Sinacori Associates, Hollister, CA) AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988. 8 p. refs
(AIAA PAPER 88-4585)

The complete stimulus set available to the pilot of high-performance aircraft in both low and high g environments (the onset and sustained cuing modes) is studied. It is noted that the use of thermal and vibrotactile stimulation as well as direct neural stimulation may provide some of the somatosensory and vestibular cues without the use of moving platforms, loaders, and pressure devices. K.K.

A88-53849

HUMAN FACTORS IN FLIGHT

FRANK H. HAWKINS Aldershot, England, Gower Technical Press, 1987, 360 p. refs

The application of human-factors theory and research to the design of aircraft cockpits and to pilot training is examined in a critical overview of the current status, and recommendations for improvements are presented. Chapters are devoted to the history and evolution of human-factors research; the nature of human error; fatigue, body rhythms, and sleep; fitness and performance; vision and visual illusions; motivation and leadership; language and speech communication; attitudes and persuasion; training and training devices; documentation; displays and controls; space and layout; the aircraft cabin and its human payload; and education

and application. Diagrams, drawings, graphs, and flow charts are provided. T.K.

A88-55046

THE ROLE OF HUMAN FACTORS IN EXPERT SYSTEMS DESIGN AND ACCEPTANCE

AZAD M. MADNI (Perceptronics, Inc., Woodland Hills, CA) Human Factors (ISSN 0018-7208), vol. 30, Aug. 1988, p. 395-414. refs

The critical psychological and human factors issues that must be addressed in the design, prototyping, and acceptance of expert systems are discussed. Human factors considerations are addressed from the development, rapid prototyping, and end-user perspectives. Human factors guidelines are provided for each knowledge-processing stage underlying expert system development, prototyping, evaluation, and acceptance. K.K.

A88-55048* Behavioral Research Associates, West Lafayette, Ind.,

LIKELIHOOD ALARM DISPLAYS

ROBERT D. SORKIN (Behavioral Research Associates; Purdue University, West Lafayette, IN), BARRY H. KANTOWITZ (Battelle Memorial Institute, Seattle, WA), and SUSAN C. KANTOWITZ (Behavioral Research Associates, West Lafayette, IN) Human Factors (ISSN 0018-7208), vol. 30, Aug. 1988, p. 445-459. refs
(Contract NAS2-12360)

In a likelihood alarm display (LAD) information about event likelihood is computed by an automated monitoring system and encoded into an alerting signal for the human operator. Operator performance within a dual-task paradigm was evaluated with two LADs: a color-coded visual alarm and a linguistically coded synthetic speech alarm. The operator's primary task was one of tracking; the secondary task was to monitor a four-element numerical display and determine whether the data arose from a 'signal' or 'no-signal' condition. A simulated 'intelligent' monitoring system alerted the operator to the likelihood of a signal. The results indicated that (1) automated monitoring systems can improve performance on primary and secondary tasks; (2) LADs can improve the allocation of attention among tasks and provide information integrated into operator decisions; and (3) LADs do not necessarily add to the operator's attentional load. Author

A88-55050* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPEECH RESPONSES AND DUAL-TASK PERFORMANCE - BETTER TIME-SHARING OR ASYMMETRIC TRANSFER?

MICHAEL A. VIDULICH (NASA, Ames Research Center, Moffett Field, CA) Human Factors (ISSN 0018-7208), vol. 30, Aug. 1988, p. 517-529. refs

The value of speech controls in a dual-task experiment that also evaluated asymmetric transfer effects is considered. There was no evidence of asymmetric transfer in spite of significant effects supporting the advantage of mixing manual and speech responses. The data suggest that speech controls can be used to enhance performance in operational multiple-task environments. K.K.

A88-55336#

SPACE STATION HABITATION MODULE - PRIVACY AND COLLECTIVE LIFE

DANIELE BEDINI and ROBERTO PINOTTI (Futuro, Florence, Italy) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 11 p. refs
(IAF PAPER 88-080)

A design for the Space Station habitation module is proposed and illustrated. Problems in designing the module include creating an adaptable configuration, providing a design that will minimize psychological and sociological stress, allowing for an equilibrium between private and collective life. The need for architectural variety and flexibility of architectural elements is examined. The areas of the module are described, noting the possible uses of each section. R.B.

A88-55485

TRAINING FUTURE TOMCAT AND INTRUDER AIRCREWS

HARRY F. BEATON (Grumman Corp., Electronics Systems Div., Bethpage, NY) Horizons (ISSN 0095-7615), vol. 24, no. 1, 1988, p. 2-7, 9.

A simulator complex which is part of a U.S. Navy program to develop common tactical aircrew trainers is discussed. The advantages of concurrent trainer development and aircraft modification are examined, included cost reductions and readily available trainers for modified aircraft. Aspects of the simulator complex include 22 interacting microcomputers, the ability to place up to 128 targets on the simulated radar presentations, the use of color, and three-dimensional displays. The complex, which houses separate facilities for F-14D and A-6 training, is described and illustrated, and the history of U.S. Navy training devices is reviewed. R.B.

N88-29284# Air Command and Staff Coll., Maxwell AFB, Ala.

FUTURE AIR-TO-AIR TRAINING FOR THE RF-4

JOHN W. DRAIN Apr. 1988 34 p
(AD-A194363; ACSC-88-0780) Avail: NTIS HC A03/MF A01
CSCL 05F

This study examines the adequacy of current RF-4 upgrade and continuation training programs if the AIM-9L is mounted on the RF-4 and two-ship formation tactics are increasingly employed. Current training at Lead-In Fighter Training (LIFT) and the RF-4 Operational Training Course (OTC) are shown to inadequately train crewmembers in the air-to-air skills they require. This study proposes a new RF-4 OTC air-to-air program based on the air-to-air phase of the F-4 OTC syllabus. Mission Qualification Training (MQT) and Continuation Training (CT) are shown to inadequately maintain the air-to-air skills taught at LIFT and the OTC. Changes to the MQT syllabus and CT program are proposed. The result is a complete training program for the RF-4 crewmember in offensive and defensive Basic Fighter Maneuvers and Defensive Air Combat Maneuvers. GRA

N88-29285# Air Command and Staff Coll., Maxwell AFB, Ala.

PROPOSED IMPROVEMENTS TO THE USAF FLIGHT SCREENING PROGRAM

DOUGLAS W. KNUITSEN May 1988 49 p
(AD-A194506; ACSC-88-1485) Avail: NTIS HC A03/MF A01
CSCL 05I

This study looks at ways to improve USAF Flight Screening Programs (FSP) in order to reduce attrition in Undergraduate Pilot Training (UPT). A literature search was performed to discover what had already been done in this area. A synopsis of several studies on FSPs is included in the text. This study fills a void in the literature by comparing the USAF FSPs to other service and foreign FSPs. This approach identified several different ways to screen potential pilot candidates. Some of these flight screening techniques could reduce USAF UPT attrition rates if implemented in the USAF FSPs. Further consolidation and standardization of USAF FSPs and increased emphasis on light aircraft screening offer the greatest potential to reduce attrition in UPT. GRA

N88-29286# Air Force Human Resources Lab., Brooks AFB, Tex.

VALIDITY OF THE ACADEMIC APTITUDE COMPOSITE OF THE AIR FORCE OFFICER QUALIFYING TEST (AFOQT) Final Report, Oct. 1986 - Dec. 1987

DARRELL D. HARTKE and LAWRENCE O. SHORT Apr. 1988 14 p
(AD-A194753; AFHRL-TP-87-61) Avail: NTIS HC A03/MF A01
CSCL 05H

This paper addresses the use of the Schmidt-Hunter meta-analysis procedure to determine the generalizability of the Air Force Officer Qualifying Test (AFOQT) validities across Air Force Specialties (AFSs). Meta-analyses were conducted on all available Academic Aptitude composite validities aggregated and disaggregated into major occupational subgroupings. The results suggest that although the validity of the Academic Aptitude

composite of the AFOQT may vary across AFSs, the AFOQT is of general value in officer selection. GRA

N88-29287# Human Resources Research Organization, Alexandria, Va.

LITERATURE REVIEW: VALIDITY AND POTENTIAL USEFULNESS OF PSYCHOMOTOR ABILITY TESTS FOR PERSONNEL SELECTION AND CLASSIFICATION

JEFFREY J. MCHENRY and SHARON R. ROSE Apr. 1988 254 p Prepared in cooperation with Personnel Decisions Research Inst., Minneapolis, Minn.
(Contract MDA903-82-C-0531; DA PROJ. 2Q2-63731-A-792)
(AD-A193558; ARI-RN-88-13) Avail: NTIS HC A12/MF A01
CSCL 14B

The psychomotor ability literature was reviewed to determine the validity and potential usefulness of psychomotor ability tests for personnel selection and classification. Over 2,200 psychomotor test validity coefficients were located. These were tabulated by ability (using Fleishman's psychomotor ability taxonomy), criterion (e.g., school vs. training vs. job performance), and job type. Analyses of these data showed that psychomotor tests had been used successfully to predict training and job performance for many different occupations. Barriers to the use of psychomotor tests were also investigated. Reliability data indicate that psychomotor measures are not unstable. Moreover, the possibility of using computerized tests in the future to assess psychomotor abilities should eradicate the problem of apparatus differences. GRA

N88-29288# New York Univ., New York.

VISUAL MOTION PERCEPTION AND VISUAL ATTENTIVE PROCESSES Final Report, 30 Sep. 1985 - 30 Nov. 1987

GEORGE SPERLING Apr. 1988 18 p
(Contract AF-AFOSR-0364-85)
(AD-A193640; AFOSR-88-0551TR) Avail: NTIS HC A03/MF A01
CSCL 06D

The motion projects described in this report include the specification of low level motion detection systems which are both Fourier and NonFourier in kind, investigations in visual persistence in motion, higher level issues in structure from motion, cue integration and decision theory, and object recognition. The attention projects concern the human ability to process information arriving simultaneously at different locations in the visual field and to coordinate concurrent visual and auditory inputs. A common goal of projects was the attention description of the human abilities and limitations in the allocation of mental processing resources, and correspondingly, the theoretical derivation of visual and auditory stimulus codes that take optimum advantage of human abilities. GRA

N88-29289# Navy Personnel Research and Development Center, San Diego, Calif.

RELIABILITY AND CONSTRUCT VALIDITY OF REACTION TIME, INSPECTION TIME AND MACHINE-PACED TESTS OF COGNITIVE SPEED

GERALD E. LARSON, CHARLES R. MERRITT, and KATHRYN E. LATTIN Apr. 1988 14 p
(AD-A193779; NPRDC-TN-88-37) Avail: NTIS HC A03/MF A01
CSCL 05I

In order to evaluate the psychometric characteristics of cognitive speed tests, a battery of reaction time, inspection time, and machine-paced tests was administered to 267 male Navy recruits. Two hundred and twenty of these subjects returned approximately one month later to be retested. The final evaluation of each test was based on whether or not it met two or more of the following standards: Test-retest reliability of .70, split-half reliability of .90, and construct validity of .30. The results indicate that the majority of the tests meet these standards. GRA

N88-29290# Pennsylvania Univ., Philadelphia.

TRANSFORMATIONS OF SHORT-TERM VISUAL MEMORY Final Report, 1 Sep. 1985 - 31 Aug. 1987

SAUL STERNBERG 15 Mar. 1988 10 p

53 BEHAVIORAL SCIENCES

(Contract N00014-85-K-0643; DA PROJ. RR0-4204)
(AD-A193873) Avail: NTIS HC A02/MF A01 CSCL 05H

This is the Final Report of research supported by a contract entitled Transformations of Short-Term Visual Memory. After a section on Short-term dynamics of visual representation: Background and previous research, the report provides a synopsis of the principal research supported by the contract, under the following headings: Technical advances, Principal phenomena in the spatial probe paradigm, Comparison of visual and tactical probes, The roles of uncertainty about position, target, and response in information retrieval, The effect of memory load on the time to name an element indicated by a spatial probe, Nature of the transformation process, Comparison of the time course of slope and intercept changes with probe delay, Test of direct access by color, Comparison of naming of a marked element with location-specific matching, Location-specific matching of digits versus unfamiliar and nameless shapes, Relation of the rapid transformation of small arrays to the decay of iconic memory of large arrays, and Plans for use of event-related potentials (ERPs) to monitor the rapid transformation. GRA

N88-30288# Naval Ocean Systems Center, San Diego, Calif.
MULTILEVEL COMPUTATIONAL THEORY OF STEREOSCOPIC VISUAL IMAGE PROCESSING Final Report, 15 Jun. 1985 - 31 Dec. 1987

WILLIAM R. UTTAL Mar. 1988 19 p
(AD-A195331; NOSC/TR-1216) Avail: NTIS HC A03/MF A01 CSCL 05H

This is the final report of a research program that explored the perception of visual forms. The project consisted of psycho-physical studies in which stereoscopically generated, three-dimensional forms were studied in terms of their detectability, discriminability, recognizability, and reconstructability. The project produced a book and 11 articles, all of which spoke to the problem of how humans see forms in space. Two more articles are in progress. This report summarizes the findings of the extensive series of experiments carried out during the program. Results of this study are applicable to a wide range of U.S. Navy interests including computer vision, autonomous vehicles, remotely controlled devices (teleoperators), and displays. GRA

N88-30289# Tennessee Univ., Knoxville. Dept. of Psychology.
ADVANCEMENT OF LATENT TRAIT THEORY Final Report, 1981 - 1987

FUMIKO SAMEJIMA Feb. 1988 153 p
(Contract N00014-81-C-0569; PROJ. RR0-4204)
(AD-A194302) Avail: NTIS HC A08/MF A01 CSCL 05H

There were six main objectives in the original research proposal, and they can be summarized as follows: (1) Investigation of theory and method for estimating the operating characteristics of discrete item responses, which include the plausibility functions of the distractors of the multiple-choice test item, as well as the graded item responses of the free-response test item, without assuming any specific mathematical forms, and without using too many examinees in the whole procedure; (2) Investigation of the various characteristics of the new family of models for the multiple-choice test item, both in theory and in practice; (3) Production and revision of a set of systematic procedures for applying some combinations of a method and an approach for estimating the operating characteristics of discrete item responses, by modifying and reorganizing all the computer programs written for this purpose; (4) Development of latent trait theory further, and include more varieties of situations; (5) Investigation of ways of bridging across mathematical psychology and cognitive psychology, through latent trait theory; and (6) Systematizing theories and methods to eventually lead to a good introductory book on latent trait theory and other publications. GRA

N88-30290# Retina Foundation, Boston, Mass. Eye Research Inst.

EYE MOVEMENTS AND SPATIAL PATTERN VISION Annual Report, 1 Mar. 1987 - 29 Feb. 1988

LAWRENCE E. AREND 31 Mar. 1988 19 p

(Contract AF-AFOSR-0128-86)
(AD-A195496; AFOSR-88-0547TR) Avail: NTIS HC A03/MF A01 CSCL 06D

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

N88-30291# Dayton Univ., Ohio. Research Inst.
COMPARATIVE ASPECTS OF MULTIPLE PROCESSES OF ATTENTION Final Report, Aug. 1986 - Sep. 1987

MARYLOU CHEAL May 1988 27 p
(Contract F3615-84-C-0066)
(AD-A195805; AFHRL-TR-87-53) Avail: NTIS HC A03/MF A01 CSCL 05H

In this paper, first, there are examples of human and animal research in which attention is separated into various components. Terms used to designate various aspects or subcomponents of attention are compared from different research paradigms. Secondly, four experiments on the time course of human attentional effects on discrimination of different stimuli are discussed in relationship to other research in the literature. For these experiments, a precue was used to move attention to the target location. Accuracy in discrimination of the target as a function of the time between precue and target was measured. In three of these experiments, targets differed as to line arrangement or line orientation. It was suggested that line arrangement discrimination requires focused attention whereas line orientation discrimination may not. The data were related to some of the dichotomous terms used to describe processes that differ in the need for focused attention. In a fourth experiment, eccentricity of the target was varied. These data provided evidence of time invariant attention movement for distance less than ten degrees. GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A88-53627*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WIDE FIELD OF VIEW HELMET MOUNTED DISPLAY SYSTEMS FOR HELICOPTER SIMULATION

LORAN A. HAWORTH, NANCY M. BUCHER (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA), and ROBERT T. HENNESSY (Monterey Technologies, Inc., Carmel, CA) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 1-9. refs
(AIAA PAPER 88-4575)

This paper elaborates on visually-coupled Wide Field of View Helmet Mounted Display (WFOVHMD) system technology as a viable visual presentation system for helicopter simulation. Critical

research issues on helmet mounted displays are reviewed. Tradeoffs associated with this mode of presentation as well as research and training applications are discussed. Author

A88-53655#**SIMULATION TOOLS FOR CREW SYSTEM ASSESSMENT**

BRETT A. STOREY (Lockheed Aeronautical Systems Co., Burbank, CA) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 226-229. refs (AIAA PAPER 88-4614)

The paper presents a methodology of simulation research tools which are designed to accomplish the objectives for assessing the effectiveness of a crew system for fighter aircraft. It is noted that the specific objective in a crew system assessment program is to perform a comprehensive evaluation of cockpit control (display integration, pilot procedures/tactics, mission scenarios, pilot workload, situation awareness, and system effectiveness). It is concluded that the proper data must be taken, that data must be displayed meaningfully to the analyst, and the crew system designer/analyst must have the ability to look at all available data in a time correlated sequence. K.K.

A88-53656#**A METHODOLOGY FOR SIMULATION VALIDATION USING OPTIMAL TIME HISTORY MATCHING**

ROBERT A. HESS, BARBARA H. STANKA, and MARGARET BALD PURDY (Systems Control Technology, Inc., Lexington Park, MD) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 236-243. refs (AIAA PAPER 88-4617)

The technique most widely used for simulation validation consists of matching measured aircraft response with simulation predicted aircraft response. Though this technique is generally considered the best method available for simulation validation, it has shown itself to often be unsuitable for validating aircraft simulations. Specifically, time history matching can be very difficult to perform due to errors in the measured aircraft response, aircraft irregularities, and the inability to isolate the errors caused by inaccuracies in various portions of the simulation model. Presented in this paper is a description of a new technique for simulation validation which alleviates many of the problems associated with time history matching by providing a direct link of modern systems identification with the aircraft simulation environment. Author

A88-53660#**HUMAN PERFORMANCE DATA IN SIMULATION DESIGN**

KENNETH R. BOFF (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and EDWARD A. MARTIN (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 264-266. refs (AIAA PAPER 88-4621)

The objectives of the Integrated Perceptual Information for Designers (IPID) Project are discussed. Its main objective is to provide 'high value' human performance data as a 'low-cost' resource to designers of operational crew systems and training devices. Other objectives include the consolidation of existing data, the packaging of data to facilitate use, and the training and sensitizing of designers. K.K.

A88-53661#**VISUAL-VESTIBULAR INTERACTION IN PILOT'S PERCEPTION OF AIRCRAFT OR SIMULATOR MOTION**

R. J. A. W. HOSMAN and J. C. VAN DER VAART (Delft, Technische Hogeschool, Netherlands) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 271-281. refs (AIAA PAPER 88-4622)

The control behavior and performance of subjects in

target-following and disturbance-compensation tracking tasks are studied. The results of stimulus response experiments designed to gather insight in central and peripheral visual and vestibular perception of motion are summarized. It is concluded that peripheral visual and cockpit motion cues are highly important in actual or simulated manual aircraft control and that, in simulation, the compensation for simulator motion system dynamics, computing time-delays, and motion control laws deserve much more attention. K.K.

A88-53662#**MATCHING PILOT PERCEPTIONS OF REAL WORLD AND SIMULATED LIGHT SOURCES IN VISUAL FLIGHT SIMULATORS**

JACK TUMBLIN (IVEX Corp., Norcross, GA) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 282-287. refs (AIAA PAPER 88-4623)

Image generators for flight simulation often specify object brightnesses in display units, such as integer RGB values, so artistic judgment during color selection usually sets the relation between real-world and simulator brightnesses, here named 'brightness mapping'. As lighting and weather changes, such ad-hoc methods can cause inconsistencies in mappings which may distort a simulator pilot's perception of visibility, illumination, and distance. This paper gives a basic mathematical method and model for brightness mapping, and uses it to directly relate real-world brightnesses in units of optical power to display system units for an example simulator. The model is built from available human eyesight data, simulator display brightness and contrast performance, and five supported hypotheses about brightness perception. Author

A88-53668#**EYE-SLAVED AREA-OF-INTEREST DISPLAY SYSTEMS - DEMONSTRATED FEASIBLE IN THE LABORATORY**

G. BLAIR BROWDER and WALT S. CHAMBERS (U.S. Navy, Naval Training Systems Center, Orlando, FL) IN: AIAA, Flight Simulation Technologies Conference, Atlanta, GA, Sept. 7-9, 1988, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1988, p. 332-342. refs (AIAA PAPER 88-4636)

Two unique simulator display concepts that use eye-slaved area-of-interest (AOI) technology have been evaluated for their engineering and psychophysical characteristics. These visual systems exploit the limitations of the physiology of the human eye. That is, that the eye perceives the world as high resolution everywhere even though the high acuity region of the eye is less than 10 degrees wide in the direction of gaze. The results of these evaluations prove that this technology is both feasible and practical, and can potentially save millions of dollars in visual simulators where high detail and resolution approaching that of the human eye is required over a large field-of-view. Author

A88-54023#**THE SIMULATION OF THERMAL MICROCLIMATE IN THE GARMENT SIMILAR TO THOSE OBSERVED IN THE WEIGHTLESSNESS**

L. NOVAK, B. ULICNY, Z. WILHELM, J. BARAK (Universita J. E. Purkyne, Brno, Czechoslovakia), V. S. KOSHCHIEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR) et al. (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) Physiologist, Supplement (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-38, S-39.

The transfer of heat from the chest and shin regions of the clothed human body in weightlessness and in -12-deg head-down tilt (HDT) is investigated experimentally. Data from the Salyut-6 mission and from laboratory experiments designed to simulate microgravity conditions by HDT are compared in graphs and discussed in detail. The temperature increase at the chest is found to be similar in weightlessness and HDT, but that at the shin

remains unchanged in HDT and increases significantly in weightlessness. It is recommended that future HDT simulations employ ventilatory heating and cooling to match the heat-transfer characteristics seen in space. T.K.

A88-54047#
MORBIDITY REDUCTION OF IN-FLIGHT ACCELERATION INDUCED LOSS OF CONSCIOUSNESS

E. H. WOOD, E. H. LAMBERT, and C. F. CODE (Mayo Clinic, Rochester, MN) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-106 to S-109. refs (Contract N66001-87-C-0079)

The fact that gravity acceleration induced loss of consciousness (G-LOC) is preceded by the loss of the ear opacity pulse can be used for designing a system for correcting the potential consequences of LOC. In this paper it is shown that a loss of the ear opacity pulse (detected noninvasively by means of wearing Millikan-type oximeter earpieces) for longer than 2-3 sec could be used to activate a visual or auditory signal which would warn the pilot of the impending LOC and/or activate an automatic plane-takeover system. It is recommended that pilots should be subjected to several incidents of human-centrifuge-induced LOC as part of their training program, in order to prepare them for the measures to be taken in case of impending LOC. I.S.

A88-54065#
ARTIFACT-FREE RECORDING OF THE ECG SIGNAL IN THE COURSE OF ACCELERATION STRESS

J. HANOUSEK, Z. MAKOC, J. SVACINKA, and J. SULC (Ustav Leteckeho Zdravotnictvi, Prague, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 9th, Nitra, Czechoslovakia, Sept. 28-Oct. 2, 1987) *Physiologist, Supplement* (ISSN 0031-9376), vol. 31, Feb. 1988, p. S-148, S-149.

The hardware and procedures used in continuous EKG monitoring of rats being accelerated up to 20 +Gz on an animal centrifuge developed at the Institute of Aviation Medicine in Prague are described. The signal from bipolar lead II and the heart-rate (HR) signal are amplified by a selective amplifier on a small platform on the rotation axis of the centrifuge and transferred to the stationary part of the apparatus via 40-mm-diameter collector rings and brushes, which also carry the + or - 10-V power supply for the amplifier. The amplified EKG signal can then be displayed on an oscilloscope and/or recorded, and the HR is displayed digitally. Sample EKG traces are shown. T.K.

A88-55047
ADAPTIVE AIDING FOR HUMAN/COMPUTER CONTROL

WILLIAM B. ROUSE (Search Technology, Inc., Norcross, GA) *Human Factors* (ISSN 0018-7208), vol. 30, Aug. 1988, p. 431-443. refs (Contract F33615-86-C-0545)

Experimental and theoretical research on adaptive aiding that has been carried out as part of an ongoing program initiated in 1974 is described. The development and proof of concept are discussed as well as the use within adaptive aids of human performance models and on-line assessment methods. A framework for design is presented that focuses on a structured set of design questions that may be addressed in terms of principles of adaptation and principles of interaction. K.K.

A88-55049
PERFORMANCE MEASUREMENT DURING SIMULATED AIR-TO-AIR COMBAT

MICHAEL J. KELLY (Georgia Institute of Technology, Atlanta) *Human Factors* (ISSN 0018-7208), vol. 30, Aug. 1988, p. 495-506. refs

Existing approaches to automated aircrew performance measurement are reviewed. Particular attention is given to the practicing of air-to-air combat skills in simulated combat environments such as the U.S. Air Force air combat maneuvering

instrumentation or ground-based visual flight simulators. It is concluded that measures such as control manipulation and the management of kinetic and potential energy must supplement the most common measurement models to provide a refined performance algorithm. K.K.

A88-55319#
THE TELEROBOTIC CONCEPTS OF ROTEX - GERMANY'S FIRST STEP INTO SPACE ROBOTICS

GERHARD HIRZINGER (DFVLR, Institut fuer Dynamik der Flugsysteme, Weessling, Federal Republic of Germany) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 9 p. refs (IAF PAPER 88-017)

The paper outlines the telerobotic concepts of a robot technology experiment ROTEX proposed to fly with the next German spacelab mission D2 (in 1991). It provides a small, six-axis robot inside a space-lab rack, equipped with a multisensory gripper (force/torque, an array of range finders, stereo camera). The robot is supposed to perform several assembly and 'servicing tasks' and to grasp floating objects. The paper focuses on the man-machine and supervisory control concepts for teleoperation from the spacecraft and from ground and explains the predictive estimation schemes for an extensive use of delay-compensating three-dimensional computer graphics. Author

A88-55323*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ROBOTIC VISION TECHNOLOGY AND ALGORITHMS FOR SPACE APPLICATIONS

KUMAR KRISHNEN (NASA, Johnson Space Center, Houston, TX) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 11 p. refs (IAF PAPER 88-028)

The vision data requirements for various automation and robotics applications for the Space Station are discussed. The advanced systems technology involved with robotic sensing for perception is reviewed, noting the unique requirements of vision systems in space. Three areas of algorithm development are discussed: shape extraction based on illumination, shape extraction by sensor fusion, and generalized image point correspondence. Possibilities for future developments in robotic vision technology are considered. R.B.

A88-55335#
ADVANCED MAN-MACHINE INTERFACES TECHNIQUES FOR EXTRA-VEHICULAR ACTIVITY

S. GALIMBERTI, R. PERSICO, and R. CORTINOVIS (Laben - Industrie per lo Spazio e le Comunicazioni S.p.A., Vimodrone, Italy) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 9 p. ESA-supported research. refs (IAF PAPER 88-077)

Man-machine interfaces (MMI) technologies which could be used to improve the efficiency and effectiveness of EVA are discussed. The servicing of the Man-Tended Free Flyer (MTFF) is given as a reference for determining performance requirements for baseline EVA. Environmental and human related EVA limitations are analyzed. MMI components which could be applied to EVA include the upper torso terminal (or display and control module), a forearm mounted terminal, head-up and helmet mounted displays, direct voice input and output and command input devices. Guidelines for optimum visual displays, command inputs, and auditory displays are given and a breadboard for MMI evaluation is presented. It is concluded that, for the servicing of the MTFF, the MMI facilities should be restricted to a helmet mounted display with a forearm mounted terminal as a back-up or support device. R.B.

A88-55392#
DYNAMICAL SIMULATION OF A FLEXIBLE MANIPULATOR ARM

MADELEINE PASCAL (Paris VI, Universite, France) IAF,

International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 6 p. Research supported by Matra Espace.
(IAF PAPER 88-319)

The dynamics of a space manipulator arm designed to be set on a servicing satellite and to grasp another satellite are discussed. A continuum approach (modal impedance) is used to describe the flexibility in the manipulator. A simplified model is used to perform analysis based on the general results for a system of hinge-connected flexible bodies obtained by Richards et al. (1977). This model may be used in simulations of the Hermes/Man-Tended Free Flyer dynamics. The concept of an impedance matrix (Hughes, 1974) is used to obtain the response of the structure to external forces. R.B.

A88-55436#

EVA SPACE SUITS - SAFETY PROBLEMS

G. I. SEVERIN, I. P. ABRAMOV, and V. I. SVERTSHEK (AN SSSR, Sovet Interkosmos, Moscow, USSR) IAF, International Astronautical Congress, 39th, Bangalore, India, Oct. 8-15, 1988. 7 p.
(IAF PAPER 88-515)

Design features of semirigid space suits and portable life support systems for the Salyut and Mir space stations are reviewed. Ways of providing system reliability in these suits are highlighted. It is shown that the solution to the problem of EVA safety is found in the selection of the proper design concepts and arrangements, adequate operating modes, proven manufacturing techniques, and comprehensive development test programs. C.D.

N88-29291# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

VISUAL EFFECTS IN THE HIGH PERFORMANCE AIRCRAFT COCKPIT

Apr. 1988 149 p Lectures held in Brussels, Belgium, 28-29 Apr. 1988, in Copenhagen, Denmark, 2-3 May 1988, in Ankara, Turkey, 5-6 May 1988, and in Athens, Greece, 9-10 May 1988 (AGARD-LS-156; ISBN-92-835-0456-9) Avail: NTIS HC A07/MF A01

Vision is the key sensory mode by which a pilot receives the vast majority of the information required to successfully fly the aircraft and accomplish his mission. Visual information is received both directly (viewing through the windscreen, heads-up display and visor) and indirectly (viewing instruments, graphics displays and imaging displays) in a continuous stream. The ability of the pilot to perceive, assimilate and act on this vast amount of visual information greatly depends on the quality of the presentation of this information. There are many factors that can reduce the effective visual capability of the pilot. Many of these factors are presented and their effect on vision and visual performance are discussed.

N88-29292# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

VISION AND VISUAL PROTECTION IN FAST JET AIRCRAFT

D. H. BRENNAN /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 13 p Apr. 1988
Avail: NTIS HC A07/MF A01

Aircrew flying fast jets such as the F-16 require high visual standards in order to be able to react quickly to tactical and emergency situations within their environment. The basic visual physiology of importance in flight is discussed together with the visual standards and associated test methods that are necessary for optimum performance. The hazards of solar radiation are reviewed together with suggestions for the optical and spectral quality of visors and corrective eyewear. Author

N88-29293# Royal Danish Air Force, Vojens.

VISUAL RELATED ACCIDENTS/INCIDENTS

L. SIMONSEN /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 8 p Apr. 1988
Avail: NTIS HC A07/MF A01

Man has evolved as a creature intended to walk on two feet

on the surface of the earth, but has acquired the skill to construct machines which enables him to fly. The process has required this basic man to learn, by training, some necessary skills for adapting his sensory systems. This sensory adaptation is rather fragile and will under situations of stress break down and cause accidents or incidents. Based on accidents/incidents, the different break down modes of man's visual sensory system in the high performance aircraft cockpit are discussed. Author

N88-29294# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.

VISION THROUGH AIRCRAFT TRANSPARENCIES

H. LEE TASK /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 14 p Apr. 1988
Avail: NTIS HC A07/MF A01

The primary purpose is to discuss in detail the optical and visual effects of aircraft transparencies including windscreens, canopies, head-up display (HUD) combiners, and visors. The majority of the paper will treat aircraft windscreens and canopies with primary emphasis on high performance aircraft. Author

N88-29295# Societe pour l'Equipment des Vehicules, Gosselies (Belgium). Service des Essais en Vol.

GENERAL OPERATIONAL AND TRAINING VISUAL CONCERNS

D. AGNEESSENS /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 17 p Apr. 1988 Prepared in cooperation with Societe Anonyme Belge de Constructions Aeronautiques, Brussels, Belgium
Avail: NTIS HC A07/MF A01

After having stated all the requirements for man-machine interface in modern cockpits, taking into account all the operational requirements, and also the physiological and environmental constraints, the emphasis is put on visual displays, more precisely on the heads-up display (HUD). How they are realized, the information which is presented to the pilot and the physiological problems encountered are discussed such as: effects of G and vertigo. For the latter, the most often cited causes of vertigo are studied. New systems are also cited such as Helmet Mounted Display (HMD) or Night Vision Goggles (NVG). Both are still under development. The need for simulators and the physiological problems associated with their use are addressed. Author

N88-29296# Royal Netherlands Air Force, Zeist.

MAINTENANCE OF VISION-RELATED COMPONENTS

J. M. HARTS /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 11 p Apr. 1988
Avail: NTIS HC A07/MF A01

Visual obtained information is of the highest importance for the pilot to fulfill his mission or in some cases to survive. Though the pilot is offered more and more information by audio-means, for example aircraft-warnings, the eyes of the pilot are his most important source of information. Through maintenance of vision-related components it can be assured that needed information can reach the pilot undamaged. Within the Royal Netherlands Airforce this maintenance encloses mainly cleaning, checking, and replacement of the vision-related component. As part of checking and replacement of the Head-Up Display boresighting is essential to assure a proper mounting, needed for accurate weapon-delivery. Author

N88-29297# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Human Engineering Div.

NIGHT LIGHTING AND NIGHT VISION GOGGLE

COMPATIBILITY

ALAN R. PINKUS /n AGARD, Visual Effects in the High Performance Aircraft Cockpit 16 p Apr. 1988
Avail: NTIS HC A07/MF A01

Proper lighting of aircraft instruments, panels, controls, indicators, and displays is essential in high performance aircraft. The lighting must be useable over a large range of ambient conditions; especially during dawn or dusk transitions and at night. It must be uniform, have low glare, and be continuously dimmable

to very low luminance levels, so the pilot can become partially dark adapted for good, out-of-the-cockpit vision. Various aspects of cockpit lighting such as intensity levels, contrast, luminance and color uniformity, red versus white versus blue-green general lighting, color coding, and other parameters are discussed. Daytime lighting requirements will be noted throughout because they are an important part of the overall design of the lighting system. A special area of interest is night vision goggle compatible cockpit lighting. As night missions evolve, night vision goggles (NVGs) are being used with greater frequency. The characteristics and usage of NVGs are overviewed. Methods of achieving night vision goggle compatibility in the cockpit using filtered incandescent lamps, external bezels, floodlighting, light emitting diodes, electroluminescent lamps, microlouver material, and black flight suits are described. Author

N88-29298# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

DISPLAY SYSTEM IMAGE QUALITY

ALAN R. PINKUS and H. LEE TASK *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit 17 p Apr. 1988
Avail: NTIS HC A07/MF A01

High performance aircraft employ several types of display systems including panel-mounted cathode-ray tube (CRT) displays, head-up displays (HUDs), and helmet-mounted displays (HMDs). These may be used to produce imagery from onboard sensors or to provide information in a symbolic format. There are a number of parameters that are used to characterize these displays such as resolution, contrast ratio, luminance, number of gray shades, line rate, interlace ratio, bandwidth, and modulation transfer functions. In the case of the HUDs and HMDs, there are other parameters that further describe the display such as distortion, transmittance, field of view, exit pupil diameter, vergence, and field curvature. These systems, the measurement of various parameters, and how they affect the quality of the display system are described. In addition, methods will be presented that combine the display parameters with human visual system characteristics to produce image quality metrics that are related to operator performance. Author

N88-29299# Societe pour l'Equipment des Vehicules, Gosselies (Belgium).

FUTURE VISUAL ENVIRONMENT AND CONCERNS

D. AGNESSENS *In* AGARD, Visual Effects in the High Performance Aircraft Cockpit 14 p Apr. 1988 Prepared in cooperation with Societe Anonyme Belge de Constructions Aeronautiques, Brussels, Belgium
Avail: NTIS HC A07/MF A01

Visual displays play an important role in the cockpit, where the information coming from various sensors is presented to the aircrew, after processing by computers. A classification of the displays is done, considering the needs in modern cockpit architecture, where different systems are possible according to the mission envisaged. For daylight operations, HMD/S or FLIR systems are considered, with their advantages but also their shortcomings and limitations. For night operations, NVG, LLLTV, or FLIR systems are assessed, and the current problems discussed. The protection of the eyes of the aircrew against intense sources of light, such as laser or nuclear flash, is also considered briefly. Author

N88-29300# High Technology Sensors, Inc., Longwood, Fla.
MINIATURE RESPIRATORY SENSOR Final Report, Aug. 1987 - Jan. 1988

Feb. 1988 33 p
(Contract N00014-87-C-0765)
(AD-A193430) Avail: NTIS HC A03/MF A01 CSCL 05H

A miniature Non-Dispersive Infrared (NDIR) sensor suitable for incorporation within the oxygen mask of an aviator has been demonstrated. The sensor utilizes a miniature infrared source. Current is injected into the source in order to alter its emissivity to produce modulated infrared output. The source was modulated at 2.3 KHz and its output focused on a cooled lead selenide

detector. Data was taken demonstrating the capability of the sensor to detect expired carbon dioxide profiles in a breath-by-breath manner. GRA

N88-29301# Army Research Inst. of Environmental Medicine, Natick, Mass.

NUTRIENT REQUIREMENTS FOR HIGH STRESS ENVIRONMENTS Report, for Period Ending Apr. 1988

E. W. ASKEW 20 Apr. 1988 20 p
(AD-A194595) Avail: NTIS HC A03/MF A01 CSCL 06H

Certain types of stress can cause increased nutrient requirements to maintain physiological or psychological performance levels; however, not all stress elicits this response and relatively few nutrient requirements are actually increased. Environmental stress sometimes causes increased energy (particularly carbohydrate) requirement. Water requirements are often increased by heat, cold, and altitude exposure. Certain aspect of mental performance may be enhanced during environmental stress by dietary precursors of brain neurotransmitters such as tyrosine. GRA

N88-29302# Ollis Engineering, Sedalia, Colo.

ADVANCED DEVELOPMENT WASTE PROCESSING UNIT FOR COMBAT VEHICLES, PHASE 2 Final Report, 1 Sep. 1986 - 31 Jan. 1987

CARTER K. LORD 29 Dec. 1987 72 p
(Contract DAAE07-86-C-R089)
(AD-A193793; TACOM-TR-13323) Avail: NTIS HC A04/MF A01 CSCL 24C

The work performed under Phase 2 of this contract has resulted in the design and fabrication of a system capable of the efficient disposal of human waste from within a combat vehicle operating in a nuclear, biologically, or chemically (NBC) environment with minimum impact to the vehicle or to the personnel operating within that vehicle. The Waste Processing Unit (WPU) has been demonstrated both by analysis and testing. The WPU for combat vehicle is currently undergoing further testing at Aberdeen Proving Grounds. Additionally, a modified version of the WPU was fabricated and tested to verify the feasibility of adapting the concept to marine applications. This effort has proven the feasibility of the application, and appears to have significant commercial possibilities. GRA

N88-29303# Technische Hogeschool, Delft (Netherlands).

IMPLEMENTATION OF A FLEXIBLE LINK MODEL IN A DESIGNED ROBOT SYSTEM, USING THE FINITE ELEMENT METHOD Ph.D. Thesis

KORNELIS HINDERIK DRENT 1988 143 p
(ETN-88-92902) Avail: NTIS HC A07/MF A01

The influence of elastic deformation of robot arm links and supports on positioning accuracy was studied, using a model of the mechanism formed by the links of the arm. This model is based on the finite element method and is integrated in the controller of the robot-arm. The input of the model is taken from the output of a force/torque sensor. Due to the limitation of the computation speed the corrections on the setpoint, needed to compensate for the elastic deformations, are computed only in the end point of the programmed motion. To program the robot an interpreter for commands written in the language IRDATA was developed. The controller was realized on a Motorola 68000 based system, where each axis is controlled by a Motorola 6502 processor based system. Experiments prove that the absolute positioning accuracy of the robot-system, using the model, is 0.1 mm for each load. Previously the difference in absolute position reached with and without a maximum load in the gripper was 6.9 mm. ESA

N88-29366*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

KNOWLEDGE ELICITATION FOR AN OPERATOR ASSISTANT SYSTEM IN PROCESS CONTROL TASKS

GUY A. BOY *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p

131-139 Aug. 1988 Prepared in cooperation with Office National d'Etudes et de Recherches Aeronautiques, Toulouse (France)
 Avail: NTIS HC A99/MF E03 CSCL 05H

A knowledge based system (KBS) methodology designed to study human machine interactions and levels of autonomy in allocation of process control tasks is presented. Users are provided with operation manuals to assist them in normal and abnormal situations. Unfortunately, operation manuals usually represent only the functioning logic of the system to be controlled. The user logic is often totally different. A method is focused on which illicit user logic to refine a KBS shell called an Operator Assistant (OA). If the OA is to help the user, it is necessary to know what level of autonomy gives the optimal performance of the overall man-machine system. For example, for diagnoses that must be carried out carefully by both the user and the OA, interactions are frequent, and processing is mostly sequential. Other diagnoses can be automated, in which the case the OA must be able to explain its reasoning in an appropriate level of detail. OA structure was used to design a working KBS called HORSES (Human Orbital Refueling System Expert System). Protocol analysis of pilots interacting with this system reveals that the a-priori analytical knowledge becomes more structured with training and the situation patterns more complex and dynamic. This approach can improve the a-priori understanding of human and automatic reasoning.

Author

N88-29367*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

MACHINE VISION FOR REAL TIME ORBITAL OPERATIONS
 FRANK L. VINZ *In its* Second Conference on Artificial Intelligence for Space Applications p 141-155 Aug. 1988
 Avail: NTIS HC A99/MF E03 CSCL 05H

Machine vision for automation and robotic operation of Space Station era systems has the potential for increasing the efficiency of orbital servicing, repair, assembly and docking tasks. A machine vision research project is described in which a TV camera is used for inputting visual data to a computer so that image processing may be achieved for real time control of these orbital operations. A technique has resulted from this research which reduces computer memory requirements and greatly increases typical computational speed such that it has the potential for development into a real time orbital machine vision system. This technique is called AI BOSS (Analysis of Images by Box Scan and Syntax).

Author

N88-29380*# Martin Marietta Aerospace, Denver, Colo. Space Station Program.

ARGES: AN EXPERT SYSTEM FOR FAULT DIAGNOSIS WITHIN SPACE-BASED ECLS SYSTEMS

DAVID W. PACHURA, SALEM A. SULEIMAN, and ANDREW P. MENDLER *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 277-282 Aug. 1988

Avail: NTIS HC A99/MF E03 CSCL 05H

ARGES (Atmospheric Revitalization Group Expert System) is a demonstration prototype expert system for fault management for the Solid Amine, Water Desorbed (SAWD) CO₂ removal assembly, associated with the Environmental Control and Life Support (ECLS) System. ARGES monitors and reduces data in real time from either the SAWD controller or a simulation of the SAWD assembly. It can detect gradual degradations or predict failures. This allows graceful shutdown and scheduled maintenance, which reduces crew maintenance overhead. Status and fault information is presented in a user interface that simulates what would be seen by a crewperson. The user interface employs animated color graphics and an object oriented approach to provide detailed status information, fault identification, and explanation of reasoning in a rapidly assimilated manner. In addition, ARGES recommends possible courses of action for predicted and actual faults. ARGES is seen as a forerunner of AI-based fault management systems for manned space systems.

Author

N88-29387*# Georgia Inst. of Tech., Atlanta.

CONCEPTS FOR ROBOT MOTION PRIMITIVES REQUIRED FOR SPACE STATION TELEOPERATIONS

JEFFREY L. GROVER and STEVEN A. E. SUCHTING (Boeing Aerospace Co., Huntsville, Ala.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 337-346 Aug. 1988
 Avail: NTIS HC A99/MF E03 CSCL 05H

Ground controlled teleoperations are expected to be used to augment Space Station manned extravehicular activities (EVA) and Intravehicular activities (IVA). However, ground controlled teleoperations will encounter communications time delays of from 3 to 8 secs. Time delays greater than 1 sec have been shown to be detrimental to safe and efficient teleoperations. Therefore, concepts must be developed to overcome the hazards and limitations of time delays when performing teleoperations using robots. The concept for robot motion primitives incorporate force/torque and tactile sensor feedback to implement the degree of autonomy required for interactive, ground controlled telerobotics. Several primitives are studied that augment human initiated actions by providing rapid response interaction with the physical environment of a telerobot. These primitives are detailed. They constitute a level of intelligent sensing and reaction required to augment human actions through autonomous interaction with the physical environment.

Author

N88-29408*# Alabama Univ., Huntsville.

PERSONNEL OCCUPIED WOVEN ENVELOPE ROBOT

FRANCIS WESSLING, WILLIAM TEOH, and M. CARL ZIEMKE *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 513-521 Aug. 1988

Avail: NTIS HC A99/MF E03 CSCL 05H

The Personnel Occupied Woven Envelope Robot (POWER) provides an alternative to extravehicular activity (EVA) of space suited astronauts and/or use of long slender manipulator arms such as are used in the Shuttle Remote Manipulator System. POWER provides the capability for a shirt sleeved astronaut to perform such work by entering a control pod through air locks at both ends of an inflated flexible bellows (access tunnel). The exoskeleton of the tunnel is a series of six degrees of freedom (Six-DOF) articulated links compressible to 1/6 of their fully extended length. The operator can maneuver the control pod to almost any location within about 50 m of the base attachment to the space station. POWER can be envisioned as a series of hollow Six-DOF manipulator segments or arms wherein each arm grasps the shoulder of the next arm. Inside the hollow arms is a bellow-type access tunnel. The control pod is the fist of the series of linked hollow arms. The fingers of the fist are conventional manipulator arms under direct visual control of the nearby operator in the pod. The applications and progress to date of the POWER system is given.

Author

N88-29409*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.

REMOTE SERVICING OF SPACE SYSTEMS

S. L. COLLINS and R. B. PURVES *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 523-535 Aug. 1988
 Avail: NTIS HC A99/MF E03 CSCL 05H

Space systems are difficult to maintain on orbit. The difficulty arises from the limited ability and availability of the astronaut work force in the hazardous space environment. Remote robotic manipulation can free the astronaut from the hazardous working environment while also increasing the work force. However, remote robotic servicing is not without its own set of problems and limitations, such as communication time delay and unstructured worksites. Tests and test equipment are described which are designed to increase the understanding of the remote servicing problems and to allow development of potential solutions. A half scale satellite mockup was developed for evaluating and improving upon the design of replaceable subsystems, such as batteries and electronic boxes. A servicer system, that includes a six degree

of freedom PUMA 560 robot and interchangeable end effectors (tools), was developed to aid in driving out servicer design requirements. The results include the time delay impact on servicing timelines and requirements for the servicer system. Author

N88-29410*# Boeing Aerospace Co., Huntsville, Ala. Space Station Program.

A TELEOPERATED ROBOTIC MANIPULATOR SYSTEM FOR MATERIALS PROCESSING EXPERIMENT SERVICING

STEVEN SUCHTING, R. BYRON PURVES, JEFFREY L. GROVER, and ROY SCRUGGS (Georgia Inst. of Tech., Atlanta.) *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 537-542 Aug. 1988
Avail: NTIS HC A99/MF E03 CSCL 05H

In 1984 Congress authorized NASA to begin the Space Station Program, and requested that 10 percent of program funds be spent in implementing automation and robotics (A and R) on the Space Station. In response to that request, Boeing established several Independent Research and Development (IR and D) projects to explore possible uses for A and R on the Space Station. One of those projects, and automated materials processing experiment, is discussed. The project uses a teleoperated robot to demonstrate telepresence applied to a Chemical Vapor Transport materials processing experiment. Author

N88-29421*# Tennessee Univ. Space Inst., Tullahoma. Knowledge Engineering Lab.

SEMANTIC BASED MAN-MACHINE INTERFACE FOR REAL-TIME COMMUNICATION Abstract Only

M. ALI and C.-S. AI *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 613 Aug. 1988
(Contract NAG1-513)
Avail: NTIS HC A99/MF E03 CSCL 05H

A flight expert system (FLES) was developed to assist pilots in monitoring, diagnosing and recovering from in-flight faults. To provide a communications interface between the flight crew and FLES, a natural language interface (NALI) was implemented. Input to NALI is processed by three processors: (1) the semantics parser; (2) the knowledge retriever; and (3) the response generator. First the semantic parser extracts meaningful words and phrases to generate an internal representation of the query. At this point, the semantic parser has the ability to map different input forms related to the same concept into the same internal representation. Then the knowledge retriever analyzes and stores the context of the query to aid in resolving ellipses and pronoun references. At the end of this process, a sequence of retrieval functions is created as a first step in generating the proper response. Finally, the response generator generates the natural language response to the query. The architecture of NALI was designed to process both temporal and nontemporal queries. The architecture and implementation of NALI are described. Author

N88-29428*# Martin Marietta Aerospace, Denver, Colo. Advanced Automation Technology (Robotics) Group.

NEXT-GENERATION SPACE MANIPULATOR

P. BRUNSON, W. CHUN, and P. COGEOS *In* NASA, Marshall Space Flight Center, Second Conference on Artificial Intelligence for Space Applications p 637-646 Aug. 1988
Avail: NTIS HC A99/MF E03 CSCL 05H

In 1977, the Protoflight Manipulator Arm (PFMA) was designed and built. It is one of two space qualified manipulators. A new conceptual design for the next generation manipulator of space applications is presented. The next generation manipulator and the PFMA are described in detail. Their differences could have a major influence on the construction, testing, and performance of a space arm. Assessed in detail are these technologies and their effect on the design. Servicing is an important goal of robotics in space. Parameters such as environment, type of task, time sequence, and dexterity will affect the arm and its ability to accomplish its mission. Requirements such as these are important considerations in the design of the next generation space arm. Author

N88-29736# Systems Technology, Inc., Hawthorne, Calif.

PILOT MODELING

DUANE T. MCRUER *In* AGARD, Advances in Flying Qualities 30 p May 1988
Avail: NTIS HC A09/MF A01

A description is presented of pilot control behavior in general. The essential features of pilot dynamics are emphasized for closed loop control of an aircraft. The crossover model is presented as the simplest and most useful model for the majority of flying qualities analyses. Two models are developed in some detail: a structural isomorphic form which accounts for some human subsystems as well as the total input output behavior; and an algorithmic optimal control model which attempts to mimic the pilot's total response only. Both full and divided attention conditions are treated. Author

N88-29737# Systems Technology, Inc., Hawthorne, Calif.

PILOT MODELING APPLICATIONS

IRVING L. ASHKENAS *In* AGARD, Advances in Flying Qualities 38 p May 1988
Avail: NTIS HC A09/MF A01

The role of pilot opinion and rating in defining flying qualities, and the pilot adapted control behavior that impinges on such ratings are delineated and discussed. This is preparatory to the exemplary application of frequency domain pilot models to the examination and elucidation of a variety of flying qualities situations. This examination starts with single loop situations which progress in complexity; and then shifts to multiple loop cases, which also progress in complexity. This succession is designed to increasingly reveal the basic pilot centered requirements for good flying qualities. Such requirements, which stem from easily achieved pilot adaption and good resulting closed loop responses, are more generally applicable to new unknown situations than are classical requirements on the open loop controlled element dynamic parameters. However, the latter do in fact influence the ease of piloted closure and the resulting closed loop responses so, when properly expressed in terms of characteristics in the projected crossover frequency region, may also achieve a degree of generality. The pilot centered requirements illustrated by the examples are collected and briefly discussed. Author

N88-29741# Pisa Univ. (Italy). Dipartimento di Ingegneria Aerospaziale.

THE OPTIMAL CONTROL PILOT MODEL AND APPLICATIONS

MARIO INNOCENTI *In* AGARD, Advances in Flying Qualities 17 p May 1988
Avail: NTIS HC A09/MF A01

The modeling of the human pilot behavior plays an important role in the preliminary analysis of aircraft handling qualities. This is especially true when the designer is confronted with nonconventional aircraft dynamics, tasks and/or lack of sufficient handling qualities data base. One modeling technique is reviewed which was developed in the early 1970's and has been widely used since then: the optimal control model of the human pilot. The model has been validated in a number of tasks and used in the analysis as well as the synthesis of manual control loops. The capabilities of the model are evaluated in the pilot rating prediction, in the analysis and in the synthesis of pilot/vehicle control loops from the handling qualities standpoint. Author

N88-30292# Air Force Inst. of Tech., Wright-Patterson AFF. Ohio.

A DETECTION THEORY ANALYSIS OF VISUAL DISPLAY PERFORMANCE M.S. Thesis

THOMAS R. MABRY 1988 65 p
(AD-A196291; AD-E951149; AFIT/CI/NR-88-126) Avail: NTIS HC A04/MF A01 CSCL 17K

This study investigated how information is processed from graphic vs. alphanumeric multi-element visual displays using principles derived from the Theory of Signal Detection (TSD). A diagnostic decision task was used in an evaluation of four different display formats: (1) a numerical display composed of *n* two-digit numbers arranged in a linear horizontal format; (2) a similar

numerical display in which the display elements were arranged in a square matrix array; (3) an analog gauge display composed of n vertical line gauges also organized in a square matrix array; and (4) a similar analog gauge display in which the display elements were arranged in a linear horizontal format. Performance was evaluated for 1,2,4,9, and 16 element displays and over a range of display durations. Detection performance, as measured by d' , increased as the number of display elements was increased up to an asymptotic value that was dependent on display type, arrangement and display duration. Performance was best with analog display elements arranged in a horizontal line. The relative influence of particular spatial element and the total number of elements that influence a subject's response appears to be highly dependent on display type and arrangement. GRA

N88-30293# Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Div. of Medical Technology
STUDY OF HUMAN FACTORS ENGINEERING CRITERIA FOR EXTRA VEHICULAR ACTIVITY (EVA) SYSTEMS, VOLUME 2 Final Report

E. MYRSETH, A. PASCHE, B. HOLLAND, G. BOLSTAD et al. Paris, France ESA 8 Dec. 1987 47 p Sponsored in part by the Royal Norwegian Council for Scientific and Industrial Research, Trondheim, Norway
 (Contract ESTEC-7016/87-NL-PP(SC))
 (STF23-F87025-VOL-2; ESA-CR(P)-2572-VOL-2; ETN-88-93021)
 Avail: NTIS HC A03/MF A01

Effects of thermal conditions on manual and cognitive performance for support divers in a neutral buoyancy facility training situation were assessed in three dives. The only variable significantly different from one dive to another is thermal comfort. Neither manual nor cognitive performance show any significant changes in the 18 to 19 C water compared to the 32 to 33 C water for either of 2 suits used in the colder water. A dive with a thin neoprene suit is rated as cold by the divers after 1 hr in the water, and as very cold after 2 hr. When diving with 6.5 mm neoprene wet-suits all 6 subjects rate their thermal condition as comfortable until 2 hr, and as slightly cold to cold after 3 hr. The dive with water temperature of 32 to 33 C is rated as very comfortable to too warm. ESA

N88-30294# Human Engineering Labs., Aberdeen Proving Ground, Md.

FOUR-AXIS SIDE-ARM FLIGHT CONTROL SIMULATOR INVESTIGATION Final Report

WILLIAM B. DEBELLIS May 1988 32 p
 (AD-A196026; HEL-TM-4-88) Avail: NTIS HC A03/MF A01
 CSDL 01D

This report presents the results of the second in a series of investigations to compile a data base on multi-axis side-arm flight controls. This second investigation focused on the effects that wearing a large and relatively bulky chemical and biological protective glove had on the pilots' flight control. Pilots were allowed to adjust the position of the armrest and the controller for individual comfort. A multivariate analysis of variance (MANOVA) was performed using three different arrangements of controller and armrest and two levels of clothing. In general, the root-mean-square deviation measure was not able to detect a consistent statistically significant difference between the three levels of controller/armrest arrangement or the two levels of clothing across all flight phases at the 5 percent level. This was true for both aircraft performance measures and pilot input measures. There were also no statistically significant interactions detected between these dependent measures. Additional data analysis showed that there were statistically significant differences on individual pilot performances and pilot to dependent measure interaction. GRA

N88-30295# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Psychology.

CONTRIBUTIONS TO ENGINEERING MODELS OF HUMAN-COMPUTER INTERACTION, VOLUME 1 Ph.D. Thesis

BONNIE E. JOHN 6 May 1988 124 p

(Contract N00014-87-K-0432; RR0-4209)

(AD-A195590; REPT-1-51206A-VOL-1) Avail: NTIS HC A06/MF A01 CSDL 12H

This dissertation presents two engineering models of behavior at the human-computer interface; a model of immediate behavior stimulus-response compatibility and a model of transcription typing. Formulated within the architecture of the Model Human Processor of Card, Moran and Newell, these models are able to make zero-parameter, quantitative predictions of human response time in their respective domains. They are also completely integrated, making good predictions about performance on a dual reaction-time/typing task. Parameters of the models are set using response time data from an abbreviation recall experiment. These parameters are then used to make predictions about response time in another abbreviation recall experiment, three classic stimulus-response experiments, and over 29 experiments that reflect robust phenomena associated with transcription typing. These models are the first to make successful predictions across domain boundaries, both within tasks exhibiting stimulus-response compatibility and outside that paradigm to transcription typing. GRA

N88-30296# Virginia Polytechnic Inst. and State Univ., Blacksburg. Human Factors Engineering Center.

HUMAN FACTORS REPORT ON INFORMATION MANAGEMENT REQUIREMENTS FOR NEXT-GENERATION MANNED BOMBERS Final Report, Jun. 1986 - Oct. 1987

DOUGLAS B. BEAUDET, DENNIS L. PRICE, GILBERT G. KUPERMAN, and DENISE L. WILSON Dec. 1987 529 p
 (Contract F33615-85-D-0514)
 (AD-A195870; AAMRL-TR-87-042) Avail: NTIS HC A23/MF A01
 CSDL 12A

A technology-free mission scenario was analyzed to determine crew information and system information management requirements. Criteria for technology insertion were developed and applied. Information sets were identified and display formats were prototyped. GRA

N88-30297*# California Univ., Davis. Dept. of Mechanical Engineering.

PREDICTION AND MEASUREMENT OF HUMAN PILOT DYNAMIC CHARACTERISTICS IN A MANNED ROTORCRAFT SIMULATION

RONALD A. HESS and JAMES T. REEDY 7 Oct. 1988 44 p
 (Contract NCC2-241)
 (NASA-CR-183246; NAS 1.26:183246) Avail: NTIS HC A03/MF A01 CSDL 05H

An analytical and experimental study of the human pilot control strategies in a manned rotorcraft simulation is described. The task simulated involves a low-speed, constant-altitude maneuvering task in which a head-down display is utilized to allow the pilot to track a moving hover point. The efficacy of the display law driving an acceleration symbol is determined and the manner in which the prediction and measurement of pilot/vehicle dynamics can be made part of man/machine system evaluations is demonstrated. Author

N88-30298# Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Div. of Medical Technology.

STUDY OF HUMAN FACTORS ENGINEERING CRITERIA FOR EXTRAVEHICULAR ACTIVITY (EVA) SYSTEMS, VOLUME 1 Final Report

A. O. BRUBAKK, B. HOLLAND, G. BOLSTAD, A. PASCHE, T. SYVERSEN, O. BJORSETH, H. RYVARDEN, H. FATHI, B. BREKKE, O. I. MOLVAER et al. Paris, France ESA 8 Dec. 1987 333 p Sponsored in part by the Royal Norwegian Council for Scientific and Industrial Research, Trondheim, Norway
 (Contract ESTEC-7016/87-NL-PP(SC))
 (STF23-F87025-VOL-1; ESA-CR(P)-2572-VOL-1; ETN-88-93020)
 Avail: NTIS HC A15/MF A01

Human factors engineering for EVA: anthropometry; physiological and biochemical parameters at 1g conditions; physiological effects of the space environment; structural

considerations; procedures; EVA suit design recommendations; EVA airborne support equipment; and EVA operational support equipment was reviewed. Design guidelines for man-machine interfaces for EVA systems are presented. Guidelines for astronaut training for EVA are suggested. Simulation techniques for EVA development studies and training are considered. Training systems; neutral buoyancy facilities; and water tanks and diver test systems are discussed. ESA

N88-30299# California Univ., Santa Barbara. Community and Organization Research Inst.

HAPTIC EXPLORATION IN HUMANS AND MACHINES: ATTRIBUTE INTEGRATION AND MACHINE RECOGNITION/IMPLEMENTATION Technical Report, 1 May 1987 - 30 Apr. 1988

SUSAN J. LEDERMAN, ROBERTA L. KLATZKY, CATHERINE REED R. BAJCSY, and S. A. STANSFIELD 30 Apr. 1988

57 p

(Contract N00014-86-K-0232)

(AD-A193692; TR-88-01) Avail: NTIS HC A04/MF A01 CSCL 23B

This technical report comprises three documents. The first describes the integration of haptic attributes during object categorization. The second describes a machine object recognition system with haptic as well as visual sensors. The third describes the development of a novel end effector of medium complexity. GRA

N88-30300# Crew Systems Consultants, Yellow Springs, Ohio. **IMPROVEMENT OF HEAD-UP DISPLAY STANDARDS.**

VOLUME 3: AN EVALUATION OF HEAD-UP DISPLAY SAFETY Final Report, Oct. 1984 - Jun. 1987

RICHARD L. NEWMAN Sep. 1987 36 p

(Contract F33615-85-C-3602)

(AD-A195787; AFWAL-TR-87-3055-VOL-3) Avail: NTIS HC A03/MF A01 CSCL 01D

A review of the safety aspects of head-up displays (HUDs) is presented. Because of the widespread concern about the use of HUDs during unusual attitudes, particular attention was paid to spatial disorientation and the implications of flying by reference to the HUD during unusual attitude recoveries. It is concluded that the HUD is not inherently unsafe during instrument meteorological conditions and is quite suitable for use as a primary flight display. It is clear, however, that current military training for pilots in the use of the HUD is inadequate both in terms of initial pilot training and recurrent training. Any problem with head-up displays is exacerbated by the lack of adequate training. The use of a generic HUD procedures trainer is highly recommended. GRA

N88-30301*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SPACE STATION PROXIMITY OPERATIONS WINDOWS: HUMAN FACTORS DESIGN GUIDELINES

RICHARD F. HAINES Mar. 1987 109 p

(NASA-TM-88233; A-86185; NAS 1.15:88233) Avail: NTIS HC A06/MF A01 CSCL 06K

Proximity operations refers to all activities outside the Space Station which take place within a 1-km radius. Since there will be a large number of different operations involving manned and unmanned vehicles, single- and multiperson crews, automated and manually controlled flight, a wide variety of cargo, and construction/repair activities, accurate and continuous human monitoring of these operations from a specially designed control station on Space Station will be required. Total situational awareness will be required. This paper presents numerous human factors design guidelines and related background information for control windows which will support proximity operations. Separate sections deal with natural and artificial illumination geometry; all basic rendezvous vector approaches; window field-of-view requirements; window size; shape and placement criteria; window optical characteristics as they relate to human perception; maintenance and protection issues; and a comprehensive review

of windows installed on U.S. and U.S.S.R. manned vehicles.

Author

N88-30346*# National Bureau of Standards, Gaithersburg, Md. **LOW LEVEL IMAGE PROCESSING TECHNIQUES USING THE PIPELINE IMAGE PROCESSING ENGINE IN THE FLIGHT TELEROBOTIC SERVICER**

MARILYN NASHMAN and KAREN J. CHACONAS /n NASA, Goddard Space Flight Center, The 1988 Goddard Conference on Space Applications of Artificial Intelligence p 215-229 Aug. 1988

Avail: NTIS HC A19/MF A01 CSCL 09B

The sensory processing system for the NASA/NBS Standard Reference Model (NASREM) for telerobotic control is described. This control system architecture was adopted by NASA of the Flight Telerobotic Servicer. The control system is hierarchically designed and consists of three parallel systems: task decomposition, world modeling, and sensory processing. The Sensory Processing System is examined, and in particular the image processing hardware and software used to extract features at low levels of sensory processing for tasks representative of those envisioned for the Space Station such as assembly and maintenance are described. Author

N88-30357*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE SPACE STATION ASSEMBLY PHASE: SYSTEM DESIGN TRADE-OFFS FOR THE FLIGHT TELEROBOTIC SERVICER

JEFFREY H. SMITH, MAX GYAMFI, KENT VOLKMER, and WAYNE ZIMMERMAN /n NASA, Goddard Space Flight Center, The 1988 Goddard Conference on Space Applications of Artificial Intelligence p 381-396 Aug. 1988

(Contract NAS7-918)

Avail: NTIS HC A19/MF A01 CSCL 05H

The effects of a recent study aimed at identifying key issues and trade-offs associated with using a Flight Telerobotic Servicer (FTS) to aid in Space Station assembly-phase tasks is described. The use of automation and robotic (A and R) technologies for large space systems often involves a substitution of automation capabilities for human EVA or IVA activities. A methodology is presented that incorporates assessment of candidate assembly-phase tasks, telerobotic performance capabilities, development costs, and effects of operational constraints. Changes in the region of cost-effectiveness are examined under a variety of system design assumptions. A discussion of issues is presented with focus on three roles the FTS might serve: as a research-oriented test bed to learn more about space usage of telerobotics; as a research based test bed having an experimental demonstration orientation with limited assembly and servicing applications; or as an operational system to augment EVA and to aid construction of the Space Station and to reduce the program (schedule) risk by increasing the flexibility of mission operations. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A88-52715

CONDENSATION OF OLIGOLYCINES WITH TRIMETA- AND TETRAMETAPHOSPHATE IN AQUEOUS SOLUTIONS

JUNPEI YAMANAKA, KATSUHIKO INOMATA, and YUKIO YAMAGATA (Kanazawa University, Japan) Origins of Life and Evolution of the Biosphere (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 165-178. refs

The yields of oligoglycines formed in condensation reactions between glycyglycine and trimetaphosphate at different pH values of the solution, were measured using HPLC technique to detect

the products. Tetraglycine and hexaglycine were detected, with yields at 30 days being 15 percent and 4 percent, respectively, measured at the optimal pH of 7.00. The results with tetrametaphosphate showed a similar pH dependence, but much smaller yields. Relative dimerization rates of diglycine and triglycine in equimolar concentrations were about twice and four times as large as that for glycine. Relevance of these results to the chemical evolution theory is discussed. I.S.

A88-52716
CONSTRUCTION OF PROTOCELLULAR STRUCTURES UNDER SIMULATED PRIMITIVE EARTH CONDITIONS

HIROSHI YANAGAWA, YOKO OGAWA, KIYOTSUGU KOJIMA, and MASAHIKO ITO (Mitsubishi-Kasei Institute of Life Sciences, Tokyo, Japan) *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 179-207. refs

This paper describes experimental approaches used in the construction of protocellular structures under simulated primitive conditions and examines formation and characteristics of these structures. Three kinds of protein envelopes were prepared from amino acids under different simulated primitive conditions, including fresh water-tide pool, a warm sea, and a submarine hydrothermal vent. Stable lipid envelopes were made from different dialkyl phospholipids and fatty acids, and marigranules were prepared from mixtures of glycine and acidic, basic, and aromatic amino acids at 105 C in a modified sea medium enriched with essential transition elements. Large stable lipid-protein envelopes were constructed from egg lecithin and solubilized marigranules. I.S.

A88-52717
PRIMEVAL PROCREATIVE COMET POND

BENTON C. CLARK (Martin Marietta Planetary Sciences Laboratory, Denver, CO) *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 209-238. refs

It is speculated that life originated in a small, shallow body of water containing concentrated prebiotic organic feedstocks, inorganic compounds, and catalytic agents in a diversity of microenvironments. This pond was formed by an improbable, fortuitous soft-landing of a cometary nucleus, or fragment thereof, on the surface of a suitable planet with an atmosphere in an appropriate thermodynamic state, such as earth. Author

A88-52718* Hebrew Univ. of Jerusalem, Rehovot (Israel).
LABORATORY INVESTIGATIONS OF MARS - CHEMICAL AND SPECTROSCOPIC CHARACTERISTICS OF A SUITE OF CLAYS AS MARS SOIL ANALOGS

AMOS BANIN (Jerusalem, Hebrew University, Rehovot, Israel), GLENN C. CARLE, SHERWOOD CHANG (NASA, Ames Research Center, Moffett Field, CA), LELIA M. COYNE (San Jose State University, CA), JAMES B. ORENBERG (San Francisco State University, CA) et al. *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 239-265. refs

A model system of Mars soil analog materials (MSAMs) was prepared, and the properties of these clays, such as chemical composition, surface-ion composition, water adsorption isotherms, and reflectance spectra, were examined. The results of these studies, performed along with simulations of the Viking Labeled Release Experiment using MSAMs, indicate that surface iron and adsorbed water are important determinants of clay behavior, as evidenced by changes in reflectance, water absorption, and clay surface reactions. The paper discusses the relevance of these results to the two major questions raised by prior explorations of Mars: has there ever been abundant water on Mars, and why is the iron found in the Martian soil not readily seen in the reflectance spectra of the surface? I.S.

A88-52719
CHEMICAL EVOLUTION OF PEROXIDASE - AMINO ACID PENTACYANOFERRATE (II) COMPLEXES AS MODEL

KAMALUDDIN, MALA NATH, and SUSHAMA W. DEOJUARI (Roorkee, University, India) *Origins of Life and Evolution of the*

Biosphere (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 267-280. ISRO-supported research. refs

This paper presents the results of kinetic studies on the decomposition of hydrogen peroxide catalyzed by complexes of pentacyanoferrate (II) with glycine, histidine, imidazole, or triglycine at 40 C and pH 9.18. It is shown that the decomposition of H₂O₂ catalyzed by these complexes conformed to Michaelis-Menten type kinetics and that the mechanism for the H₂O₂ decomposition was similar to that of peroxidase. Consequently, it is proposed the amino acid pentacyanoferrate (II) anion complexes are appropriate evolutionary models of peroxidases. I.S.

A88-52720
THE CHEMICAL LOGIC OF A MINIMUM PROTOCELL

HAROLD J. MOROWITZ (Yale University, New Haven, CT), BETTINA HEINZ (Frankfurt, Universitaet, Frankfurt am Main, Federal Republic of Germany), and DAVID W. DEAMER (California, University, Davis) *Origins of Life and Evolution of the Biosphere* (ISSN 0302-1688), vol. 18, no. 3, 1988, p. 281-287. refs

Traditional schemes for the origin of cellular life on earth generally suppose that the chance assembly of polymer synthesis systems was the initial event, followed by incorporation into a membrane-enclosed volume to form the earliest cells. Here, an alternative system consisting of replicating membrane vesicles, which are defined as minimum protocells, is discussed. These protocells consist of vesicular bilayer membranes that self-assemble from relatively rare organic amphiphiles present in the prebiotic environment. If some of the amphiphiles are primitive pigment molecules asymmetrically oriented in the bilayer, light energy can be captured in the form of electrochemical ion gradients. This energy could then be used to convert relatively common precursor molecules into membrane amphiphiles, thereby providing an initial photosynthetic growth process, as well as an appropriate microenvironment for incorporation and evolution of polymer synthesis systems. Author

A88-55202* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

WHAT SHOULD WE LOOK FOR WHEN WE RETURN TO MARS?

G. A. SOFFEN (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: *Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987*. Dordrecht, Kluwer Academic Publishers, 1988, p. 3-13.

The current state of knowledge about Mars is examined, and the details of current planned missions (Phobos and the Mars Orbiter) are considered. Speculations on some of the major future avenues of Mars research are presented; particular attention is given to questions relating to the early geological processes that resulted in Martian surface features, the effect liquid water has had on the planet, the volatile dynamics and chemistry, the chemistry of the iron-rich clays, the organic-compound mystery, and the biological issue. B.J.

A88-55203
WATER - AN ABSOLUTE REQUIREMENT FOR LIFE

A. KATSUKI (Shinshu University, Matsumoto, Japan) IN: *Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987*. Dordrecht, Kluwer Academic Publishers, 1988, p. 15-19. refs

It is noted that, as the environment of living beings, the planet earth has a mechanism of entropy elimination, namely the circulation of water. It is further noted that living beings have two types of low-entropy materials, low-energy liquid water and high-energy carbohydrate. It is concluded that water is absolutely important for life not only as the place where elementary bioprocesses proceed, but also as the low-energy and low-entropy material indispensable for entropy elimination from the living system in question. The implications of this thesis for extraterrestrial life are briefly considered. B.J.

A88-55204* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EUROPA - THE PROSPECTS FOR AN OCEAN

R. T. REYNOLDS, C. P. MCKAY, J. F. KASTING (NASA, Ames Research Center, Moffett Field, CA), and S. W. SQUIRES (Cornell University, Ithaca, NY) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 21-28. refs

Tidal dissipation in the satellites of a giant planet may provide sufficient heating to maintain a liquid water ocean below a thin ice layer. In the solar system, Europa, one of the Galilean satellites of Jupiter, may have such an ocean. Both theoretical calculations and certain observations support its existence, although proof is lacking. The putative ocean would probably have temperatures, pressures, and chemistry conducive to biologic activity. However, the environment would be severely energy limited. Possible energy sources include transient transmission of sunlight through fractures in the ice and hydrothermal activity on the ocean floor. While temporary conditions could exist that are within the range of adaptation of certain terrestrial organisms, origin of life under such conditions seems unlikely. In other solar systems, however, larger satellites with more significant heat flow could provide environments that are stable over an order of aeons and in which life could perhaps evolve. Author

A88-55205

IS URANUS THE MOST PROMISING PLANET FOR SETI?

N. G. BOCHKAREV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 29, 30. refs

It is suggested that the layer with a temperature of 300 K and a density of 0.07 g/cu cm in the Uranus atmosphere (and perhaps the Neptune atmosphere) is the most suitable extraterrestrial location in the solar system for the appearance and maintenance of life. It is argued that the high density of CH₄, NH₃, NH₂SH, H₂O, etc., as well as the presence of water drops and electrical discharges, facilitates the emergence of life on this planet. B.J.

A88-55207

COMETS AND LIFE

A. HAJDUK (Slovenska Akademia Vied, Astronomicky Ustav, Bratislava, Czechoslovakia) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 39, 40. refs

It is proposed that catastrophic collisions of the earth with large interplanetary bodies, possibly connected with mass extinctions, be investigated on the basis of studies of the orbital evolution of long-period comets. It is suggested that this may be a way to bring the study of such collisions from the stage of probability estimates to the more precise determination of such events. It is concluded that an investigation of the orbital evolution of long-period comets and the observation of their debris may enable the nongeological timing of mass extinctions. B.J.

A88-55219* Houston Univ., Tex.

CONSTRAINTS IMPOSED BY COSMIC EVOLUTION TOWARDS THE DEVELOPMENT OF LIFE

J. ORO (Houston, University, TX) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 161-165. refs (Contract NGR-44-005-002)

The probability of terrestrial-type life emerging in any other place of the universe will depend on the constraints imposed by cosmic evolution on that particular place. A systematic examination of cosmic constraints, which must have provided the necessary and sufficient conditions for the origin and evolution of life on earth, shows that they are concerned with the nature of the central star, the planetary system, and the specific life-bearing planet, as

well as with the chemical and biological evolution processes involved. These constraints or universal requirements for life are briefly described. Author

A88-55220

COSMIC METABOLISM - THE ORIGIN OF MACROMOLECULES

C. N. MATTHEWS (Illinois, University, Chicago) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 167-178. refs

Three possible routes for the synthesis of macromolecules - geochemical, biochemical, and astrochemical - are shown to be directed by water, hydrogen cyanides, and silicates, respectively. These different routes correspond, respectively, to the origin of volatiles and refractories, the origin of proteins and nucleic acids, and the origin of stars and planets. It is concluded that, taken together, these preferred pathways suggest that planets are natural companions of stars in spiral galaxies, and that life is a universal phenomenon on earthlike planets. B.J.

A88-55221

EXOTIC CHEMICAL LIFE

RONALD D. BROWN (Monash University, Clayton, Australia) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 179-185.

It is speculated that it will be found that exotic chemical life is based on carbon chemistry. This view is contrasted to that of Cairns-Smith (1982, 1985), for whom the montmorillonite clay system is the alternative. B.J.

A88-55222

HYDROTHERMAL ENERGY FLOW OF PLANETARY BODIES AND THE CREATION OF LIVING SYSTEMS

J. B. CORLISS (Eotvos Lorand Tudományegyetem, Budapest, Hungary; Georgetown University, Washington, DC) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 195-200. refs

Life on earth is characterized as an attractor emerging within the natural hierarchy of dissipative systems which transfer heat from the planetary interior. The key elements in this hierarchy are submarine hot springs. It is concluded that the phase space trajectories which the fluid components are constrained by history to follow in these reactors can lead to the assembly of complex organic molecules and organized structures. It is suggested that this model implies the possibility that life can emerge and be sustained in parts of planetary systems where the flux of solar radiation is negligible, such as the Galilean satellites of Jupiter. B.J.

A88-55223

SURVIVAL STRATEGIES FOR LIFE IN HIGH UV, VERY LOW DENSITY ENVIRONMENT

G. HORNECK (DFVLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 201-205. refs

Laboratory studies and in-flight investigations of the response of microorganisms to the space environment have shown that desiccated systems can survive short-term exposure to free space if they are shielded against solar UV radiation. Simultaneous treatment with solar UV radiation and space vacuum exerted a synergistic interaction in connection with the killing of the cells. It has been suggested that less repairable vacuum-specific photoproducts are causally involved in this synergistic response. It is concluded that these data shed light on the likelihood of the interplanetary transport of life. B.J.

A88-55224

THE RIGHT-LEFT ASYMMETRY IN BIOLOGY

IA. B. ZEL'DOVICH IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 213-222.

The theory of parity violation is discussed in connection with the origin of life. It is concluded that, in the case when radiochemical processes (with polarized electrons giving an initial asymmetry of the order of 10^{-6} to the 10^{-7}) are important, they can determine the choice of chirality, fixed thereafter by autocatalysis. On the other hand, the neutral-current energy effects of the order of 10^{-17} are too small even in the sensitive bifurcation situation. It is noted that the simple theory of autocatalysis and bifurcation does not include random molecular fluctuations.

B.J.

A88-55225

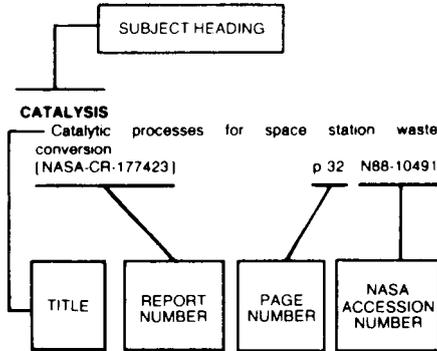
CHEMICAL PRODUCTION OF OPTICALLY PURE SYSTEMS

G. SPACH (Rouen, Universite, Mont-Saint-Aignan, France) and A. BRACK (CNRS, Centre de Biophysique Moleculaire, Orleans, France) IN: Bioastronomy - The next steps; Proceedings of the Ninety-ninth IAU Colloquium, Balaton, Hungary, June 22-27, 1987. Dordrecht, Kluwer Academic Publishers, 1988, p. 223-231. refs

The significance of optically active molecules and of the related biopolymer chiral structures in present-day terrestrial living systems is examined. Chiral fields that were possibly acting during evolution may give a clue to the origin of optical activity arising from a given handedness, but the opposite handedness is most probably not biologically forbidden. A tentative coherent approach to the problem of chirality in the course of evolution is developed in the form of an integrated model which takes into account the main homochiral molecular families (aminoacids, sugars, lipids, etc.) and suggests the design of new prebiotic simulation experiments.

Author

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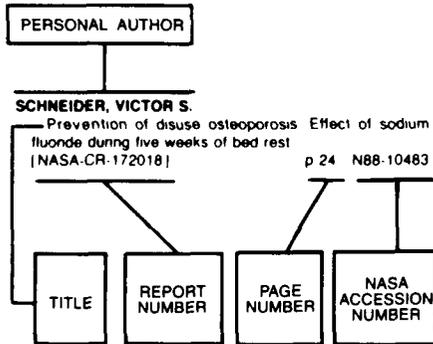
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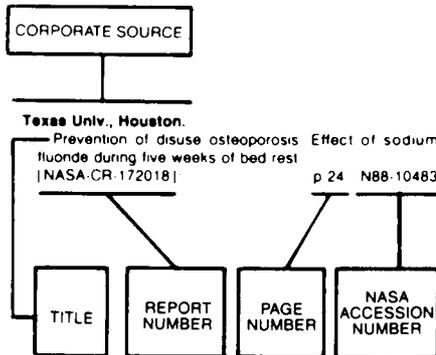
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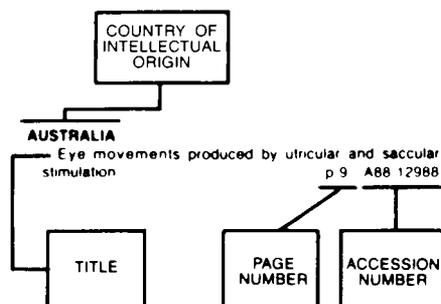
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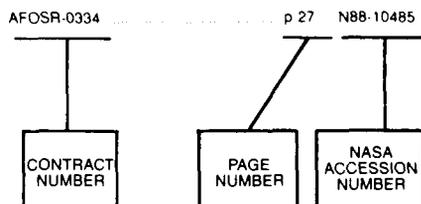
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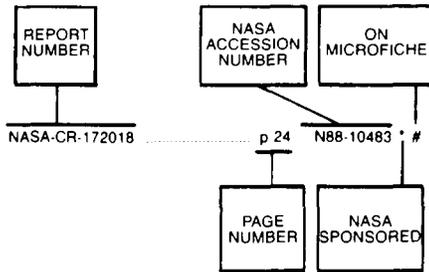
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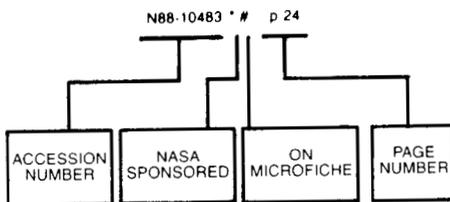


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