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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 331)

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 1989 in

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

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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 129 reports, articles and other documents announced during December 1989 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 1989 Supplements.

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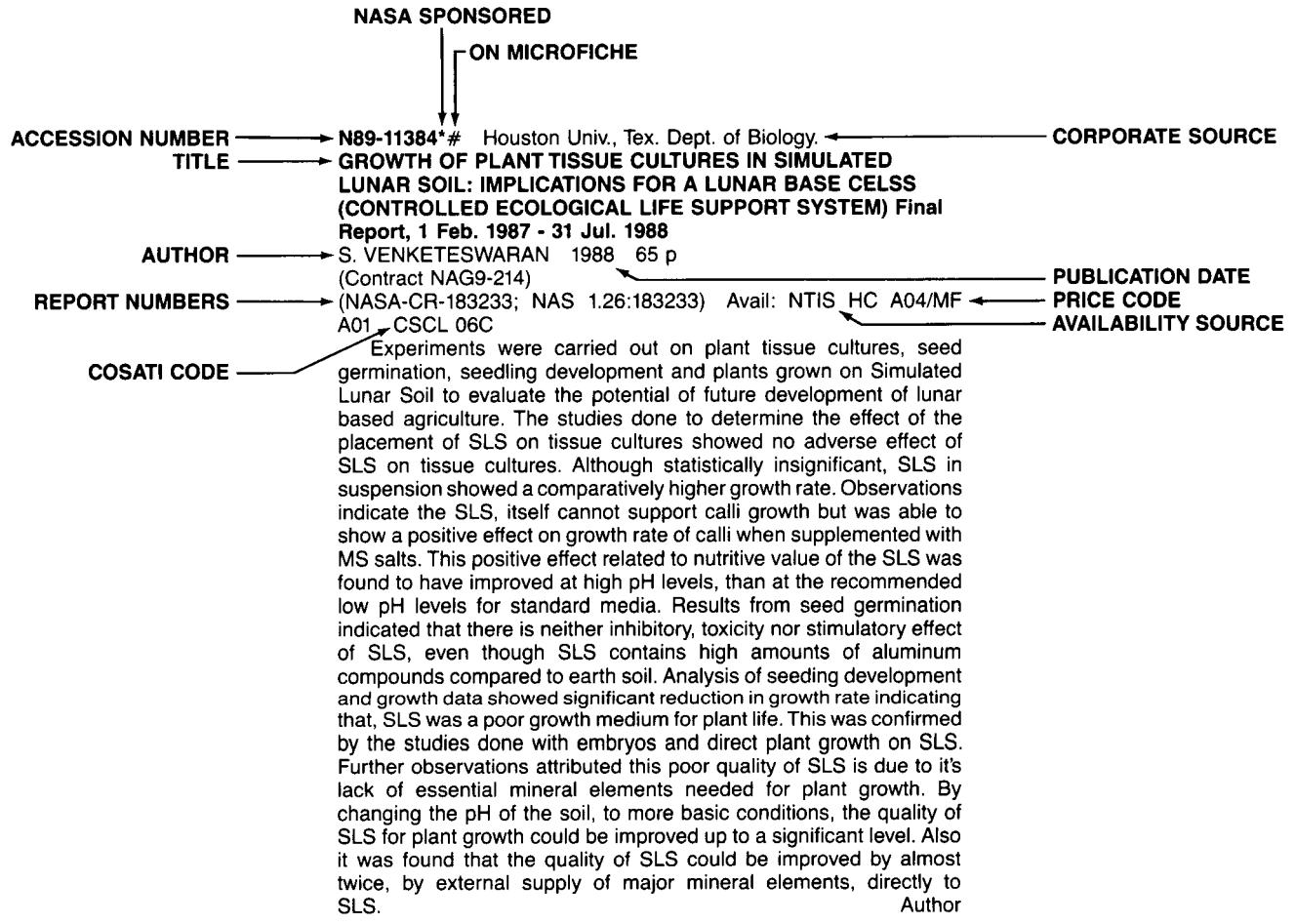
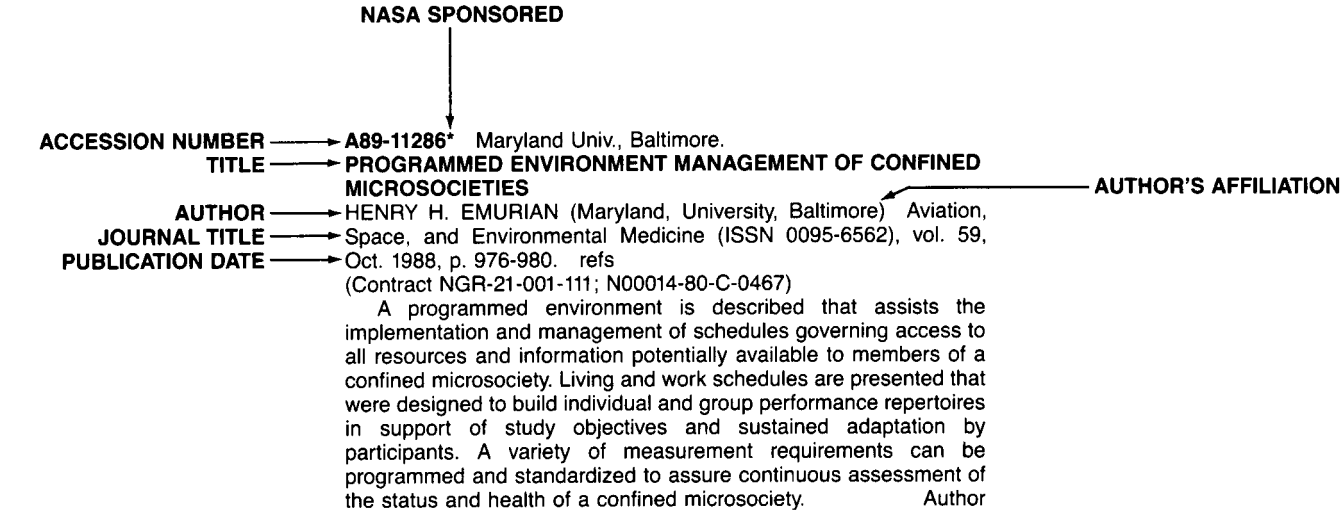
TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 331)

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LIFE SCIENCES (GENERAL)

A89-51854
CELL BIOLOGY IN SPACE - FROM BASIC SCIENCE TO BIOTECHNOLOGY. III
A. COGOLI, F. K. GMUENDER, and C. G. NORDAU (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland) IN: Space commerce; Proceedings of the Second International Conference and Exhibition on the Commercial and Industrial Uses of Outer Space, Montreux, Switzerland, Feb. 21-25, 1988. New York, Gordon and Breach Science Publishers, 1988, p. 353-366. Research supported by the Eidgenoessische Technische Hochschule Zuerich. refs
(Contract SNSF-3,382,0,82)

Consideration is given to results from experiments using the clinostat on the Spacelab centrifuge during the D-1 mission are reviewed, focusing on the adaptation of single cells to altered gravity conditions. Microgravity experiments involving cell cultures performed before Spacelab and in Spacelab are reviewed. Experiments with lymphocyte, mammalian cell, protozoa, bacteria, and plant cell cultures are discussed. Plans for future experiments are presented, including cell cultivation, electrofusion, and testing electrophoresis equipment. R.B.

A89-52058* Nijmegen Univ. (Netherlands).
OLIGOMERIZATION OF DEOXYNUCLEOSIDE-BIPHOSPHATE DIMERS - TEMPLATE AND LINKAGE SPECIFICITY
J. VISSCHER, R. VAN DER WOERD, C. G. BAKKER, and ALAN W. SCHWARTZ (Nijmegen, Katholieke Universiteit, Netherlands) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 3-6.
(Contract NGR-05-067-001)

The oligomerization of the activated 3-prime-5-prime pyrophosphate-linked dimer, pdAppdAp, is presently noted to be selectively favored by a poly(U) template over the 3-prime-3-prime and 5-prime-5-prime linked dimers. Both overall yields and the production of the longest oligomers were markedly stimulated by poly(U)'s presence; in its absence, the 5-prime-5-prime linked dimer became the most reactive, yielding chains of the order of 60 monomer-unit lengths. Remarkable self-organization properties are noted for the 5-prime-5-prime dimer of pdAp. O.C.

A89-52059* Salk Inst. for Biological Studies, San Diego, CA.
THERMAL SYNTHESIS AND HYDROLYSIS OF POLYGLYCERIC ACID
ARTHUR L. WEBER (Salk Institute for Biological Studies, San Diego, CA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 7-19. refs
(Contract NSG-7627)

Polyglyceric acid was synthesized by thermal condensation of glyceric acid at 80 C in the presence and absence of two mole percent of sulfuric acid catalyst. The acid catalyst accelerated the polymerization over 100-fold and made possible the synthesis of insoluble polymers of both L- and DL-glyceric acid by heating for less than 1 day. Racemization of L-glyceric acid yielded less than 1 percent D-glyceric acid in condensations carried out at 80 C with catalyst for 1 day and without catalyst for 12 days. The condensation of L-glyceric acid yielded an insoluble polymer much more readily than condensation of DL-glyceric acid. Studies of the hydrolysis of poly-DL-glyceric acid revealed that it was considerably more stable under mild acidic conditions compared to neutral pH. The relationship of this study to the origin of life is discussed. Author

A89-52062
OPTIMIZATION AND THE GENETIC CODE
A. FIGUREAU (Lyon I, Universite, Villeurbanne, France) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 57-67. refs

The present paper will focus on the relation between the structure of the table of the genetic code and the evolution of primitive organisms: it will be shown that the organization of the code table according to an optimization principle based on the notion of resistance to errros can provide a criterium for selection. The ordered aspect of the genetic code table makes this result a plausible starting point for studies of the origin and evolution of the genetic code: these could include, besides a more refined optimization principle at the logical level, some effects more directly related to the physicochemical context, and the construction of realistic models incorporating both aspects. Author

A89-52063
A POSSIBLE ORIGIN OF RNA CATALYSIS IN MULTIENZYME COMPLEXES
MATTHEW R. EDWARDS (Toronto, University, Canada) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 69-72. refs

Numerous attempts have recently been made to ascribe a preeminent role to RNA enzymes in primitive life systems. A model is proposed in which coenzyme-dependent RNA enzymes were initially organized in multienzyme complexes featuring (1) the continuous attachment of substrates to CoA-like carriers, as in fatty acid synthesis; and (2) the ordering of RNA enzymes via mRNA-like instructional strands. In this format, RNA enzymes would not have been required to recognize and specifically bind soluble substrates. The enzymes in this case may have required far less complexity than contemporary protein enzymes and thus less genetic information for their synthesis. An analogy is made between the proposed scheme and the protein translation mechanism, for which it may have been an evolutionary precursor. Author

A89-52080
HIGH-RESOLUTION LEAF-FOSSIL RECORD SPANNING THE CRETACEOUS/TERTIARY BOUNDARY
KIRK R. JOHNSON (Yale University, New Haven, CT), DOUGLAS J. NICHOLS, MOSES ATTREP, JR. (USGS, Denver, CO), and CHARLES J. ORTH (Los Alamos National Laboratory, NM) Nature (ISSN 0028-0836), vol. 340, Aug. 31, 1989, p. 708-711. Research supported by Yale University and Geological Society of America. refs

Megafloral data from a 100-m-thick, composite K/T boundary section in North Dakota have been combined with detailed palynological analysis, and the results are reported. The boundary is marked by a 30 percent palynofloral extinction coincident with

iridium and shocked-mineral anomalies and lies about 2 m above the highest dinosaur remains. The megaflora undergoes a 79 percent turnover across the boundary, and smaller changes 17 m and 25 m below it. This pattern is consistent with latest Cretaceous climatic warming preceding bolide impact. C.D.

A89-52197* *Jet Propulsion Lab., California Inst. of Tech., Pasadena.*
IN VITRO FLOW MEASUREMENTS IN ION SPUTTERED HYDROCEPHALUS SHUNTS
Y. I. CHO and L. H. BACK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Journal of Biomechanics (ISSN 0021-9290), vol. 22, no. 4, 1989, p. 335-337, 339-342. refs
(Contract NAS7-100)

This paper describes an experimental procedure for accurate measurements of the pressure-drop/flow rate relationship in hydrocephalus shunts. Using a fish-hook arrangement, small flow rates in a perforated ion-sputtered Teflon microtubule were measured in vitro in a pressured system and were correlated with pressure in the system. Results indicate that appropriate drainage rates could be obtained in the physiological range for hydrocephalus shunts. I.S.

A89-52200* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANATOMICAL EVIDENCE FOR RED NUCLEUS PROJECTIONS TO MOTONEURONAL CELL GROUPS IN THE SPINAL CORD OF THE MONKEY
GERT HOLSTEGE (NASA, Ames Research Center, Moffett Field; California, University, San Francisco; Rotterdam, Universiteit, Netherlands), BERTIL F. BLOK (Rotterdam, Universiteit, Netherlands), and DIANE DALY RALSTON (California, University, San Francisco) Neuroscience Letters (ISSN 0304-3940), vol. 95, 1988, p. 97-101. Research supported by R. A. van der Laan Fonds, A. A. van Beek Fonds, Fundatie Vrijvrouwe van Renswoude, Bekker la Bastide Fonds, and Universiteit Rotterdam. refs
(Contract NCC2-491; NIH-NS-23347)

In four rhesus monkeys wheat germ agglutinin-horseradish peroxidase (WGA-HRP) injections were made in the mesencephalic tegmentum. In three cases with injections involving the red nucleus (RN), rubrospinal fibers descended mainly contralaterally to terminate in laminae V, VI and dorsal VII of the spinal cord and in the lateral motoneuronal cell groups at the level of the cervical and lumbosacral enlargements. In all four cases the area of the interstitial nucleus of Cajal (INC) was injected, which resulted in labeled interstitiospinal fibers in the medial part of the ipsilateral ventral funiculus of the spinal cord. The results indicate that there is no major qualitative difference between the mesencephalic (RN and INC) and motor cortical projections to the spinal cord.
Author

A89-52773
DISCRETE MACROSCOPIC FLUCTUATIONS IN PROCESSES OF DIFFERENT NATURE [DISKRETNYE MAKROSKOPICHESKIE FLUKTUATSII V PROTSESSAKH RAZNOI PRIRODY]
S. E. SHNOL', N. V. UDAL'TSOVA, N. B. BODROVA, and V. A. KOLOMBET (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Biofizika (ISSN 0006-3029), vol. 34, July-Aug. 1989, p. 711-722. In Russian. refs

This paper reviews data obtained during the last 30 years on processes of different nature (from biochemical reactions to radioactive decay), for which it was found that the results on subsequently sampled specimens fluctuate discretely. It is concluded that the discrete nature of the corresponding state spectra can be explained by both mathematical causes and cosmophysical factors. The amplitudes and shapes of the corresponding state spectra of objects are considered to depend on the universal external cosmophysical factors. General problems arising in connection with the analysis of the result scatter and nonreproducibility of measurements are discussed. I.S.

A89-52774
MACROSCOPIC FLUCTUATIONS - A PHENOMENON OR AN ARTIFACT? [MAKROSKOPICHESKIE FLUKTUATSII - FENOMEN ILI ARTEFAKT?]
N. L. VEKSHIN (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Biofizika (ISSN 0006-3029), vol. 34, July-Aug. 1989, p. 723-731. In Russian. refs

Reports of macroscopic fluctuations in data on various biochemical, chemical, and physical systems are critically analyzed. It is shown that the evidence of the greater spread of the velocities of the processes with respect to time, relative to that in the control experiments, can be caused by the presence of temperature, concentration, and other gradients. It is suggested that the similarity of the statistical spectal histograms reported for different processes measured at close time intervals can be explained by incorrect processing of data and procedures of spectra superposition. It is concluded that macroscopic fluctuations are essentially an artifact. I.S.

A89-52807
DOSE THRESHOLDS IN THE IMPAIRMENT OF PHYSICAL WORK CAPACITY OF MICE AND RATS AFTER IRRADIATION [DOZOVYE POROGI NARUSHENII FIZICHESKOI RABOTOSPOSOBNOSTI MYSHEI I KRYS POSLE OBLUCHENIIA]
V. N. MALAKHOVSKII and P. P. MIKHAILICHENKO (Voenno-Meditsinskaia Akademiia, Leningrad, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, May-June 1989, p. 379-383. In Russian. refs

The effects of exposure of mice and rats to gamma rays (in the 35-200 Gy dose range) on the physical efficiency of the animals were investigated by measuring radiation-induced changes in muscular endurance and motor coordination indices. It was found that the dose threshold at which the stability in the accomplishment of learned operations was impaired was 40 Gy. Two hours following the administration of 70-100 Gy, the accomplishment of operations decreased to 50 percent of the initial level, followed by gradual restoration to initial levels after 24 h of rest. At 200 Gy, the disturbances were irreversible. I.S.

A89-52808
THE RATE OF REPAIR OF RADIATION INJURY TO THE CENTRAL NERVOUS SYSTEM AFTER PROLONGED AND FRACTIONATED IRRADIATION [SKOROST' REPARATSII RADIATSIONNOGO PORAZHENIIA TSENTRAL'NOI NERVNOI SISTEMY PRI PROTIAZHENNOM I FRAKTSIONIROVANNOM OBLUCHENII]
V. N. MALAKHOVSKII and M. I. BOKK (Voenno-Meditsinskaia Akademiia, Leningrad, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, May-June 1989, p. 384-388. In Russian. refs

The rate of recovery of dogs and guinea pigs from radiation injuries to the central nervous system (CNS) due to single or fractionated (two fractional doses with a 24-h interval) gamma irradiation (114 Gy/h) was estimated by recording locomotor disturbances caused by irradiation. It was found that, even after massive irradiation, there were significant differences between the one-time and two-time irradiation groups, indicating that the CNS underwent intensive recovery in the 24 hours after the first dose. An equation was derived relating the rate of recovery, the time between the two fractionated doses, and the dose of the 'residual injury'. I.S.

A89-52809
PHASE STRUCTURE OF EARLY DISTURBANCES IN THE PHYSICAL EFFICIENCY OF RATS AFTER IRRADIATION [FAZOVAIA STRUKTURA RANNIKH NARUSHENII DEESPOSOBNOSTI POSLE OBLUCHENIIA KRYS]
V. N. MALAKHOVSKII, M. I. BOKK, A. E. EGOROV, and O. A. STEMPARZHETSKII (Voenno-Meditsinskaia Akademiia, Leningrad, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, May-June 1989, p. 389-394. In Russian. refs

The sequence of changes in various indices of the physical efficiency of rats due to an exposure to gamma rays (60 Gy/min)

or high-velocity electrons (8 MeV, 20 Gy/sec) was studied by recording the numbers of movements per minute of rats in the 'Ugo Basile' activity chamber. Results indicated that an early decrease in physical efficiency due to irradiation involves several partially superimposed phases. Phases of excitation, hypokinesia, and neurological disorders could be identified in early transient inefficiency, which were followed by phases of an early transient efficiency decrease with a reversible impairment in the execution of learned operations; simultaneously, a phase of an irreversible decrease in the central nervous system capacity for transmitting information was recorded. I.S.

A89-52810
THE EFFECT OF HIGH-DOSE IONIZING RADIATION ON THE CONTENT OF CYCLIC NUCLEOTIDES IN THE RAT BRAIN [VLIIANIE IONIZIRUIUSHCHIKH IZLUCHENII V VYSOKIKH DOZAKH NA SODERZHANIE TSIKLICHESKIKH NUKLEOTIDOV V GOLOVNOM MOZGE KRYS]
L. A. SHAROVA (Voenno-Meditsinskaia Akademiia, Leningrad, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, May-June 1989, p. 395-398. In Russian. refs

Dynamic changes in the contents of cyclic AMP (CAMP) and GMP (CGMP) in the brains of rats subjected to irradiation by higher-than-lethal doses (100 and 500 Gy) of high-energy electrons were monitored by measuring the contents of CAMP and CGMP 2 min, 10 min, 30 min, 1 h, 2 h, 6 h, and 24 h after exposures. It was found that the contents of cyclic nucleotides in the brain tissues underwent two considerable changes after a 500 Gy dose, 2 min after irradiation and in the postradiation period between 6 and 24 h. The contents of CAMP decreased in both the cerebrum and the cerebellum tissues, whereas the CGMP decreased only in the cerebral cortex and in the cerebellum. I.S.

A89-52881
THERMOREGULATION CURVES AND FACTORS THAT CONTROL THEM [KRIVYE TERMOREGULIATSII I OPREDELIAIUSHCHIE IKH FAKTORY]
I. G. VLADIMIROVA and A. I. ZOTIN (AN SSSR, Institut Biologii Razvitiia, Moscow, USSR) Uspekhi Fiziologicheskikh Nauk (ISSN 0301-1798), vol. 20, July-Sept. 1989, p. 21-42. In Russian. refs

The effects of an animal's physical characteristics, the stage of its ontogeny, and its life conditions on its thermoregulation functions were analyzed. It is shown that the thermoregulation curves are changed in the course of ontogeny, and are affected by the body mass of the animal, its systematic order, the degree of acclimatization to new temperature conditions, the altitude and the geographical latitude, and the change from life on dry land to life in water. Two new allometric relationships were found: one was between the metabolic cost of chemical thermoregulation and the body mass of a homoiothermal animal, and the other was between the position of the critical point on the thermoregulation curve and body mass. In addition, a nonallometric relationship was found between the width of the thermoneutral zone and body mass. I.S.

A89-52882
MECHANISM OF THE ORIGIN OF INFRADIAN BIOLOGICAL RHYTHMS [MEKHANIZM PROISKHOZHDENIIA INFRADIANNYKH BIOLOGICHESKIKH RITMOV]
N. N. SHABATURA (Kievskii Gosudarstvennyi Pedagogicheskii Institut, Kiev, Ukrainian SSR) Uspekhi Fiziologicheskikh Nauk (ISSN 0301-1798), vol. 20, July-Sept. 1989, p. 86-103. In Russian. refs

The exogenic and endogenic origins of infradian (from one to 30 days) biological rhythms are examined together with the physiological processes involved in their formation. Results of long-term observations of human subjects indicated the presence of rhythmic fluctuations with periods of 5-7 and 10-14 days in the intensity of energy exchange, body temperature, and the activities of the cardiovascular and respiratory systems. Results of experiments on albino rats showed that the destruction of suprachiasmatic hypothalamic nuclei, as well as around-the-clock illumination, distorts both circadian and infradian rhythms. A hypothesis is proposed for the formation of infradian biological rhythms in the framework of the circadian rhythm system. I.S.

A89-52957
THE ROLE OF CHANCE IN THE EVOLUTIONARY PROCESS
E. J. COFFEY British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 437-442. refs

The differences between physical (especially astrophysical) and biological evolution are discussed, focusing on the role of chance in biological evolution. Darwinian evolution, the origins of life, the limits of biological diversity, and the genesis of multicellular phyla are reviewed. The implications of the impossibility of predicting the characteristics of possible extraterrestrials for SETI are discussed. R.B.

A89-54201
LIFE SCIENCES AND SPACE RESEARCH XXIII(4) - RADIATION BIOLOGY; PROCEEDINGS OF THE TOPICAL MEETINGS AND WORKSHOP XIX OF THE 27TH COSPAR PLENARY MEETING, ESPOO, FINLAND, JULY 18-29, 1988
U. HAGEN, ED. (Gesellschaft fuer Strahlenforschung mbH, Institut fuer Strahlenbiologie, Neuherberg, Federal Republic of Germany), G. HORNECK, ED. (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), and R. J. M. FRY, ED. (Oak Ridge National Laboratory, TN) Meetings and Workshop sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, 344 p. For individual items see A89-54202 to A89-54239.

Topics discussed in this volume are on the molecular and cellular effects of heavy ions, the impact of environmental factors on radiobiological processes in space, and radiation research related to Space Station and missions beyond the magnetosphere. Papers are presented on physical events in the track structure of heavy ions and their relation to alterations of biomolecules, the stochastics of HZE-induced microlesions, DNA lesion and cell death by alpha-particles and nitrogen ions, molecular mechanisms responsible for neoplastic cell transformation by high-LET radiation, and the combined effects of radiation and trauma. Attention is also given to photoproducts in DNA irradiated in vitro and in vivo under extreme environmental conditions, a parametric study of space radiation exposures to critical body organs for low-earth-orbit missions, a model analysis of Space Shuttle dosimetry data, and late cataractogenesis caused by particulate radiations and photons in long-lived mammalian species. I.S.

A89-54202
RADIATION BIOLOGY IN SPACE - A CRITICAL REVIEW
U. HAGEN (Gesellschaft fuer Strahlenforschung mbH, Institut fuer Strahlenbiologie, Neuherberg, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 3-8. refs

A short summary of the results of radiobiological studies in space or on respective particles on ground is given. Among the various types of radiation in space, the effect of heavy ions with high energy are most essential. Cell death, mutation and malignant transformation can be studied on ground with heavy ions of different energy with suitable accelerators or in space. In space, however, the effect of microgravity has to be considered and there are hints that under weightlessness the biological effect of radiation may be enhanced. Author

A89-54203
PHYSICAL EVENTS IN THE TRACK STRUCTURE OF HEAVY IONS AND THEIR RELATION TO ALTERATIONS OF BIOMOLECULES
H. G. PARETZKE (Gesellschaft fuer Strahlenforschung mbH, Institut fuer Strahlenschutz, Neuherberg, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4)

- Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 15-20. refs

Heavy charged particles interacting with biological cells can produce a wide variety of different physical, chemical and biological consequencies. A rigorous identification of relevant chemical and biological alterations of biomolecules in cells, however, is still lacking and, thus, it is difficult to identify the potential biological importance of different early physical events. In addition, due to experimental and theoretical problems, also little is known about the details of energy transfer, -absorption and -decay from projectiles to atoms/molecules in condensed targets; this is particularly true for not completely stripped heavy ions. Nevertheless, available data suggest that higher densities of physical energy absorption events have a significantly higher probability to lead to qualitatively more severe biochemical alterations as regards the induction of DNA double strand breaks and of chromatin damage. It is not very likely that energy migration along the DNA molecule in biological cells over long distances plays a significant role as contributor to these biological radiation effects. Author

A89-54204
QUANTITATIVE INTERPRETATION OF HEAVY IONS EFFECTS - MODELS FOR THE BIOLOGICAL EFFECTS OF HEAVY IONS
J. KIEFER and H. STRAATEN (Giessen, Universitaet, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 21-29. Research supported by the Gesellschaft fuer Schwerionenforschung mbH and BMFT. refs

The parameters used in the models of biological effect of radiation and the mathematical expressions determining the response function of a cell or an organism are considered. Particular attention is given to the radiation-effect concept of Kellerer and Rossi (1972), which relates the number of biologically significant lesions to the square of the specific energy in sensitive sites, and the track structure theory of Butts and Katz (1967), which relates the effectivity of different radiation types to the track structure leading to variations in local energy deposition. It is suggested that these two models can be combined to quantify the effect of heavy-ion irradiation on living cell (as expressed by a number of double DNA-strand breaks). I.S.

A89-54205
STOCHASTICS OF HZE-INDUCED MICROLESIONS
P. TODD (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 31-34. refs

Fundamental biological experiments with bacteria, yeast, and mammalian cells irradiated with ions heavier than helium indicate that maximal probability of single-hit inactivation does not occur when the ion has LET below about 100-200 keV/micron. Theoretical treatments of cell inactivation data and the radiation chemistry in particle tracks are consistent with this finding. If a 'microlesion' is defined as a linear array, within a tissue, of cells inactivated with maximum probability, surrounded by nonlethally damaged cells, then, by this definition, there must be an LET below which 'microlesion' damage cannot be expected. In a retrospective survey of experimental literature in which single-particle effects in tissues were sought, it was found that little or no evidence has been reported supporting single-particle effects in tissues when LET was below 200 keV/micron, while some experimenters who irradiated tissues with particles having LET greater than 200 keV/micron reported effects that could be attributed to single-particle tracks. Author

A89-54206
FREE RADICALS INDUCED IN SOLID DNA BY HEAVY ION BOMBARDMENT
J. HUETTERMANN, A. SCHAEFER (Saarland, Universitaet, Homburg, Federal Republic of Germany), and G. KRAFT (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 35-44. refs

Free radical formation after heavy-ion bombardment was studied in solid, polycrystalline pellets of DNA-constituents by analyzing the dose-yield curves and the spectra obtained by ESR-spectroscopy at low and ambient temperatures. The dose-yield curves were found to correlate with those found after X-irradiation but shifted to higher doses and lower saturation concentrations. The corresponding radical yields (per 100 eV) exhibit values which are one to two orders of magnitudes lower. The structural aspects as revealed from powder ESR-spectra gave a complex inter-relation between substance. LET, dose and irradiation temperature, which is discussed in terms of mechanistic models. Author

A89-54207
THE INFLUENCE OF RADIATION QUALITY ON THE FORMATION OF DNA BREAKS
R. ROOTS, W. HOLLEY, A. CHATTERJEE, E. RACHAL (California, University, Berkeley), and G. KRAFT (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 45-55. refs
(Contract NIH-CA-15184; DE-AC03-76SF-00098)

A comprehensive review is presented of the formation of DNA strand breaks induced by high LET radiation. Data obtained from DNA in solution as well as from the formation and 'repair' of strand breaks in cell DNA are discussed. There is good agreement, qualitatively, between these two systems. Results are evaluated for two parameters: (1) effectivity per particle and (2) the strand break induction frequency as number of breaks per Gy per unit DNA. The data presented cover results obtained for helium to uranium particles, covering a particle incident energy range of about 2 to 900 MeV/u with a corresponding LET range of near 16 to 16000 keV./micron. Author

A89-54208
CELLULAR AND SUBCELLULAR EFFECT OF HEAVY IONS - A COMPARISON OF THE INDUCTION OF STRAND BREAKS AND CHROMOSOMAL ABERRATION WITH THE INCIDENCE OF INACTIVATION AND MUTATION
G. KRAFT, W. KRAFT-WEYRATHER, S. RITTER, M. SCHOLZ, and J. STANTON (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 59-72. Research supported by BMFT. refs
(Contract CEC-B16-0197-D)

A89-54209
DNA-LESION AND CELL DEATH BY ALPHA-PARTICLES AND NITROGEN IONS
I. KANEKO, K. EGUCHI-KASAI, T. KOSAKA, K. NAKANO, A. MARUHASHI (Institute of Physical and Chemical Research, Wako, Japan) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 73-81. refs

The induction of nonrepairable DNA breaks by beams of nitrogen ions, alpha particles, and gamma-rays in two mammalian cell lines (human melanoma cells HMV-I and Chinese hamster

cells HA-1) cultured in monolayers was examined, and the cross-link characteristics in the residual lesions present after postirradiation incubation were investigated. It was found that there was no close relationship between the dose-response curve of the single-strand-breaks (SSBs) or double-strand-breaks (DSBs) and the dose-survival curves after gamma-ray or N-ion radiation. However, the number of nonrepairable DSBs in the two cell lines was the same at the same level of survival, regardless of the quality of radiation, indicating that there is a close relationship between cell death and the induction of nonrepairable DNA strand breaks. I.S.

A89-54210
REPAIR AND MISREPAIR OF HEAVY-ION-INDUCED CHROMOSOMAL DAMAGE

E. GOODWIN, E. BLAKELY, G. IVERY, and C. TOBIAS (California, University, Berkeley) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 83-89. refs
(Contract NIH-RR-05918; NIH-CA-15184; DE-AC03-76SF-00098)

The premature chromosome condensation (PCC) technique was used to investigate chromosomal damage, repair, and misrepair in the G1 phase of a human/hamster hybrid cell line that contains a single human chromosome. Plateau-phase cell cultures were exposed to either X-rays or a 425 MeV/u beam of neon ions near the Bragg peak where the LET is 183 keV/microns. An in situ hybridization technique coupled to fluorescent staining of PCC spreads confirmed the linearity of the dose response for initial chromatin breakage in the human chromosome to high doses (1600 cGy X-ray or 1062 cGy Ne). Ne ions were about a factor of 1.5 more effective per unit dose compared to X-rays at producing the initially measured chromatin breakage. 90 percent of the X-ray-induced breaks rejoined in cells incubated at 37 C after exposure. In contrast, only 50 percent of Ne-ion-induced breaks rejoined. In the irradiated G1 cells, ring PCC aberrations increased with time apparently by first order kinetics after either X-ray or Ne exposures. However, far fewer rings formed in Ne-irradiated cells after a dose giving a comparable initial number of chromatin breaks. Following X-ray exposures, the yield of rings formed after long repair times (6 to 9 hrs) fit a quadratic dose-response curve. These results indicate quantitative and qualitative differences in the chromosomal lesions induced by low- and high-LET radiations. Author

A89-54211
CELL CYCLE DELAYS INDUCED BY HEAVY ION IRRADIATION OF SYNCHRONOUS MAMMALIAN CELLS

M. SCHOLZ, W. KRAFT-WEYRATHER, S. RITTER, and G. KRAFT (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 91-96. Research supported by BMFT. refs
(Contract CEC-B16-0197-D)

Cell cycle effects of very high LET particles on synchronous V79 Chinese Hamster cells have been studied in a track segment experiment by means of flow cytometric methods. Cells were irradiated with 10 MeV/u Pb-ions (LET = 35,000 keV/micron) at an average fluence of 2 particles per cell nucleus, corresponding to a survival level of about 25 percent. Instantaneous drastic reductions of cell proliferation in all cycle phases have been observed, which affect the cell cycle for at least 50 hours after exposure to heavy ions. These findings are in clear contrast to the results from low LET radiation experiments, where significant delays can only be observed in S-phase and G2M-phase and for comparatively short time intervals of a few hours. Additionally, high LET radiation gives rise to prolonged DNA synthesis bypassing cell division, which leads to cells with DNA content greater than that of G2M-cells. Author

A89-54212* Colorado State Univ., Fort Collins.
THE ROLE OF REPAIR IN THE SURVIVAL OF MAMMALIAN CELLS FROM HEAVY ION IRRADIATION - APPROXIMATION TO THE IDEAL CASE OF TARGET THEORY

J. T. LETT (Colorado State University, Fort Collins), A. B. COX, and M. D. STORY (USAF, School of Aerospace Medicine, Brooks AFB, TX) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 99-104. Research supported by DOE. refs
(Contract NAG9-10; NIH-CA-10714)

Experiments are discussed in which the cell-cycle dependency of the repair deficiency of the S/S variant of the L5178Y murine leukemic lymphoblast was examined by treatment with the heavy ions, Ne-20, Si-28, Ar-40, Fe-56, and Nb-93. Evidence from those studies provide support for the notion that as the linear energy transfer of the incident radiation increases the ability of the S/S cell to repair radiation damage decreases until it is eliminated around 500 keV/micron. In the region of the latter linear energy transfer value, the behavior of the S/S cell approximates the ideal case of target theory where post-irradiation metabolism does not influence cell survival. Author

A89-54213
CELL INACTIVATION, REPAIR AND MUTATION INDUCTION IN BACTERIA AFTER HEAVY ION EXPOSURE - RESULTS FROM EXPERIMENTS AT ACCELERATORS AND IN SPACE

G. HORNECK, M. SCHAEFER, K. BALTSCHUKAT, U. WEISBROD, U. MICKE (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 105-116. Research supported by BMFT and DFVLR. refs

To understand the mechanisms of accelerated heavy ions on biological matter, the responses of spores of B. subtilis to this structured high LET radiation was investigated applying two different approaches. By the use of the Biostack concept, the inactivation probability as a function of radial distance to single particles' trajectory (i.e., impact parameter) was determined in space experiments as well as at accelerators using low fluences of heavy ions. It was found that spores can survive even a central hit and that the effective range of inactivation extends far beyond impact parameters where inactivation by delta-ray dose would be effective. Concerning the space experiment, the inactivation cross section exceeds those from comparable accelerator experiments by roughly a factor of 20. From fluence effect curves, cross sections for inactivation and mutation induction, and the efficiency of repair processes were determined. They are influenced by the ions characteristics in a complex manner. Author

A89-54214
EARLY AND LATE DAMAGES INDUCED BY HEAVY CHARGED PARTICLE IRRADIATION IN EMBRYONIC TISSUE OF ARABIDOPSIS SEEDS

U. BORK, K. E. GARTENBACH, and A. R. KRANZ (Frankfurt, Universitaet, Frankfurt am Main, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 117-121. refs

Early and late effects of accelerated heavy ions (HZE) on the embryonic tissue of Arabidopsis thaliana seeds were investigated seeing that initial cells of the plant eumeristems resemble the original cells of animal and human tissues with continuous cell proliferation. The endpoints measured were lethality and tumorization in the M1-generation for early effects and embryonic lethality in the M2-generation for late effects. The biological endpoints are plotted as functions of the physical parameters of the irradiation, i.e., ion fluence (p/sq cm), dose (Gray), charge Z,

and linear energy transfer (LET). The results presented contribute to the estimation of the principles of biological HZE effects and thus may help to develop a unified theory which could explain the whole sequence from physical and chemical reactions to biological responses connected with heavy ion radiation. Author

A89-54215
THE QUANTIFICATION OF WOUND HEALING AS A METHOD TO ASSESS LATE RADIATION DAMAGE IN PRIMATE SKIN EXPOSED TO HIGH-ENERGY PROTONS
A. B. COX (USAF, School of Aerospace Medicine, Brooks AFB, TX) and J. T. LETT (Colorado State University, Fort Collins) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 125-130. refs
(Contract F33615-85-C-4514)

In an experiment examining the effects of space radiations on primates, different groups of rhesus monkeys (Macaca mulatta) were exposed to single whole-body doses of 32- or 55-MeV protons. Survivors of those exposures, together with age-matched controls, have been monitored continuously since 1964 and 1965. Late effects of nominal proton doses ranging from 2-6 Gray have been measured in vitro using skin fibroblasts from the animals. A logical extension of that study is reported here, and it involves observations of wound healing after 3-mm diameter dermal punches were removed from the ears (pinnae) of control and irradiated monkeys. Tendencies in the reduction of competence to repair cutaneous wounds have been revealed by the initial examinations of animals that received doses greater than 2 Gy more than 2 decades earlier. These trends indicate that this method of assessing radiation damage to skin exposed to high-energy radiations warrants further study. Author

A89-54216* California Univ., Berkeley.
NEOPLASTIC CELL TRANSFORMATION BY HIGH-LET RADIATION - MOLECULAR MECHANISMS
TRACY CHUI-HSU YANG, LAURIE M. CRAISE, CORNELIUS A. TOBIAS (California, University, Berkeley), and MAN-TONG MEI (South China Agricultural University, Guangzhou, People's Republic of China) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 131-140. refs
(Contract NASA ORDER T-7163-B; NIH-CA-15184; DE-AC03-76SF-00098)

Quantitative data were collected on dose-response curves of cultured mouse-embryo cells (C3H10T1/2) irradiated with heavy ions of various charges and energies. Results suggests that two breaks formed on DNA within 80 A may cause cell transformation and that two DNA breaks formed within 20 A may be lethal. From results of experiments with restriction enzymes which produce DNA damages at specific sites, it was found that DNA double strand breaks are important primary lesions for radiogenic cell transformation and that blunt-ended double-strand breaks can form lethal as well as transformational damages due to misrepair or incomplete repair in the cell. The RBE-LET relationship for high-LET radiation is similar to that for HGPRT locus mutation, chromosomal deletion, and cell transformation, indicating that common lesions may be involved in these radiation effects. I.S.

A89-54217
NEOPLASTIC TRANSFORMATION OF MOUSE C3H 10T1/2 AND SYRIAN HAMSTER EMBRYO CELLS BY HEAVY IONS
L. HIEBER, G. K. PONSEL, K. TRUTSCHLER, S. FENN, and A. M. KELLERER (Wuerzburg, Universitaet, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 141-149. Research supported by the Gesellschaft fuer Schwerionenforschung mbH. refs
(Contract DFG-SFB-172)

A89-54218
SPACE ENVIRONMENTAL FACTORS AFFECTING RESPONSES TO RADIATION AT THE CELLULAR LEVEL
H. PLANEL, Y. GAUBIN, B. PIANEZZI, and G. GASSET (Toulouse III, Universite, France) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 157-160. refs

Previous space experiments suggest a high value for the RBE of cosmic radiation. A possible explanation could be a change in cell radiosensitivity due to the combined effect of radiation and other factors related to the space environment and space flight. Results of the EXOBLOC II experiment support this assumption. On earth, vibrations or accelerations applied before or after irradiation can change the responses to radiation. Microgravity could be the main factor affecting the radiosensitivity and DNA repair, but this hypothesis must be confirmed by additional experiments. Author

A89-54219
INFLUENCE OF COSMIC RADIATION AND/OR MICROGRAVITY ON DEVELOPMENT OF CARAUSIUS MOROSUS
G. REITZ, H. BUECKER, R. FACIUS, G. HORNECK (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany), E. H. GRAUL (Marburg, Universitaet, Federal Republic of Germany) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 161-173. refs

Eggs of Carausius morosus were exposed to spaceflight conditions in two spaceflight missions, the German 7-day Spacelab mission D1 and the Soviet 12.56-day Biosatellite mission Cosmos 1887. During space flight the eggs continued their development. Eggs of five different ages representing different sensitivity to radiation and different capacity for regeneration were used to investigate the influence of cosmic radiation and/or microgravity on insect development. After retrieval, hatching rates, embryonic and larval growth kinetics, and anomaly frequencies were determined. Microgravity leads to a reduced hatching rate of eggs exposed in the early stages of development. Hatching was normal in eggs which were exposed on the 1-g reference centrifuge. Hits by heavy ions caused body anomalies. The combined action of heavy ions and microgravity resulted in an unexpectedly high frequency of anomalies. The results suggest some microgravity-induced functional impairment of the hatching activity, rather than blockage in embryonic development. Author

A89-54220
CELL-CYCLE RADIATION RESPONSE - ROLE OF INTRACELLULAR FACTORS
E. BLAKELY, P. CHANG, L. LOMMEL, K. BJORNSTAD, M. DIXON (California, University, Berkeley) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 177-186. Research supported by DNA. refs
(Contract NIH-CA-15184; DE-AC03-76SF-00098)

Variations of radiosensitivity and endogenous cellular factors have been studied during the course of progression through the human and hamster cell cycle. After exposure to low-LET radiations, the most radiosensitive cell stages are mitosis and the G1/S interface. The increased activity of a specific antioxidant enzyme such as superoxide dismutase in G1-phase, and the variations of endogenous thiols during cell division are thought to be intracellular factors of importance to the radiation survival response. These factors may contribute to modifying the age-dependent yield of

lesions or more likely, to the efficiency of the repair processes. A summary comparison of various cell-cycle-dependent endpoints measured with low- or high-LET radiations is given and includes a discussion of the possible additional effects introduced by microgravity. Author

A89-54221
MODIFYING FACTORS ON REPAIR PHENOMENA
H. FRITZ-NIGGLI (Zuerich, Universitaet, Zurich, Switzerland) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 187-195. refs

The types of the repair of DNA damage due to radiation are discussed together with agents that affect damage repair. Attention is given to such modifiers of chromosomal repair as genetic facors, the electron acceptors and donors, the membrane activity, and the chromosome structure. Particular consideration is given to the radiation-damage inhibitors that affect different stages of DNA repair, such the incision step, polymerization, or ligation, and to radioprotective agents. It is noted that the conditions of a space flight could not only modify the radiation-induced damages but could also change the frequency of natural errors. I.S.

A89-54222
COMBINED EFFECTS OF RADIATION AND TRAUMA
OTFRIED MESSERSCHMIDT (Chirurgische Klinik Innenstadt und Chirurgische Poliklinik, Munich, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 197-201. refs

Wounds or burns which, in general, do not cause septicaemia could become entrance ports for bacteria when animals are exposed to whole-body irradiation. Thrombocytopenia is the reason for hemorrhages in wounds. The susceptibility to shock is increased considerably in combined injuries and the formation of callus in the bone fractures is significantly delayed. The healing of wounds and burns in the initial phase of the radiation syndrome does not always differ from healing in the nonirradiated organism. However, a few days or weeks later very serious wound infections and hemorrhages can occur. The additional injuries almost always worsen the development and prognosis of radiation-induced disease. The recommended treatment for combined injuries will differ in many respects from the treatment of wounds and burns or the radiation syndrome. Author

A89-54223
CHEMICAL PROTECTION AGAINST IONIZING RADIATION
J. R. MAISIN (Louvain, Universite Catholique, Bruxelles; Centre d'Etudes de l'Energie Nucleaire, Mol, Belgium) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 205-212. refs

Some of the problems related to chemical protection against ionizing radiation are discussed with emphasis on definition, classification, degree of protection, mechanisms of action, and toxicity. Results on the biological response modifyers (BRMs) and on the combination of nontoxic (i.e., low) doses of sulphydryl radioprotectors and BRMs are presented. Author

A89-54224
NEW CONSIDERATIONS OF THE OXYGEN EFFECTS IN RADIATION BIOLOGY
E. L. POWERS (Texas, University, Austin; Charleston, College, SC) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 213-221. refs

The original demonstration in the bacterial spore of the multiple actions of oxygen in modifying the responses of cells to ionizing radiation has now been verified in mammalian systems, pointing up the need for separate inquiry into each of the several components if the responses of mammalian cells are to be understood. Physicochemical explanations have been provided for only two of the four (at least) oxygen elements recognized in the spore; the reaction of diatomic oxygen with organic free radicals in dry spores; and an action of the hydroxy radical (OH) in spores at low O2. This paper discusses newly recognized features of the oxygen responses that could reveal the nature of the other components. It examines modulation of response by oxides of nitrogen, the similarities and differences among them, and explanations for them that suggest further experiment, the importance of concentration of additive in determining both quantity and quality of response, and a general model that explains sensitizer action in terms of inhomogeneous chemistry. Author

A89-54225
PHOTOPRODUCTS IN DNA IRRADIATED IN VITRO AND IN VIVO UNDER EXTREME ENVIRONMENTAL CONDITIONS
EMANUEL RIKLIS (Israel Atomic Energy Commission, Negev Nuclear Research Centre, Beersheba, Israel) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 223-232. refs

The isolation, structure and properties of photoproducts which are formed in UV-irradiated frozen thymine solutions are described. Urea, n-propylurea, and dihydrothymine are obtained as photolytic products by high radiation doses in low concentrations of thymine. The cyclobutane cis-anti thymine dimer is obtained at high concentrations of thymine, following several cycles of freezing, thawing and irradiations. A trimer is obtained with 290 nm UV light filterd through Pyrex. It reverts back to thymine dimer and thymine when reirradiated in solution. The cis-syn dimer is obtained at all concentrations of frozen thymine and in a dose dependent form. In vacuum-dried thymine or DNA, other photoproducts are formed, including the spore-product, TDHT. Author

A89-54237* Columbia Univ., New York, NY.
MICROLESIONS - THEORY AND REALITY
BASIL V. WORGUL, JAN P. KONIAREK, and WOLF KREBS (Columbia University, New York) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 315-323. refs
(Contract NIH-EY-02648; NAG9-256)

Efforts to assess radiation risk in space have been complicated by the considerable unknowns regarding the biological effects of the heavy ion component (HZE particles) of the cosmic rays. The attention has focused primarily on the assignation of a quality factor (Q) which would take into account the greater effectiveness of heavy ions vis-a-vis other forms of ionizing radiation. If, however, as the so-called 'microlesion theory' allows, the passage of HZE particles through living tissue produces unique biological damage, the traditional use of Q becomes meaningless. Therefore, it is critical to determine if microlesions, in fact, do exist. While the concept does not necessarily require detectable morphological damage, 'tunnel-lesions' or holes in ocular tissues have been cited as evidence of microlesions. These data, however, are open to reinterpretation. Ongoing light, scanning and transmission electron microscopic studies of the corneas, lenses and retinas of rat eyes exposed to 450 MeV/amu Fe-56 ions thus far have not revealed tunnel-lesion damage. The morphological effects of the heavy ions have been found to be qualitatively similar to the changes following other kinds of ionizing radiation. Author

A89-54238* Colorado State Univ., Fort Collins.
LATE CATARACTOGENESIS CAUSED BY PARTICULATE RADIATIONS AND PHOTONS IN LONG-LIVED MAMMALIAN SPECIES

J. T. LETT, A. C. LEE (Colorado State University, Fort Collins), A. B. COX, and D. H. WOOD (USAF, School of Aerospace Medicine, Brooks AFB, TX) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 325-331. Research supported by DOE. refs
(Contract NAG9-10; F33615-85-C-4514)

Radiation cataractogenesis induced by small acute doses of particulate radiations and photons in the New Zealand white rabbit (Oryctolagus cuniculus), the beagle dog (Canis familiaris) and the rhesus monkey (Macaca mulatta) is discussed in the context of the use of animal models to assess the radiation hazards faced by humans during lengthy sojourns in deep space. Attention is paid to (1) the importance of lifespan studies with long-lived species - the above animals have median lifespans in captivity of 5-7, 13-14 and 25 years, respectively; and (2) the magnitudes of possible dose thresholds for cataractogenesis from sparsely ionizing radiations and the modifications of those thresholds by the late degenerative phase of the phenomenon. Author

A89-54239
BEHAVIORAL AND NEUROCHEMICAL ABNORMALITIES AFTER EXPOSURE TO LOW DOSES OF HIGH-ENERGY IRON PARTICLES
WALTER A. HUNT, JAMES A. JOSEPH, and BERNARD M. RABIN (U.S. Armed Forces Radiobiology Research Institute, Bethesda, MD) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 333-336. Research supported by DNA. refs

Exposure of rats to high-energy iron particles (600 MeV/amu) has been found to alter behavior after doses as low as 10 rads. The performance of a task that measures upper body strength was significantly degraded after irradiation. In addition, an impairment in the regulation of dopamine release in the caudate nucleus (a motor center in the brain), lasting at least 6 months, was also found and correlated with the performance deficits. A general indication of behavioral toxicity and an index of nausea and emesis, the conditioned taste aversion, was also evident. The sensitivity to iron particles was 10-600 times greater than to gamma photons. These results suggest that behavioral and neurobiological damage may be consequence of exposure to low doses of heavy particles and that this possibility should be extensively studied. Author

A89-54522
THE MECHANISM OF DNA TRANSFER IN THE MATING SYSTEM OF AN ARCHAEBACTERIUM
ILAN ROSENSHINE, RONEN TCHELET, and MOSHE MEVARECH (Tel Aviv University, Israel) Science (ISSN 0036-8075), vol. 245, Sept. 22, 1989, p. 1387-1389. Research supported by the Charles H. Revson Foundation. refs

The genetic transfer system in the extremely halophilic archaebacterium Halobacterium volcanii is the only archaebacterial mating system known. The mechanism of genetic transfer of this archaebacterium was studied by using the immobile plasmids pHV2 and pHV11 as cytoplasmic markets. It was found that the cytoplasms of the parental types do not mix during the mating process, that each parental type can serve both as a donor and as a recipient, and that cytoplasmic bridges, with dimensions of up to 2 micrometers long and 0.1 micrometer in diameter, were formed between the parental types. These bridges appear to be used for the transfer of DNA from one cell to another. If so, this archaebacterial mating system is different from both eubacterial conjugation and eukaryotic sexual cell fusion. Author

A89-54626
STIMULATIVE EFFECT OF LOW-LEVEL IONIZING RADIATION ON GLUCOKINASE SYNTHESIS IN THE LIVER OF DEVELOPING RATS [STIMULIRUIUSHCHEE DEISTVIE MALYKH DOZ IONIZIRUIUSHCHEI RADIATSII NA SINTEZ GLIUKOKINAZY V PECHENI RAZVIVAIUSHCHIKHSIA KRYS]
L. V. SLOZHENIKINA, L. A. FIALKOVSKAIA, and A. M. KUZIN (AN SSSR, Institut Biologicheskoi Fiziki, Pushchino, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, July-Aug. 1989, p. 473-476. In Russian. refs

The effect of low-level radiation on the rate of glucokinase synthesis in the liver of young rats was investigated. Rats aged 9 and 19 days were subjected to irradiation from Cs-137 in doses of 0.01, 0.02, 0.05, 2.5, or 10 Gy, and the 105,000 g supernatants of liver homogenates, obtained from rats aged 13 to 30 days were assayed for basal and induced glucokinase activities. Results showed that the dose of 0.01 Gy caused an increase in the rate of glucokinase synthesis, in particular in rats aged 16 days and older, i.e., after the onset of the spontaneous synthesis of this enzyme. The dose of 0.02 caused no further increase, whereas doses above 0.02 Gy were found to inhibit enzyme synthesis. These results confirm a previous suggestion that a natural low-radioactivity background is required for the development of mammals. I.S.

A89-54627
POSSIBLE MECHANISMS OF THE RADIATION-MODIFYING EFFECTS OF EXOGENOUS HYPOXIA AND MICROWAVES [O VOZMOZHNYKH MEKHANIZMAKH RADIOMODIFITSIRUIUSHCHEGO DEISTVIIA EKZOGENNOI GIPOKSII I ELEKTROMAGNITNOGO IZLUCHENIIA SVCH-DIAPAZONA]
R. I. TABUKASHVILI and I. B. USHAKOV (Tbilisskii Gosudarstvennyi Meditsinskii Institut, Tbilisi, Georgian SSR) Radiobiologiia (ISSN 0033-8192), vol. 29, July-Aug. 1989, p. 529-532. In Russian. refs

The radiation-protective effects of exogenous hypoxia and microwaves were investigated in rats irradiated by gamma rays (Co-60 at 8.5 Gy), and the possible biochemical mechanisms responsible for these effects are discussed. The effects of exposure to a hypoxic N2 + O2 mixture (for 8-min immediately before exposures to gamma rays) or to liver supernatants from rats exposed to hypoxia or microwaves were determined by recording the percent of animals surviving 3, 5, 7, 10, 12, 15, 17, 20, 22, 25, 27, and 30 days after a gamma-ray exposure. It was found that the preexposure of animals to hypoxia (or to liver extracts from rats exposed to hypoxia and microwaves) decreased the mortality rate of irradiated rats, indicating that the exposure to hypoxia and microwaves induces the formation of biologically active radiation-protective agents in the liver. I.S.

A89-54628
INVESTIGATION OF POSTIRRADIATION RADIOSENSITIVITY OF RATS AFTER EXTERNAL UNIFORM IRRADIATION [ISSLEDOVANIE POSTLUCHEVOI RADIOCHUVSTVITEL'NOSTI KRYS POSLE VNESHNEGO RAVNOMERNOGO OBLUCHENIIA]
G. M. AVETISOV, T. S. ARKHIPOVA, V. P. VOLODIN, G. P. ZHARKOVA, and M. V. SERGEEVA (Institut Biofiziki, Moscow, USSR) Radiobiologiia (ISSN 0033-8192), vol. 29, July-Aug. 1989, p. 533-538. In Russian. refs

The effect of preirradiation of rats by gamma rays in doses of 1, 2, 3, or 5 Gy on the radiosensitivity of these animals to a subsequently administered (1-30 days later) second gamma-ray dose were investigated using the median lethal dose as the criterion of the preirradiation effect. Clinical and laboratory indices were examined after the first irradiation. A relationship was found that links the dynamics of the radiosensitivity of rats (to the second irradiation dose) to the proliferative activity of bone marrow and its total cellularity. I.S.

A89-54888
AN ORGANISM IN A HELIUM-OXYGEN MEDIUM [ORGANIZM

V GELIO-KISLORODNOI SREDE]
GERMAN V. TROSHIKHIN Leningrad, Izdatel'stvo Nauka, 1989, 160 p. In Russian. refs

This book considers physiological effects elicited in warm-blooded animals by breathing helium-oxygen atmospheric-pressure mixtures containing different amounts of oxygen. Short-time and long-time effects on the general well-being, the central nervous system activity, the brain tissue metabolism, blood indices, and the condition of the lung tissue are described. The mechanisms responsible for the effects of He-O2 mixtures with different amounts of oxygen are examined. I.S.

N89-29946# Virginia Univ., Charlottesville. School of Medicine.
THE EFFECT OF MODERATE PRESSURE ON BIOLOGICAL PROCESSES Annual Report, 1 Jun. 1988 - 31 May 1989
RODNEY L. BILTONEN and M. L. JOHNSON 7 Jun. 1989 10 p
(Contract N00014-88-K-0326)
(AD-A209329) Avail: NTIS HC A02/MF A01 CSCL 06/2

A volume-perturbation calorimeter, which measures time-dependent temperature changes in response to a pressure perturbation, has been used to probe the relaxation dynamics of phospholipid bilayers in the gel to liquid crystalline transition region. The principal relaxation time is between 50 milliseconds to 5 sec. The relaxation dynamics appear to be insensitive to pressure over a pressure range of 10 to 20 atm., thus suggesting that the most important effect of pressure is on the equilibrium properties of the system. Bilayer-bilayer interactions have been assessed by studies of multi-lamellar systems in the presence of dextran which dehydrates the interior bilayer-bilayer spaces and forces closer approach between lamellae. Dehydration is accompanied by a reduction in the enthalpy change of about 3 kcal/mole of lipid and produces a broadening of the transition profile. No such effects are observed in uni-lamellar vesicles. Monolayer-monolayer interactions have been assessed by use of externally added lathanides to shift the transition temperature of the inner and outer monolayers of uni-lamellar vesicles. Complete separation of the melting of the two monolayers can be achieved, indicating that monolayer-monolayer coupling is small. GRA

N89-29947# Army Medical Research Inst. of Chemical Defense, Aberdeen Proving Ground, MD.
ULTRASTRUCTURAL VISUALIZATION OF ACETYLCHOLINE AT THE NEUROMUSCULAR JUNCTION Final Report, Sep. 1986 - Jan. 1989
JOHN P. PETRALI, KENNETH R. MILLS, and TRACEY A. JUSTUS May 1989 18 p
(AD-A207676; USAMRICD-TR-89-04) Avail: NTIS HC A03/MF A01 CSCL 06/1

A new cytochemical strategy was explored for the in-situ visualization of acetylcholine at the neuromuscular junction. It was based on the known precipitation reaction between molybdic or tungstic heteropolyanions and quaternary ammonium compounds, such as choline, to form insoluble salts which are non-diffusible, resistant to routine tissue processing and electron dense. This ionic fixation of choline was used for the identification, compartmentation and distribution of acetylcholine at the neuromuscular junction under conditions of normal and abnormal synaptic function in selected muscle tissue of the rat and rabbit. Rat diaphragm, masseter and tongue muscle were used from control animals, from animals exposed to 0.9LD50 soman, and from animals exposed to 0.9LD50 hemicholinium. Rabbit gastrocnemius muscle was used from experiments for studying intra-arterial administration of soman at multiple LD50 doses in circulatory-isolated limb preparations. The results of this electron microscopy study suggest that ionic fixation of choline may be useful for the identification and tracking of acetylcholine at the neuromuscular junction and other cholinergic synapses. GRA

N89-29948# Georgia Univ., Athens.
THE MICROBIOLOGY AND PHYSIOLOGY OF ANAEROBIC FERMENTATIONS OF CELLULOSE Progress Report, Nov. 1988 - Jul. 1989
HARRY D. PECK, JR., LARS G. LJUNGDAHL, LEONARD E. MORTENSON, and JUERGEN K. W. WIEGEL 1989 94 p
(Contract DE-FG09-86ER-13614)
(DE89-015790; DOE/ER-13614/3) Avail: NTIS HC A05/MF A01

In this progress report we describe an integrated study of some individual anaerobic bacteria that are important for the complete conversion of cellulose to methane and CO sub 2, and of enzymes such as formate dehydrogenase, hydrogenase and CO dehydrogenase which are of special concern to syntropic interactions between the bacteria. DOE

N89-29949# Duke Univ., Durham, NC. Dept. of Botany.
PHOTOSYNTHETIC ACCLIMATION TO ELEVATED CO2 Status Report
JENNIFER D. CURE Jul. 1989 4 p
(Contract DE-FG05-88ER-69010)
(DE89-015965; DOE/ER-69010/1) Avail: NTIS HC A02/MF A01

The objectives of the first year were to install Sunbrella Lighting Systems into Phytotron C chambers; to assemble a gas exchange system for measurement of photosynthetic parameters under controlled conditions; to work out methods of sample handling and measurement of protein, chorophyll, initial and activated RuBP Carboxylase activity and active site concentration; to begin studying the effects of light intensity on the photosynthetic acclimation of a fast growing species to elevated CO2. DOE

52

AEROSPACE MEDICINE

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

A89-51751* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ENERGY AND THERMAL REGULATION DURING BED REST AND SPACEFLIGHT
JOHN E. GREENLEAF (NASA, Ames Research Center, Moffett Field, CA) Journal of Applied Physiology (ISSN 0161-7567), vol. 67, Aug. 1989, p. 507-516. refs

This paper presents data available from bed-rest and flight studies on the energy metabolism and thermoregulatory parameters and their changes during long-duration space missions which may influence requirements of astronauts for food and water. It is calculated, on the basis of 3100 kcal and 2.2 l water a day, with 1 h/day moderate exercise, that the requirements for a 2-yr flight would be 2,263,000 kcal and 1606 l water for each astronaut. One daily 5-h-long extravehicular sortie would require an additional 529,250 kcal and 1,095 l of water per year. Changes in the efficiency of work or metabolism would affect these nutritional requirements for long spaceflights. Factors that would increase food and water requirements are discussed. I.S.

A89-51752
REVERSAL OF HYPOXIA-INDUCED DECREASE IN HUMAN CARDIAC RESPONSE TO ISOPROTERENOL INFUSION
JEAN-PAUL RICHALET, JEAN-LOUIS LE-TRONG, CHRISTIAN RATHAT, PASCAL MERLET, PHILIPPE BOUISSOU (Association pour la Recherche en Physiologie de l'Environnement; Institut National de la Sante et de la Recherche Medicale, Creteil; Service Hospitalier Frederic Joliot, Orsay, France) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 67, Aug. 1989, p. 523-527. Research supported by Laboratoires Sandoz. refs

The cardiac response to isoproterenol (IP) infusion in subacute hypoxia (eight days) and its rate of recovery after oxygen inhalation or rapid return to sea level were investigated in human subjects who received an IP infusion under normoxia (condition N), after eight days at 4350 m (condition H8), on the same day at this altitude after inhalation of O2 and restoring normoxic arterial O2 saturation (condition HO), and 6-11 h (condition RN) and 4-5

months after return to sea level. Cardiac response to IP, evaluated by the mean increase in heart rate from the base value, was lower in condition H8 than in N; it was slightly higher in conditions HO and RN than in condition H8, but still significantly lower than in condition N. The results confirm the hypothesis of a hypoxia-induced decrease in cardiac chronotropic function. Two possible mechanisms are suggested, one which is O2-dependent and rapidly reversible with restoration to normoxia, and the other, which is slowly reversible, involving a downregulation of the cardiac beta-receptors. I.S.

A89-51753
EFFECTS OF ANGIOTENSIN BLOCKADE ON THE SPLANCHNIC CIRCULATION IN NORMOTENSIVE HUMANS
CARSTEN STADEAGER, BIRGER HESSE, OLE HENRIKSEN, NIELS JUEL CHRISTENSEN, FLEMMING BONDE-PETERSEN (Hvidovre and Glostrup Hospitals; Herlev Hospital; Rigshospitalet, Copenhagen, Denmark) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 67, Aug. 1989, p. 786-791. Research supported by the Danish Space Board, Merck, Sharp and Dohme, and Leo Pharmaceutical Products. refs

The influence of the renin-angiotensin system (RAS) on the splanchnic and central hemodynamics was evaluated in moderately salt-depleted human subjects by measuring blood flow and arterial and venous pressure before and during an application of gravitational stress induced by lower-body negative pressure (LBNP). The effect of RAS inhibition was evaluated by administering enalapril, an inhibitor of angiotensin-converting enzyme (ACE), during the rest and the LBNP study periods. Results demonstrated that acute ACE inhibition causes splanchnic vasodilation at rest and results in the absence of splanchnic vasoconstriction during LBNP in sodium-depleted healthy subjects. It is suggested that acute ACE inhibition decreases splanchnic vascular resistance at rest and abolishes splanchnic vasoconstriction during LBNP; furthermore, ACE inhibition may interfere with autonomic nervous system control of the circulation. I.S.

A89-51754
TEN WEEKS OF AEROBIC TRAINING DO NOT AFFECT LOWER BODY NEGATIVE PRESSURE RESPONSES
J. TIMOTHY LIGHTFOOT, RANDAL P. CLAYTOR, DONALD J. TOROK, THOMAS W. JOURNELL, and SUZANNE M. FORTNEY (Johns Hopkins University, Baltimore, MD; Miami, University, Oxford, OH) Journal of Applied Physiology (ISSN 0161-7567), vol. 67, Aug. 1989, p. 894-901. Research supported by the University of Miami. refs
(Contract NIH-HL-07534; NIH-HL-10342)

The hypothesis that aerobic training may decrease lower body negative pressure (LBNP) tolerance through an attenuation in both high- and low-pressure baroreflex gain was tested experimentally by comparing the LBNP responses of control (CON) subjects with those of experimental (EXP) subjects who underwent a 10-week treadmill and cycle ergometer training program. Before and after training, the EXP and CON groups participated in LBNP tolerance tests and neck pressure-suction testing (to describe the carotid sinus-heart rate baroreflex). Results showed that LBNP tolerance and the baroreflex gain were not altered after training. Moreover, there were no changes in LBNP heart rate, blood pressure, leg circumference, forearm blood flow, or forearm vascular resistance responses at any level of LBNP challenge after training. I.S.

A89-51892
CRUCIAL FACTOR - HUMAN
V. GARSHNEK (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 5, Aug. 1989, p. 201-216. refs

Biomedical, performance, and environmental advances necessary for extending manned space flights are discussed. The physical deconditioning effects of prolonged weightlessness and measures to counteract these effects are examined. Consideration is given to the medical care and facilities required and the types of psychological and life supports needed. Some of the US and USSR activities related to improving and extending manned space flights are described. It is noted that further research is necessary in order to launch manned, long-term missions. I.F.

A89-53319*
DEFINITION OF TOLERANCE TO CONTINUOUS HYPEROXIA IN MAN - AN ABSTRACT REPORT OF PREDICTIVE STUDIES V
C. J. LAMBERTSEN, J. M. CLARK, R. GELFAND, J. B. PISARELLO, W. H. COBBS et al. IN: International Symposium on Underwater and Hyperbaric Physiology, 9th, Sydney, Australia, Mar. 1-4, 1987, Proceedings. Bethesda, MD, Undersea and Hyperbaric Medical Society, 1987, p. 717-735. refs
(Contract N00014-81-C-0826; NAS9-17238)

The overall goals, design, and procedures of Predictive Studies V are discussed as well as the specific elements of neural effects produced by prolonged hyperoxia. It is noted that Predictive Studies V study of oxygen poisoning in normal men during uninterrupted exposures to oxygen over the range of hyperbaric oxygen exposure most useful in diving, the treatment of gas lesion diseases, and general hyperbaric medicine. It is found that, throughout the study, the most striking observations were related to effects on visual function, on the lung, and the probable interactions of preconvulsive neural activity with effects on cardiovascular and respiratory-pulmonary functions. K.K.

A89-53698*
PULMONARY TOLERANCE IN MAN TO CONTINUOUS OXYGEN EXPOSURE AT 3.0, 2.5, 2.0, AND 1.5 ATA IN PREDICTIVE STUDIES V
J. M. CLARK, R. GELFAND, N. D. FLORES, C. J. LAMBERTSEN, and J. B. PISARELLO Undersea and Hyperbaric Medical Society, International Symposium on Underwater and Hyperbaric Physiology, 9th, Sydney, Australia, Mar. 1-4, 1987, Paper. 13 p. refs
(Contract N00014-81-C-0826; NAS9-17238)

Oxygen effects on pulmonary function were measured in normal, resting men who breathed oxygen continuously at 3.0, 2.5, 2.0, and 1.5 ATA to predefined limits of CNS, cardiac, or pulmonary tolerance. Rates of pulmonary symptom intensification and decrease in vital capacity (VC) increased progressively with elevation of inspired oxygen pressure. Although VC decrements occurred concurrently with symptoms, the lung volume changes became prominent when symptoms were still mild. The observed effects were consistent with the interpretation that small airway function is impaired more selectively by oxygen exposure at 3.0 and 2.5 ATA than by exposure at 2.0 and 1.5 ATA. Despite similar VC changes after oxygen exposure at 2.0 ATA for nearly 10 hr and exposure at 1.5 ATA for almost 18 hr, the 2.0 ATA exposure caused greater impairment of pulmonary function and required a longer recovery period. C.D.

A89-53699*
EFFECTS ON RESPIRATORY HOMEOSTASIS OF PROLONGED, CONTINUOUS HYPEROXIA AT 1.5 TO 3.0 ATA IN MAN IN PREDICTIVE STUDIES V
R. GELFAND, J. M. CLARK, C. J. LAMBERTSEN, and J. B. PISARELLO Undersea and Hyperbaric Medical Society, International Symposium on Underwater and Hyperbaric Physiology, 9th, Sydney, Australia, Mar. 1-4, 1987, Paper. 11 p. refs
(Contract N00014-81-C-0826; NAS9-17238)

Prolonged exposures of men to continuous hyperoxia at 3.0, 2.5, 2.0, and 1.5 ATA were conducted to define CNS oxygen tolerance and to investigate the effects of prolonged hyperoxia on CNS and other organ functions. Altered respiratory homeostasis was evident during exposures of men to 2.5 and 3.0 ATA O2 as nonprogressive increment in ventilation and reciprocal decrement in PET(CO2). These changes were progressive during exposure at 1.5 ATA O2. Mean values of respiratory reactivity at CO2 were somewhat increased following prolonged hyperoxia at 1.5 and 2.5 ATA, compared to preexposure mean values. Hypoxic ventilatory response was unchanged or enhanced after oxygen exposures at 1.5 and 2.5 ATA. Observed respiratory and body temperature

changes were not of sufficient magnitude to impair function. C.D.

A89-53700*
HUMAN CIRCULATORY RESPONSES TO PROLONGED HYPERBARIC HYPEROXIA IN PREDICTIVE STUDIES V
J. B. PISARELLO, J. M. CLARK, C. J. LAMBERTSEN, and R. GELFAND Undersea and Hyperbaric Medical Society, International Symposium on Underwater and Hyperbaric Physiology, 9th, Sydney, Australia, Mar. 1-4, 1987, Paper. 10 p.
(Contract N00014-81-C-0826; NAS9-17238)

Selected results of cardiocirculatory measurements in healthy volunteers who breathed 100 percent O2 continuously at 3.0 ATA for up to 3.5 hr, at 2.5 ATA for up to 6.0 hr, at 2.0 ATA for up to 11.9 hr, and at 1.5 ATA for up to 19.0 hr are reported. The results indicate that resting hemodynamic responses to prolonged hyperbaric oxygen breathing in man usually consist of small deviations from normal sea-level responses. Rapid onset of bradycardia occurred at all four oxygen pressures investigated. This effect was accompanied by a rate-dependent reduction in cardiac output and a degree of systematic vasoconstriction which were small in magnitude and appeared to be functionally unimportant. C.D.

A89-54629
CEREBRAL HEMODYNAMICS OF PILOTS UNDER MONITORED PHYSICAL LOADS [SOSTOIANIE GEMODINAMIKI GOLOVNOGO MOZGA U LETCHIKOV PRI DOZIROVANNYKH FIZICHESKIKH NAGRUZKAKH]
L. I. STARIKOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), June 1989, p. 45-49. In Russian. refs

The relationship between cerebral hemodynamics and the amount of physical exercise was investigated in pilots undergoing bicycle exercises of stepped intensity, using the partial-integral rheography method developed by Starikov (1986) to estimate the rate of brain-blood supply in 27 subjects undergoing gradually increasing bicycle exercises (loads of 58, 108, 133, and 158 Wt). It was found that subjects characterized by relatively low physical endurance exhibited disorders of cerebral hemodynamics, which were manifested most often during the period of restitution. I.S.

N89-29007# Los Alamos National Lab., NM. Neuromagnetism Lab.
MONTE CARLO ANALYSIS OF LOCALIZATION ERRORS IN MAGNETOENCEPHALOGRAPHY
PATRICIA A. MEDVICK, PAUL S. LEWIS, CHERYL AINE, and EDWARD R. FLYNN 1989 5 p Presented at the 7th International Conference on Biomagnetism, New York, NY, 14-18 Aug. 1989
(Contract W-7405-ENG-36)
(DE89-013221; LA-UR-89-1579; CONF-890849-2) Avail: NTIS HC A02/MF A01

In magnetoencephalography (MEG), the magnetic fields created by electrical activity in the brain are measured on the surface of the skull. To determine the location of the activity, the measured field is fit to an assumed source generator model, such as a current dipole, by minimizing chi-square. For current dipoles and other nonlinear source models, the fit is performed by an iterative least squares procedure such as the Levenberg-Marquardt algorithm. Once the fit has been computed, analysis of the resulting value of chi-square can determine whether the assumed source model is adequate to account for the measurements. If the source model is adequate, then the effect of measurement error on the fitted model parameters must be analyzed. Although these kinds of simulation studies can provide a rough idea of the effect that measurement error can be expected to have on source localization, they cannot provide detailed enough information to determine the effects that the errors in a particular measurement situation will produce. In this work, we introduce and describe the use of Monte Carlo-based techniques to analyze model fitting errors for real data. Given the details of the measurement setup and a statistical description of the measurement errors, these techniques determine the effects the errors have on the fitted model parameters. The effects can then be summarized in various ways such as parameter variances/covariances or multidimensional confidence regions. DOE

N89-29008# Los Alamos National Lab., NM. Life Sciences Div.
TRANSIENT VISUAL EVOKED NEUROMAGNETIC RESPONSES: IDENTIFICATION OF MULTIPLE SOURCES
CHERYL AINE, J. GEORGE, PATRICIA A. MEDVICK, E. FLYNN, I. BODIS-WOLLNER, and S. SUPEK 1989 5 p Presented at the 7th International Conference on Biomagnetism, New York, NY, 14-18 Aug. 1989
(Contract W-7405-ENG-36)
(DE89-013438; LA-UR-89-1729; CONF-890849-1) Avail: NTIS HC A02/MF A01

Neuromagnetic measurements and associated modeling procedures must be able to resolve multiple sources in order to localize and accurately characterize the generators of visual evoked neuromagnetic activity. Workers have identified at least 11 areas in the macaque, throughout occipital, parietal, and temporal cortex, which are primarily or entirely visual in function. The surface area of the human occipital lobe is estimated to be 150 to 250 cm. Primary visual cortex covers approximately 26 sq cm while secondary visual areas comprise the remaining area. For evoked response amplitudes typical of human MEG data, one report estimates that a two-dipole field may be statistically distinguishable from that of a single dipole when the separation is greater than 1 to 2 cm. Given the estimated expanse of cortex devoted to visual processes, along with this estimate of resolution limits it is likely that MEG can resolve sources associated with activity in multiple visual areas. Researchers have noted evidence for the existence of multiple sources when presenting visual stimuli in a half field; however, they did not attempt to localize them. Numerous human MEG field patterns were examined resulting from different visual field placements of a small sinusoidal grating which suggest the existence of multiple sources. The analyses utilized for resolving multiple sources in these studies differ depending on whether there was evidence of: (1) synchronous activation of two spatially discrete sources, or (2) two discrete asynchronous sources. In some cases observed field patterns were observed which appear to be adequately explained by a single source changing its orientation and location across time. DOE

N89-29009# Army Research Inst. of Environmental Medicine, Natick, MA.
THERMOREGULATORY COMPETENCE DURING EXERCISE TRANSIENTS IN A GROUP OF HEAT-ACCLIMATED YOUNG AND MIDDLE-AGED MEN IS INFLUENCED MORE DISTINCTLY BY MAXIMAL AEROBIC POWER THAN AGE
RICHARD R. GONZALEZ and KENT B. PANDOLF May 1989 7 p
(AD-A209753; USARIEM-M48-89) Avail: NTIS HC A02/MF A01 CSCL 06/10

A fundamental change that occurs with advancing age is a diminishing maximal aerobic power (VO2 max). In sedentary individuals the rate of decline in VO2 max as a function of age is estimated at 10 percent per ten years after age 20 but becomes more gradual in endurance-trained individuals regardless of gender, approaching about 5 percent with each ten year span. It is thought that reduced sweating and vasomotor responses to heat stress indicate deterioration in thermoregulatory function. A scrutiny of thermoregulatory mechanisms in the aging process is necessary because other quantitative studies of actual efferent thermoregulatory drive point to a maintenance of thermoregulatory competence well into the sixth decade of life provided a level of aerobic fitness is sustained. Pandolf and others studied a group of nine young and nine middle-aged men having parallel body weights, skin surface areas, percent body fat and maximal aerobic power. These groups displayed almost equivalent thermoregulatory responses to comparable exercise and heat stress conditions following 10-days of heat acclimation. The present paper is an examination of the above study's thermoregulatory responses during exercise transients. Transient analysis to specific exercise/

heat stress provocation provides a clearer understanding of the influence of age and aerobic fitness on thermoregulatory control of sweating than steady-state analysis. GRA

N89-29010# Vision Sciences Research Corp., San Ramon, CA.
SUPRATHRESHOLD CONTRAST SENSITIVITY VISION TEST CHART Annual Progress Report
ARTHUR P. GINSBURG 15 Jun. 1989 26 p
(Contract F49620-88-C-0083)
(AD-A209915) Avail: NTIS HC A03/MF A01 CSCL 06/4

This research period concentrated on the further design and development of a suprathreshold contrast sensitivity test chart with which to create a family of contrast matching functions. Three different chart configurations were developed and tested for suitability. Preliminary test-retest, subject instruction, and chart configuration experiments were completed. The results show good test-retest reliability. Individual differences in contrast matching using previously developed suprathreshold contrast sensitivity charts are also evident in these new data. Different subject instructions having the subjects either make the contrast judgements using global or local contrast analysis resulted in similar results. The spatial positioning of grating test patches appears to bias the contrast matches and warrants further investigation. Future research will finalize the suprathreshold contrast sensitivity chart configuration and compare the resulting contrast matching data to that obtained using a computer-video system and continuous contrast test increments. The final chart will be used for large population, clinical and performance testing. GRA

N89-29011# Harvard Univ., Cambridge, MA.
COMPONENTS OF HIGH-LEVEL VISION: A COGNITIVE NEUROSCIENCE ANALYSIS AND ACCOUNTS OF NEUROLOGICAL SYNDROMES Annual Report, Dec. 1987 - Dec. 1989
STEPHEN M. KOSSLYN 28 Feb. 1989 89 p
(Contract AF-AFOSR-0012-88; AF PROJ. 2313)
(AD-A207848; TR-89-1; AFOSR-89-0628TR) Avail: NTIS HC A05/MF A01 CSCL 12/9

High level visual processes make use of stored information, and are invoked during object identification, navigation, tracking, and visual mental imagery. A theory of the component processing subsystems used in high level vision is examined. This theory was developed by considering neuroanatomical, neurophysiological, and computational constraints. The theory has led to three kinds of empirical work: First, specific claims associated with individual processing subsystems were tested. For example, the analysis of the representation of spatial relations led to the prediction that two subsystems are used to encode this information, and a set of experiments was conducted that provided support for this distinction. Second, predictions from the theory as a whole were formulated, and some of these predictions are now being tested. And third, the subsystems were implemented in a running computer simulation model, which was used to generate predictions about specific neurological syndromes. The model can be damaged in a variety of ways, and its performance on a set of tasks then observed. The experiments conducted to data and predictions from the computer model are summarized. In addition, the most common dysfunctions of vision following brain damage are reviewed, and accounts are offered by reference to the simulation model. GRA

N89-29012# Letterman Army Inst. of Research, San Francisco, CA.
TRANSIENT VISUAL EFFECTS OF PROLONGED SMALL SPOT FOVEAL LASER EXPOSURE Report, Jan. - Mar. 1989
HARRY ZWICK, DAVID O. ROBINS, and NAWIM MAGSOOD Mar. 1989 19 p
(AD-A207945; LAIR-373) Avail: NTIS HC A03/MF A01 CSCL 06/7

In recent experiments, the effects were evaluated of acute, threshold damage levels of small spot foveal laser exposure. These experiments revealed transient changes in acuity and contrast sensitivity lasting from 10 to 15 minutes postexposure. Following recovery from such effects, normal acuity and contrast sensitivity are not necessarily degraded, although continuous exposure at these levels does result in parafoveal compensation for foveal damage and eventual deficit in fine visual acuity. Development of a test of foveal function during and after small spot foveal exposure was the primary objective of this investigation. This objective was accomplished. At retinal damage levels, only a small focal foveal lesion was observed indicating the ability to utilize the fovea during such exposure. Postexposure recovery effects analyzed for target size and contrast conditions suggest retinal and possibly cortical saturation processes. GRA

N89-29013# Army Command and General Staff Coll., Fort Leavenworth, Kansas. School of Advanced Military Studies.
SLEEP DEPRIVATION AND ITS EFFECT ON COMBAT EFFECTIVENESS Report, 1988 - 1989
CLINTON T. ANDERSON 26 Nov. 1988 46 p
(AD-A207970) Avail: NTIS HC A03/MF A01 CSCL 06/10

The effects of sleep loss on the combat effectiveness of the US Army's leaders and soldiers were examined. It begins with an examination of U.S. and Soviet doctrine for conducting continuous operations. This section discusses the doctrinal methods and procedures that both major powers employ to maintain continuous pressure on their opponent. After laying the theoretical groundwork, it then examines the changes that have occurred in tactical force design since World War 2 to determine what was done to enhance or degrade the ability to execute that doctrine. After this discussion on the mechanical aspect of combat, the paper discusses the effects of sleep loss on units and the individual soldier. It concludes that the U.S. Army currently has no doctrine for the conduct of combat over an extended period of time. Adequate doctrine was provided for the conduct of operations in periods of both limited and unlimited visibility, but the doctrine necessary to transition to continuous operations is not available. Furthermore, recent changes in the force structure of combat units (primarily Armor and Mechanized Infantry) have significantly reduced the redundancy and robustness in those units that is necessary to conduct continuous operations. During continuous operations, the units will be effected by loss of sleep. Sleep deprivation affects the cognitive skills of the leaders greater than the physical skills of the soldiers. GRA

N89-29014# Brigham and Women's Hospital, Boston, MA.
A PROGRAM FOR THE STUDY OF SKELETAL MUSCLE CATABOLISM FOLLOWING PHYSICAL TRAUMA Annual Report, 21 Feb. 1988 - 20 Feb. 1989
DOUGLAS W. WILMORE 15 Mar. 1989 10 p
(Contract DAMD17-86-C-6157; DA PROJ. 351-62772-A-874)
(AD-A207983; AD-E951354) Avail: NTIS HC A02/MF A01 CSCL 06/5

Following injury or infection there is accelerated net breakdown of skeletal muscle protein associated with negative nitrogen balance. A variety of factors influence this response, including food intake, inactivity and the hormonal environment. In studies that control for food intake and exercise, infusion of the catabolic hormones causes negative nitrogen balance but does not account for the accelerated proteolysis that occurs following moderate to severe injury. The recent recognition that injured tissue or invasive infection stimulates the production of a variety of cytokines has caused a variety of investigators to hypothesize that these mediators may serve as the signal to accelerate skeletal muscle proteolysis. Some of the initial in vitro studies have suggested that increased skeletal muscle protein breakdown may be simulated by activation of the cyclooxygenase pathway. Others have presented data which demonstrates that proteolysis may continue even when prostinoid mechanisms are not activated. Infusion of Prostaglandin E2 (PGE2) into the single hind leg of the dog failed to stimulate the increased release of amino acids. Additional animals underwent lumbar sympathectomy and then sympathetic nerve stimulation. Following sympathectomy, leg blood flow increased, and with stimulation leg blood flow returned toward control values. Glucose Flux did not change in either leg throughout the study and was similar in both hind limbs. Amino acid analysis is presently in process. GRA

N89-29015# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
CANADIAN FORCES AIRCREW EJECTION, DESCENT, AND LANDING INJURIES, 1 JANUARY 1975 - 31 DECEMBER 1987
WAYNE R. STURGEON Jan. 1989 21 p
(AD-A208116; DCIEM-88-RR-56) Avail: NTIS HC A03/MF A01 CSCL 06/10

During the 13 year period from January 1975 through December 1987, there were 78 attempted ejections from Canadian Forces (CF) aircraft of which 67 were successful. Fifty-eight of these ejectees received injuries from four main causative mechanisms: harness (restraint and parachute), body contact with cockpit surroundings during ejection, windblast force, and ejection acceleration force. Nineteen individuals (28.3 percent) received major injuries (dislocations, fractures, connective tissue injury, and organ contusion) from ejection jolt, windblast flail, collision with the seat structure, and landing. Fourteen of these individuals (20.9 percent) suffered fractured vertebrae, six (8.7 percent) during ejection and eight (12.2 percent) during landing. Minor injuries were primarily superficial abrasions, contusions, and lacerations. The majority of these were caused by the harness system (ballistic inertia reel yoke and parachute saddle), followed by windblast pressure on the helmet and oxygen mask, and lastly, contact with cockpit surroundings during ejection. Aircrew factors that contributed to injury were: improper position on ejection, loose restraint system and parachute harness, loose oxygen mask and helmet, and failure to release the seat pack prior to landing.
GRA

N89-29016*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MUSCLE CHANGES WITH ECCENTRIC EXERCISE: IMPLICATIONS ON EARTH AND IN SPACE
ALAN R. HARGENS, SCOTT PARAZYNSKI, MICHAEL ARATOW, and JAN FRIDEN (Umea Univ., Sweden) Aug. 1989 17 p Presented at the International Society for Myochemistry Meeting, Nice, France, 12-14 Oct. 1989 Sponsored by Swedish Medical Research Council; Tore Nilsson Foundation; Swedish Sports Research Council
(Contract NIH-AM-25501)
(NASA-TM-102227; A-89224; NAS 1.15:102227) Avail: NTIS HC A03/MF A01 CSCL 06/16

Recent investigations of fluid pressure, morpholo gy, and enzyme activities of skeletal muscle exercised eccentrically or concentrically in normal human subjects are reviewed. Intramuscular pressures were measured before, during, and after submaximal exercise and correlated with subjective muscle soreness, fiber size, water content, and blood indices of muscle enzymes. High intensity eccentric exercise is characterized by post exercise pain, elevated intramuscular pressures, and swelling of both type 1 and 2 fibers as compared to concentric exercise. Thus, long periods of unaccustomed, high level eccentric contraction may cause muscle injury, fiber swelling, fluid accumulation, elevated intramuscular pressure, and delayed muscle soreness. Training regimens of progressively increasing eccentric exercise, however, cause less soreness and are extremely efficacious in increasing muscle mass and strength. It is proposed that on Earth, postural muscles are uniquely adapted to low levels of prolonged eccentric contraction that are absent during weightlessness. The almost complete absence of eccentric exercise in space may be an important contributor to muscle atrophy and therefore equipment should be designed to integrate eccentric contractions into exercise protocols for long-term spaceflight.
Author

N89-29017*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
VISUAL SUPPRESSION OF THE VESTIBULO-OCULAR REFLEX DURING SPACE FLIGHT
JOHN J. URI, WILLIAM E. THORNTON, THOMAS P. MOORE (Methodist Hospital, Indianapolis, IN.), and SAM L. POOL Aug. 1989 14 p
(NASA-TM-102157; S-598; NAS 1.15:102157) Avail: NTIS HC A03/MF A01 CSCL 06/16

Visual suppression of the vestibulo-ocular reflex was studied in 16 subjects on 4 Space Shuttle missions. Eye movements were recorded by electro-oculography while subjects fixated a head mounted target during active sinusoidal head oscillation at 0.3 Hz. Adequacy of suppression was evaluated by the number of nystagmus beats, the mean amplitude of each beat, and the cumulative amplitude of nystagmus during two head oscillation cycles. Vestibulo-ocular reflex suppression was unaffected by space flight. Subjects with space motion sickness during flight had significantly more nystagmus beats than unaffected individuals. These susceptible subjects also tended to have more nystagmus beats before flight.
Author

N89-29018# Southampton Univ. (England). Inst. of Sound and Vibrational Research.
A STUDY OF THE EFFECT OF STIMULUS UPON THE REFLEX RESPONSE AS ELICITED AND RECORDED BY THE TYMPANIC MEMBRANE DISPLACEMENT MEASUREMENT DEVICE
S. M. MOSS, R. J. MARCHBANKS, and A. M. MARTIN Mar. 1989 71 p Sponsored by the Action Research for the Crippled Child and the Medical Research Council, United Kingdom
(ISVR-TR-177; ETN-89-95531) Avail: NTIS HC A04/MF A01

The possibility of using a ramp stimulus to obtain the reflex response as measured by the Tympanic Membrane Displacement (TMD) technique is investigated. Three reflex growth functions produced from three stimuli used upon the same individual are constructed. The first growth function is constructed using three intensities of the routinely used stimulus. The second using just the response to the routinely used stimulus at 115 decibels sound pressure level, and the third an intensity ramp stimulus. The ramp stimulus is repeated, and two analysis techniques are used upon both results. The study leads to the conclusion that the decision as to whether a ramp stimulus can be used to elicit the reflex depends on the experience of the tester to interpret the reflex response. If the test is to be performed by inexperienced operators, then it is better that three separate reflex responses are obtained.
ESA

N89-29950* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 326)
Feb. 1989 50 p
(NASA-SP-7011(326); NAS 1.21:7011(326)) Avail: NTIS HC A03; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 108 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during July, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance.
Author

N89-29951* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 327)
Feb. 1989 53 p
(NASA-SP-7011(327); NAS 1.21:7011(327)) Avail: NTIS HC A03; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06/5

This bibliography lists 127 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during August, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance.
Author

N89-29952# School of Aerospace Medicine, Brooks AFB, TX.
USAF STANDARDIZED 100 PERCENT OXYGEN DELIVERY SYSTEM Final Report, Mar. - Nov. 1988
DAVID W. PRIDGEN, THOMAS M. SUNDLY, NEAL BAUMGARTNER, and DARRELL W. CRISWELL Dec. 1988 33 p
(AD-A208075; USAFSAM-TR-88-39) Avail: NTIS HC A03/MF A01 CSCL 06/12

The U.S. Air Force (USAF) medical treatment facilities are provided with a standardized method of delivering 100 percent O2 via an aviator's oxygen mask to patients suffering from decompression sickness, carbon monoxide poisoning, and other ailments which require the administration of 100 percent O2. Studies show that administration of 100 percent O2 is the most effective method of treating decompression sickness and carbon monoxide poisoning short of hyperbaric oxygen therapy. However, the options for delivering 100 percent O2 to a patient under present conditions are highly varied and ineffective; very few methods ever deliver 100 percent O2 to the patient. The standardized 100 percent O2 delivery system replaces the standard hospital oxygen equipment with a Pressure demand oxygen system that has the capability of delivering 100 percent O2 uninterrupted from the time of diagnosis in the emergency room to the time the patient arrives at the hyperbaric treatment facility. GRA

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BEHAVIORAL SCIENCES

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

A89-52806
MULTIFACTOR STUDY OF RELATIVE POSTIRRADIATION CHANGES IN VARIOUS TYPES OF BEHAVIORAL REACTIONS IN RATS [MNOGOFAKTORNOE ISSLEDOVANIE OTNOSITEL'NYKH POSTLUCHEVYKH IZMENENII RAZLICHNYKH KATEGORII POVEDENCHESKIKH REAKTSII KRYS]
B. I. DAVYDOV, V. S. TIKHONCHUK, V. N. KARPOV, and I. B. USHAKOV Radiobiologiia (ISSN 0033-8192), vol. 29, May-June 1989, p. 367-374. In Russian. refs

The effects of exposing rats to gamma rays (of doses between 0.258 and 1.29 C/kg) prior to the performance of a behavioral task, and of the degree of strengthening of the conditioned reflex on the probability of behavioral disturbances were investigated. Results of observations indicated that an exposure of rats to gamma rays leads to decreases, in a discrete manner, in the probability of making the first decision in a behavioral task. It was found that both the dose and the degree of strengthening of the conditioned reflex significantly affected the probability of fulfilling the task by the animals. The effect of the interaction of the two factors was not significant. I.S.

A89-53328* Purdue Univ., West Lafayette, IN.
SEEING TONES AND HEARING RECTANGLES - ATTENDING TO SIMULTANEOUS AUDITORY AND VISUAL EVENTS
PATRICIA A. CASPER and BARRY H. KANTOWITZ (Purdue University, West Lafayette, IN) IN: Trends in ergonomics: Human factors II. Amsterdam, North-Holland, 1985, p. 41-50. refs
(Contract NCC2-228)

The allocation of attention in dual-task situations depends on both the overall and the momentary demands associated with both tasks. Subjects in an inclusive- or reaction-time task responded to changes in simultaneous sequences of discrete auditory and visual stimuli. Performance on individual trials was affected by (1) the ratio of stimuli in the two tasks, (2) response demands of the two tasks, and (3) patterns inherent in the demands of one task. Author

A89-53659#
APTITUDE SELECTION FOR OPERATORS OF COMPLEX TECHNICAL SYSTEMS [EIGNUNGSAUSWAHL VON OPERATEUREN KOMPLEXER TECHNISCHER SYSTEME]
PETER MASCHKE (DLR, Hamburg, Federal Republic of Germany) Ortung und Navigation (ISSN 0474-7550), vol. 30, no. 2, 1989, p. 176-183. In German.

The psychological evaluation procedures employed by the FRG aerospace agency DLR in selecting prospective air and space crew members, air-traffic controllers, etc. are reviewed. The role of human error in aerospace accidents is recalled; the inadequacy of biographical data, educational records, and physical examination results as predictors of performance in operating complex systems is pointed out; and particular attention is given to the process of aptitude diagnosis, the aptitude criteria (knowledge, operational characteristics, and personality traits), and selection principles. It is shown on the basis of statistical analysis that the DLR psychological aptitude tests are able to increase the candidate success rate, as measured by performance in training programs and on the job. Also discussed are the economic and safety benefits of accurate selection. T.K.

A89-54523
OCULAR RESPONSES TO LINEAR MOTION ARE INVERSELY PROPORTIONAL TO VIEWING DISTANCE
U. SCHWARZ, C. BUSETTINI, and F. A. MILES (NIH, Laboratory of Sensorimotor Research, Bethesda, MD) Science (ISSN 0036-8075), vol. 245, Sept. 22, 1989, p. 1394-1396. refs

Eye movements exist to improve vision, in part by preventing excessive retinal image slip. A major threat to the stability of the retinal image comes from the observer's own movement, and there are visual and vestibular reflexes that operate to meet this challenge by generating compensatory eye movements. The ocular responses to translational disturbances of the observer and of the scene were recorded from monkeys. The associated vestibular and visual responses were both linearly dependent on the inverse of the viewing distance. Such dependence on proximity is appropriate for the vestibular reflex, which must transform signals from Cartesian to polar coordinates, but not for the visual reflex, which operates entirely in polar coordinates. However, such shared proximity effects in the visual reflex could compensate for known intrinsic limitations that would otherwise compromise performance at near viewing. Author

N89-29019# Air Force Human Resources Lab., Brooks AFB, TX.
PREVENTION, REDUCTION, AND MEASUREMENT OF COMBAT STRESS REACTIONS: A BIBLIOGRAPHY Interim Paper May 1986 - Nov. 1988
CHERYL L. BATCHELOR Jun. 1989 17 p
(AD-A209375; AFHRL-TP-88-61) Avail: NTIS HC A03/MF A01 CSCL 05/8

The Combat Logistics Branch of the Air Force Human Resources Laboratory's Logistics and Human Factors Division is tasked with developing programs and methods which will enhance aircraft maintenance performance in peacetime as well as in combat environments. This focus on aircraft maintenance is the real lifeline of the Air Force because without effective and efficient aircraft maintenance, the routine maintenance tasks, as well as troubleshooting repairs, would not be accomplished. If routine maintenance and troubleshooting repairs were not accomplished, the required combat sortie generation rate would not be achieved. If the required combat sortie generation rate were not achieved, then U.S. air superiority could not be attained. This bibliography lists source documents relevant to combat stress. While this list is certainly not all-inclusive, the documents listed served as a basis for current research efforts in the area of combat stress. Other areas are also important, but these areas have been studied extensively. Aircraft maintenance personnel are tasked to repair the aircraft and let someone else take care of the enemy. A similar situation exists for other support personnel as well. As this bibliography illustrates, there is very little information available on

the peacetime stresses of aircraft maintenance personnel. Information about their reactions in combat is even scarcer.
GRA

N89-29020*# Massachusetts Inst. of Tech., Cambridge. Space Systems Lab.
SPACECRAFT FLIGHT SIMULATION: A HUMAN FACTORS INVESTIGATION INTO THE MAN-MACHINE INTERFACE BETWEEN AN ASTRONAUT AND A SPACECRAFT PERFORMING DOCKING MANEUVERS AND OTHER PROXIMITY OPERATIONS
ADAM R. BRODY Sep. 1988 97 p
(Contract NAGW-21)
(NASA-CR-177502; NAS 1.26:177502) Avail: NTIS HC A05/MF A01 CSCL 05/9

The anticipated increase in rendezvous and docking activities in the various space programs in the Space Station era necessitates a renewed interest in manual docking procedures. Ten test subjects participated in computer simulated docking missions in which the influence of initial velocity was examined. All missions started from a resting position of 304.8 meters (1000 feet) along the space station's +V-bar axis. Test subjects controlled their vehicle with a translational hand controller and digital auto pilot which are both virtually identical to their space shuttle counterparts. While the 0.1 percent rule (range rate is equal to 0.1 percent of the range) used by space shuttle pilots is comfortably safe, it is revealed to be extremely inefficient in terms of time and not justifiable in terms of marginal safety. Time is worth money, not only because of training and launch costs, but because the sooner a pilot and spacecraft return from a mission, the sooner they can begin the next one. Inexperienced test subjects reduced the costs of simulated docking by close to a factor of 2 and achieved safe dockings in less than 4 percent of the time the baseline approach would entail. This reduction in time can be used to save lives in the event of an accident on orbit, and can tremendously reduce docking costs if fuel is produced from waste water on orbit.
Author

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A89-52560#
INTEGRATED DYNAMIC PLANNING IN THE PILOT'S ASSOCIATE
C. A. LEAVITT and D. M. SMITH (Lockheed Aeronautical Systems Co., Marietta, GA) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 327-331. refs
(AIAA PAPER 89-3464)

The design of the Pilot's Associate (PA) being developed under DARPA sponsorship to provide AI-based assistance to the pilots of advanced fighter aircraft is described, with a focus on the real-time modification of plans during a deep interdiction mission. In the PA, planning functions are divided among the Mission Planner, the Tactics Planner, and the pilot (via the Pilot-Vehicle Interface). The AI approach in the PA is to combine expertise from different disciplines (represented as a hypothetical four-man crew) and integrate it to provide real-time responses to the single-pilot user. Particular attention is given to the communication between experts via a plan-goal graph, planning integration, and dynamic application of the Mission Planner. T.K.

A89-52610#
EFFECTS OF BIODYNAMIC COUPLING ON THE HUMAN OPERATOR MODEL
S. J. MERHAV (Technion - Israel Institute of Technology, Haifa) and M. IDAN IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 1. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 816-826. refs
(AIAA PAPER 89-3518)

This paper addresses the problem whether, and how, the response of the human operator and his associated describing function are influenced by cockpit motion induced by his own control commands. It is suggested that the motion-induced biodynamic stick feedthrough affecting the inner kinesthetic control loop can be interpreted as a modification of the dynamics of the controlled vehicle. By assuming that the crossover model remains valid under conditions of vehicle motion, an extended analytical model of the human operator describing function is derived. Computer simulation of this analytical model provides reference characteristics of the describing function and remnant noise. A validation of this model, accomplished by extensive dynamical tests on a moving base simulator, is described. Author

A89-52647*# Case Western Reserve Univ., Cleveland, OH.
NEW RESULTS CONCERNING THE USE OF KINEMATICALLY REDUNDANT MANIPULATORS IN MICROGRAVITY ENVIRONMENTS
R. D. QUINN and N. J. LIN (Case Western Reserve University, Cleveland, OH) IN: AIAA Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989, Technical Papers. Part 2. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 1150-1157. refs
(Contract NAG3-761)
(AIAA PAPER 89-3562)

This paper is concerned with the development of control strategies for kinematically redundant manipulators to be used in Space Station laboratories. These robots must be able to conduct experiments and manufacturing processes without disturbing the microgravity environment, and thus their dynamic base reactions/motions must be nearly eliminated. Redundant degrees of freedom permit the inverse kinematics problem to be solved in conjuction with the minimization of a cost function defined as a weighted sum of the base reactions. It is shown that the weights in the cost function should be used as an additional set of parameters in the minimization problem. The actual performance of the local optimal trajectory approach is demonstrated to be not as good as was previously reported. Author

A89-52713#
PILOT'S ASSOCIATE - AN INFLIGHT MISSION PLANNING APPLICATION
J. D. CORRIGAN and K. J. KELLER (McDonnell Aircraft Co., Saint Louis, MO) AIAA, Guidance, Navigation and Control Conference, Boston, MA, Aug. 14-16, 1989. 18 p. Research supported by DARPA.
(Contract F33615-86-C-3802)
(AIAA PAPER 89-3462)

A pilot's associate system has been developed to support the pilot in a battlefield air-interdiction mission. The system, which has been demonstrated in manned air-combat simulator, generates alternative mission plans in response to events such as pop-up threats, a resource depletion, or a mission redirect. Its mission-planning capabilities include selecting waypoints and generating a route plan, representing threat potential in a danger map, scheduling resources, alerting the pilot to special mission events (e.g., fence check), and providing target area planning. The planning process is interfaced to a flight manager which drives steering cues on the head-up display or flies the aircraft if autopilot is selected. Author

A89-53227
A REVIEW OF THE EFFECTS OF TRANSLATIONAL WHOLE-BODY VIBRATION ON CONTINUOUS MANUAL CONTROL PERFORMANCE
R. W. MCLEOD and M. J. GRIFFIN (Southampton, University, England) Journal of Sound and Vibration (ISSN 0022-460X), vol. 133, Aug. 22, 1989, p. 55-115. refs

A review of the literature concerned with experimental studies of the effects of translational whole-body vibration on continuous manual control performance is presented. Results from studies of the effects of vibration variables (vibration frequency, magnitude, axis, random vibration and multi-axis vibration) are compared. Evidence of the influence of control system variables (physical characteristics of the control, control gain, system dynamics and display variables) is also provided. Studies of the effects of vibration duration on manual control performance are reviewed separately. A behavioral model is presented to summarize the mechanisms (including vibration breakthrough, visual impairment, neuromuscular interference and central effects) by which whole-body vibration may interfere with the performance of continuous manual control tasks. The model emphasizes the adaptive ability of the human operator. Author

A89-53422
CONTROLLER DESIGN IN THE PHYSICAL DOMAIN (APPLICATION TO ROBOT IMPEDANCE CONTROL)
ANDRE SHARON, NEVILLE HOGAN, and DAVID E. HARDT (MIT, Cambridge, MA) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 1. Washington, DC, IEEE Computer Society Press, 1989, p. 552-559. refs

Design in the physical domain is proposed as a means of integrating control systems design with mechanical systems design. It is shown how this philosophy can lead to a robot architecture (macro/micromanipulator) that is inherently stable and well suited for high-bandwidth endpoint position and force control. Experimental verification is presented. A force-control bandwidth of 60 Hz, 32 times higher than the first structural mode of the robot, was achieved against an environment that is five times stiffer than the robot structure. An endpoint-position-control bandwidth of 28 Hz, 15 times higher than the first structural mode of the robot, was also achieved. This is beneficial in regulating interface forces and modulating endpoint impedance. I.E.

A89-53455#
SPACE ROBOTICS - AUTOMATA IN UNSTRUCTURED ENVIRONMENTS
RONALD LUMIA (NIST, Robot Systems Div., Gaithersburg, MD) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 3. Washington, DC, IEEE Computer Society Press, 1989, p. 1467-1471. refs

The problems associated with the development of robots for space applications are reviewed. Within the Space Station context, robots will operate in a relatively unstructured environment and must have the ability to deal with unexpected events; hence a great deal of experimentation is required to determine the best algorithms for task decomposition, world modeling, and sensory processing. The NASA/NBS Standard Reference Model for telerobot systems (NASREM), an architecture which supports the evolutionary development of the robot, is presented. NASREM forms the basis for a testbed system which allows researchers to develop, test, and evaluate different hardware and software approaches. NASREM is also used in the telerobot, so that the transition from the teleoperated mode to more autonomous modes of robot operation is gradual rather than abrupt. NASREM has been adopted by NASA for the Flight Telerobotic Servicer, a two-armed robot intended to help build and maintain the Space Station. I.E.

A89-53463* New York Univ., New York.
CALIBRATING A VPL DATAGLOVE FOR TELEOPERATING THE UTAH/MIT HAND
JIAWEI HONG and XIAONAN TAN (New York University, NY) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 3. Washington, DC, IEEE Computer Society Press, 1989, p. 1752-1757.
(Contract NAG2-493; NSF DCR-83-20085)

A system able to control the Utah/MIT hand with the VPL DataGlove has been developed. To get the actual joint angles from the DataGlove sensor values, a least-squares fit is used to find the best-fit exponential curve for each sensor, and then the correlation between the sensors is reduced by the iterative correlation elimination procedure. The calibration depends both on the wearer and the particular DataGlove being used. The first-level calibration is simple and can be done under 15 min with experience. The second level is fixed and requires no adjustments. To control the hand, a mapping from the DataGlove angles to the hand angles is applied, making the hand fingertips follow the DataGlove fingertips. The hand can successfully implement various high-level tasks under the DataGlove wearer's control. I.E.

A89-53464
TRANSFORMATION OF HUMAN HAND POSITIONS FOR ROBOTIC HAND CONTROL
LUCY PAO (Stanford University, Palo Alto, CA) and THOMAS H. SPEETER (AT&T Bell Laboratories, Holmdel, NJ) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 3. Washington, DC, IEEE Computer Society Press, 1989, p. 1758-1763. refs

A method for using the human hand as a multi-DOF teaching device is described. The algorithm is based on a functional analysis of the human hand and results in an algebraic transformation of human hand positions to corresponding positions in a target domain. The target domain should be of lower dimensionality (fewer degrees of freedom) than the human hand, but is not constrained in any other way. The target described here is a 16-DOF robotic hand with four fingers of four joints each. The target need not, however, be a handlike device but, for each use, should have a kinematic structure with poses similar in functionality to natural poses of the human hand. I.E.

A89-53465* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STABILITY AND PERFORMANCE TRADEOFFS IN BI-LATERAL TELEMANIPULATION
BLAKE HANNAFORD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: 1989 IEEE International Conference on Robotics and Automation, Scottsdale, AZ, May 14-19, 1989, Proceedings. Volume 3. Washington, DC, IEEE Computer Society Press, 1989, p. 1764-1767. refs

Kinesthetic force feedback provides measurable increase in remote manipulation system performance. Intensive computation time requirements or operation under conditions of time delay can cause serious stability problems in control-system design. Here, a simplified linear analysis of this stability problem is presented for the forward-flow generalized architecture, applying the hybrid two-port representation to express the loop gain of the traditional master-slave architecture, which can be subjected to similar analysis. The hybrid two-port representation is also used to express the effects on the fidelity of manipulation or feel of one design approach used to stabilize the forward-flow architecture. The results suggest that, when local force feedback at the slave side is used to reduce manipulator stability problems, a price is paid in terms of telemanipulation fidelity. I.E.

A89-53831*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TELEROBOTIC RESEARCH FOR IN-SPACE STRUCTURAL ASSEMBLY AND SERVICING
ALFRED J. MEINTEL, JR. (NASA, Langley Research Center, Hampton, VA) Space Artificial Intelligence Robotics/Automation Symposium, Tokyo, Japan, Oct. 16-19, 1989, Paper. 9 p. refs

The paper reviews Langley's Telerobotic Technology Program and the recent and planned research in automated space assembly.

Research areas include multiple manipulator coordination and control, automatic modes, evaluation of control modalities for teleoperated tasks, active sensing for world modeling and control, and architectures for distributed telerobotic systems. Studies of master/slave teleoperators performing representative space tasks showed that current teleoperator systems can be used to accomplish remote space operations. These studies also identified that research is required to improve the systems to reduce operator workload and task completion time. Closed-loop noncontact and contact sensor based control for automatic acquisition, positioning, and active compliance have been developed. A control structure for multiple manipulator coordination and control with manual, shared, and automatic modes performing space type tasks is being evaluated. C.E.

A89-54226
ABSORBED DOSE MEASUREMENTS ON EXTERNAL SURFACE OF KOSMOS-SATELLITES WITH GLASS THERMOLUMINESCENT DETECTORS
IU. A. AKATOV, V. V. ARKHANGEL'SKII, E. E. KOVALEV (Institut Mediko-Biologicheskikh Problem, Moscow, USSR), F. SPURNY, and I. VOTOCHKOVA (Czechoslovak Academy of Sciences, Institute of Radiation Dosimetry, Prague, Czechoslovakia) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 237-241. refs

In this paper, absorbed dose measurements with glass thermoluminescent detectors on external surface of satellites of Kosmos-serie flying in 1983-87 are presented. Experiments were performed with thermoluminescent aluminophosphate glasses of thicknesses 0.1, 0.3, 0.4, 0.5, and 1 mm. They were exposed in sets of total thickness between 5 and 20 mm, which were protected against sunlight with thin aluminized foils. In all missions, extremely high absorbed dose values were observed in the first layers of detectors, up to the thickness of 0.2 to 0.5 g/sq cm. These experimental results confirm that, during flights at 250 to 400 km, doses on the surface of the satellites are very high, due to the low energy component of the proton and electron radiation. Author

A89-54227* Rockwell International Corp., Houston, TX.
A PARAMETRIC STUDY OF SPACE RADIATION EXPOSURES TO CRITICAL BODY ORGANS FOR LOW EARTH ORBIT MISSIONS
W. ATWELL, E. R. BEEVER (Rockwell International Corp., Houston, TX), and A. C. HARDY (NASA, Johnson Space Center, Houston, TX) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 243-245. refs

It is shown that it is possible to calculate the extent of the exposure to space radiation of a specific body organ. Using a computerized anatomical man model and models of radiation environments and spacecraft shielding, a parametric study was carried out for several Space-Shuttle scenarios. The dose equivalent data for several blood-forming organ locations are presented (for a solar-minimum epoch) as a function of altitude and the shielding material, and the results are compared with the NASA crew exposure limits for these body organs. I.S.

A89-54228
SPACE RADIATION DOSIMETRY WITH ACTIVE DETECTIONS FOR THE SCIENTIFIC PROGRAM OF THE SECOND BULGARIAN COSMONAUT ON BOARD THE MIR SPACE STATION
TS. P. DACHEV, IU. N. MATVIICHUK, I. V. SEMKOVA, R. T. KOLEVA, B. BOICHEV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia za Kosmicheski Izsledvaniia, Sofia, Bulgaria) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 247-251. refs

A dosimetry-radiometry system has been developed at the Space Research Institute of the Bulgarian Academy of Science to measure the fluxes and dose rates on the flight of the second Bulgarian cosmonaut. The dosimetry system is designed for monitoring the different space radiations, such as solar cosmic rays and trapped particles in the earth radiation belts. The system consists of a battery operated small size detector unit and a 'read-write' and telemetry microcomputer unit. The sensitivity of the instrument permits high resolution measurements of the flux and dose rate along the track of the Mir space station. The paper presents the initial results for the period of the flight between June 7-17, 1988. Author

A89-54229
MODELING OF THE RADIATION EXPOSURE DURING THE FLIGHT OF THE SECOND BULGARIAN COSMONAUT ON BOARD THE MIR SPACE STATION
TS. P. DACHEV, IU. N. MATVIICHUK, N. G. BANKOV, R. T. KOLEVA, P. I. VELLINOV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia za Kosmicheski Izsledvaniia, Sofia, Bulgaria) et al. (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 253-255. refs

An experiment involving active detection of space radiation was carried out in the Space Research Institute (SRI) of Bulgarian Academy of Sciences, in preparation of the flight of the second Bulgarian cosmonaut. The radiations that would be encountered on the flight were modeled, including solar and Galactic cosmic rays and the particle radiation in the earth's radiation belts. The dose rate was calculated for these different radiations behind the shielding of the space station. The variations in dose rates over the period of the flight were calculated and compared with measurements made during the orbit of the Mir space station. The calculated and measured dose rates agreed within 15.35 percent. Author

A89-54230* Severn Communications Corp., Millersville, MD.
MODEL ANALYSIS OF SPACE SHUTTLE DOSIMETRY DATA
J. R. LETAW (Severn Communications Corp., Millersville, MD), R. SILBERBERG, C. H. TSAO (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, DC), and E. V. BENTON (San Francisco, University, CA) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 257-260. refs
(Contract DPR-T3452P; N00014-87-C-2251)

An extensive model analysis of plastic track detector measurements of high-LET particles on the Space Shuttle has been performed. Three Shuttle flights: STS-51F (low-altitute, high-inclination), STS-51J (high-altitude, low-inclination), and STS-61C (low-altitude, low-inclination) are considered. The model includes contributions from trapped protons and Galactic cosmic radiation, as well as target secondary particles. Target secondaries, expected to be of importance in thickly shielded space environments, are found to be a significant component of the measured LET (linear energy transfer) spectra. Author

A89-54231* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EFFECTIVE RADIATION REDUCTION IN SPACE STATION AND MISSIONS BEYOND THE MAGNETOSPHERE
THOMAS M. JORDAN (EMP Consultants, Gaithersburg, MD) and E. G. STASSINOPOULOS (NASA, Goddard Space Flight Center, Greenbelt, MD) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988)

Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 261-274. refs

This paper investigates the efficiency of low- and high-atomic number materials used as protective shields against biologically effective radiation in doses equivalent to those expected in low-earth-orbit and interplanetary manned missions. Results are presented on calculations for single-material shields from polyethylene, water, Be, Al, Fe, and Ta and multilayer shelds made from the combinations of any two or any three of these materials, for both LEO and interplanetary conditions. It is shown that, whereas for protons and Galactic cosmic rays the ordering of shield materials has a negligible effect, for electrons and secondary bremsstrahlung, both the order and the composition are important parameters. It was found that low-atomic-number materials are most effective shields against protons and galactic cosmic rays, and are most effective in decreasing bremsstrahlung production, while high-atomic-number shields are the best attenuators of both primary electrons (if the dose is dominated by primary electrons) and secondary bremsstrahlung (if this is produced). I.S.

A89-54232
STRATEGIES FOR DEALING WITH SOLAR PARTICLE EVENTS IN MISSIONS BEYOND THE MAGNETOSPHERE
G. R. HECKMAN, W. J. WAGNER, J. W. HIRMAN, and J. M. KUNCHES (NOAA, Boulder, CO) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 275-280. refs

For long duration missions beyond the magnetosphere, the hazards posed by solar particle events (SPE) require the development of new strategies to minimize both the radiation dose and the effects. Potential strategies include the development of improved short-term forecasting of SPE through better observations and research, consideration of HZE particles in real-time forecasting and monitoring, improved knowledge of the biological effects of the particles involved in SPE, and the development of methods for combining SPE forecasts with temporary shielding and chemical countermeasures. Evaluation of present capabilities and the identification of areas of further research to achieve the necessary capabilities are discussed. Author

A89-54234
RADIATION HAZARDS ON SPACE MISSIONS OUTSIDE THE MAGNETOSPHERE
J. R. LETAW (Severn Communications Corp., Millersville, MD), R. SILBERBERG, and C. H. TSAO (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, DC) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 285-291. refs
(Contract DPR-T3452P; N00014-87-C-2251)

Future space missions outside the magnetosphere will subject astronauts to a hostile and unfamiliar radiation environment. An annual dose equivalent to the blood-forming organs (BFOs) of about 0.5 Sv is expected, mostly from heavy ions in the galactic cosmic radiation. On long-duration missions, an anomalously-large solar energetic particle event may occur. Such an event can expose astronauts to up to about 25 Gy (skin dose) and up to about 2 Sv (BFO dose) with no shielding. The anticipated radiation exposure may necessitate spacecraft design concessions and some restriction of mission activities. The paper discusses the model calculations of radiation doses in several exomagnetospheric environments. Specific radiation shielding strategies are discussed. A new calculation of aluminum equivalents of potential spacecraft shielding materials demonstrates the importance of low-atomic-mass species for protection from galactic cosmic radiation. Author

A89-54235
GALACTIC COSMIC RAYS AND CELL-HIT FREQUENCIES OUTSIDE THE MAGNETOSPHERE
S. B. CURTIS (California, University, Berkeley) and J. R. LETAW (Severn Communications Corp., Millersville, MD) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 293-298. refs
(Contract DE-AC03-76SF-00098; N00014-87-C-2251)

An evaluation of the exposure of space travelers to galactic cosmic radiation outside the earth's magnetosphere is made by calculating fluences of high-energy primary and secondary particles with various charges traversing a sphere of area 100 sq microns. Calculations relating to two shielding configurations are presented: the center of a spherical aluminum shell of thickness 1 g/sq cm, and the center of a 4 g/sq cm thick aluminum spherical shell within which there is a 30 g/sq cm diameter spherical water phantom with the point of interest 5 g/sq cm from the surface. For a three-year mission, 33 percent of the cells in the more heavily shielded configuration would be hit by at least one particle with Z greater than 10. Six percent would be hit by at least two such articles. This emphasizes the importance of studying single high-Z particle effects both on cells which might be 'at risk' for cancer induction and on critical neural cells or networks which might be vulnerable to inactivation by heavy charged particle tracks. Author

A89-54236* California Univ., Berkeley.
TISSUE RESPONSES TO LOW PROTRACTED DOSES OF HIGH LET RADIATIONS OR PHOTONS - EARLY AND LATE DAMAGE RELEVANT TO RADIO-PROTECTIVE COUNTERMEASURES
E. J. AINSWORTH, S. M. J. AFZAL (California, University, Berkeley), D. A. CROUSE (Nebraska, University, Omaha), W. R. HANSON (Rush-Presbyterian-St. Luke's Hospital, Chicago, IL), and R. J. M. FRY (Oak Ridge National Laboratory, TN) (COSPAR, Plenary Meeting, 27th, Topical Meetings and Workshop XIX on Life Sciences and Space Research XXIII(4) - Radiation Biology, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 10, 1989, p. 299-313. refs
(Contract W-31-109-ENG-38; DE-AC03-76SF-00098; DE-AC05-84OR-21400; NIH-CA-15184; NASA ORDER T-7163-B)

Early and late murine tissue responses to single or fractionated low doses of heavy charged particles, fission-spectrum neutrons or gamma rays are considered. Damage to the hematopoietic system is emphasized, but results on acute lethality, host response to challenge with transplanted leukemia cells and life-shortening are presented. Recent studies on protection against early and late effects by aminothiols, prostaglandins, and other compounds are discussed. Author

A89-54249
THE BLUE COLLAR SPACESUIT
JOHN GROSSMANN Air and Space (ISSN 0886-2257), vol. 4, Oct.-Nov. 1989, p. 58-67.

The development of a spacesuit to be used aboard the Space Station is examined. The designs of two spacesuits, which must be capable of onboard maintenance and servicing, are described. The AX-5 is aluminum, contains no fabric, and weighs 185 lbs. The Mark III is 65 pct metal and 35 pct fabric and weighs 155 lbs. Both suits have rear entry, bubble helmets, stainless steel bearings, and Ortman rings for coupling and decoupling suit segments. The testing of the two spacesuits in the Weightless Environment Training Facility is discussed. I.F.

A89-54375*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SUSTAINING HUMANS IN SPACE
G. SCOTT HUBBARD and ALAN R. HARGENS (NASA, Ames Research Center, Moffett Field, CA) Mechanical Engineering (ISSN 0025-6501), vol. 111, Sept. 1989, p. 40-44.

NASA research on the functioning of biological systems in space and the resulting improvement in space suits and life-support systems is discussed. The centrifuge facility which will provide the major elements of a life science research facility for Spacelab

and Space Station Freedom is described, and the Vestibular Research Facility for studying motion sickness in space is examined. The aluminum AX-5 space suit and the Controlled Ecological Life-Support System are described, and biomedical sensors for studying bone mass changes in space are discussed. Studies on the use of exercise to control tissue-fluid shifts in space are described. C.D.

N89-29021# Human Engineering Labs., Aberdeen Proving Ground, MD.
CHOICE AND PERCEIVED CONTROL: IMPLICATIONS FOR THE DESIGN OF DISPLAYS Final Report
RICHARD A. MONTY and LAWRENCE C. PERLMUTER (Veterans Administration Learning and Memory Center, Boston, MA.) Apr. 1989 21 p
(AD-A208400; HEL-TN-5-89) Avail: NTIS HC A03/MF A01 CSCL 23/2

This report summarizes several years of research on how offering subjects a choice of task parameters leads to a perception of control over their environment, which in turn can lead to improved task performance. The development of a theoretical explanation of the phenomenon is traced, and implications for the design of displays are deduced and illustrated with hypothetical examples. GRA

N89-29022# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
INVESTIGATION OF A LINEAR SYSTEMS MODEL FOR HUMAN VISUAL DETECTION AND SPATIAL FREQUENCY DISCRIMINATION Final Report, Oct. 1986 - Dec. 1988
HAROLD S. MERKEL Dec. 1988 55 p
(AD-A209397; AAMRL-TR-88-061) Avail: NTIS HC A04/MF A01 CSCL 06/4

This research investigated the application of a linear systems model to two parameters of vision: the contrast threshold and the spatial frequency difference threshold. The contrast threshold is the contrast of a target when an observer is just able to detect its presence. The spatial frequency difference threshold is the smallest difference in spatial frequency that permits two grating targets to be distinguished. The model investigated was for observation with a fixed visual field size of one-dimensional, time-invariant sinusoidal grating targets. A mathematical development indicated that a linear model could be used to represent the human spatial frequency difference threshold function. The model was implemented using an electro-optical hardware system which consisted of a charge-coupled device video camera, a frame grabber, and a personal computer. Because of its similarities to the structure of the eye, linear response, and ability to acquire digital image data, a charge coupled device array video camera and frame grabber were used to simulate the eye. The action of the neural pathways and visual cortex was simulated by Fourier transform computations on the camera and frame grabber output. The experimental data from the electro-optical hardware system agreed with the theoretical models for both parameters. GRA

N89-29023# Naval Postgraduate School, Monterey, CA.
HUMAN FACTORS EVALUATION OF COLOR USE IN THE TARGET DATA PROCESSOR RELEASE 10 (TDP R10) M.S. Thesis
CLAUDIA J. SCHMIDLY Mar. 1989 64 p
(AD-A209438) Avail: NTIS HC A04/MF A01 CSCL 09/5

Color is provided as guidelines for static military CRT display formats. A total of 13 guidelines are discussed, relating to color as a coding dimension, the quantity of colors to include, selection of colors to use, ambient luminesce, display legibility and readability, human color deficiencies, and operator fatigue. Guidelines are then applied to the operator-machine interface of the U.S. Navy's Target Data Processor Release 10 (TDP R10), a tactical computer workstation for use in the Integrated Undersea Surveillance System. Specific color related design recommendations are included for the TDP R10 alphanumeric and geographic display screens with the goal of enhancing user performance. Since the TDP R10 is being developed using an iterative design process (design, test, redesign, etc.), test and evaluation considerations also are discussed at length. Various types of user self-support techniques are discussed, along with user performance testing, sample sizes, and data analysis procedures. GRA

N89-29024# Army Cold Regions Research and Engineering Lab., Hanover, NH.
PRELIMINARY DESIGN GUIDE FOR ARCTIC EQUIPMENT
MICHAEL R. WALSH and JAMES S. MORSE May 1989 38 p
(AD-A209455; CRREL-SR-89-13) Avail: NTIS HC A03/MF A01 CSCL 08/12

Designing equipment for arctic environments requires special considerations from the design engineer. Low temperatures and harsh environments place special demands on equipment and components. Many materials in common use will experience drastic changes in physical properties, resulting in catastrophic failure of the systems in which they are incorporated. Components may no longer meet original specifications, and instrumentation may not work properly. This design guide should familiarize the design engineer with the factors that must be considered when designing for the Arctic environment. A list of environmental factors and how they may affect a design is first presented. Then, a general design procedure is presented and a detailed analysis of problems and solutions for materials, components and systems follows. GRA

N89-29025# Anthropology Research Project, Yellow Springs, OH. Science and Advanced Technology Directorate.
ANTHROPOMETRIC SURVEY OF US ARMY PERSONNEL: SUMMARY STATISTICS Interim Technical Report, 1987 - 1988
CLAIRE C. GORDON, THOMAS CHURCHILL, CHARLES E. CLAUSER, BRUCE BRADTMILLER, JOHN T. MCCONVILLE, ILSE TEBBETS, and ROBERT A. WALKER Mar. 1989 336 p
(Contract DAAK60-86-C-0128)
(AD-A209600; NATICK-TR-89/027) Avail: NTIS HC A15/MF A01 CSCL 05/9

Results of the 1987 to 1988 anthropometric survey of Army personnel are presented in the form of summary statistics and percentile data. These anthropometric data are presented for a subset of personnel (1774 men and 2208 women) sampled to match the proportions of age categories and racial/ethnic groups found in the active duty Army of June, 1988. Dimensions included in this report include 132 standard measurements made in the course of the survey, 60 derived dimensions calculated largely by adding and subtracting standard measurement data, and 48 head and face dimensions reported in traditional linear terms but collected by means of an automated headboard designed to obtain three-dimensional data. Measurement descriptions, visual indices, and a glossary of terms are included to help identify and locate dimensions. GRA

N89-29026# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A ROBOT THAT WALKS: EMERGENT BEHAVIORS FROM A CAREFULLY EVOLVED NETWORK
RODNEY A. BROOKS Feb. 1989 15 p
(Contract N00014-86-K-0685; N00014-85-K-0124)
(AD-A207958; AI-M-1091) Avail: NTIS HC A03/MF A01 CSCL 12/9

Most animals have significant behavioral expertise built in without having to explicitly learn it all from scratch. This expertise is a product of evolution of the organisms; it can be viewed as a very long term form of learning which provides a structured system within which individuals might learn more specialized skills or abilities. This paper suggests one possible mechanism for analogous robot evolution by describing a carefully designed series of networks, each one being a strict augmentation of the previous one, which control a six legged walking machine capable of walking over rough terrain and following a person passively sensed in the infrared spectrum. As the completely decentralized networks are augmented, the robot's performance and behavior repertoire demonstrably improve. The rationale for such demonstrations is

that they may provide a hint as to the requirements for automatically building massive networks to carry out complex sensory-motor tasks. The experiments with an actual robot ensure that an essence of reality is maintained and that no critical disabling problems have been ignored. GRA

N89-29027*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METHOD AND APPARATUS FOR BIO-REGENERATIVE LIFE SUPPORT SYSTEM Patent Application
HATICE S. CULLINGFORD, inventor (to NASA) 11 Jul. 1989 34 p
(NASA-CASE-MSC-21629-1; NAS 1.71:MSC-21629-1; US-PATENT-APPL-SN-378548) Avail: NTIS HC A03/MF A01 CSCL 06/11

A life support system is disclosed for human habitation (cabin) which has a bioregenerative capability through the use of a plant habitat (greenhouse) whereby oxygen-rich air from the greenhouse is processed and used in the cabin and carbon dioxide-rich air from the cabin is used in the greenhouse. Moisture from the air of both cabin and greenhouse is processed and reused in both. Wash water from the cabin is processed and reused in the cabin as hygiene water, and urine from the cabin is processed and used in the greenhouse. Spent water from the greenhouse is processed and reused in the greenhouse. Portions of the processing cycles are separated between cabin and greenhouse in order to reduce to a minimum cross contamination of the two habitat systems. Other portions of the processing cycles are common to both cabin and greenhouse. The use of bioregenerative techniques permits a substantial reduction of the total consumables used by the life support system. NASA

N89-29953* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
MULTI-ADJUSTABLE HEADBAND Patent
PIERCE C. TOOLE, inventor (to NASA), HOWARD E. CHALSON, inventor (to NASA), and WALTER S. BUSSEY, inventor (to NASA) (Planning Research Corp., Kennedy Space Center, FL.) 8 Nov. 1988 11 p Filed 8 Aug. 1986 Supersedes N87-25765 (25 - 19 p 2646)
(NASA-CASE-KSC-11322-1; US-PATENT-4,783,822; US-PATENT-APPL-SN-894541; US-PATENT-CLASS-381-187; US-PATENT-CLASS-2-201; US-PATENT-CLASS-24-68B; US-PATENT-CLASS-381-183) Avail: U.S. Patent and Trademark Office CSCL 05/8

This invention relates to a headband for a headset having separate coarse and fine adjustment features. The adjustments may be to the axial distance between at least one earpiece element and a side support. Such adjustment to the axial distance varies the pressure exerted on the head of the user. The present fine adjustment feature may be used while the headset is being worn, thereby permitting a user to optimize the amount of pressure between the contending criteria of comfort and keeping the headset in place on the user's head.
Official Gazette of the U.S. Patent and Trademark Office

N89-29954# Air Force Human Resources Lab., Brooks AFB, TX.
AIR FORCE HUMAN RESOURCES LABORATORY MISSION AND CAPABILITIES Final Report, Oct. 1986 - Sep. 1987
RUTH M. BUESCHER, ed., MICHELLE OLVERA, ed., and LEASLEY BESETSNY, ed. May 1989 100 p
(AD-A208066; AFHRL-TP-88-62) Avail: NTIS HC A05/MF A01 CSCL 05/9

This technical paper presents the Air Force Human Resources Laboratory (AFHRL) mission and capabilities. It outlines the AFHRL organizational structure, functions of the divisions and staff offices, and available technical support. Technical support includes software and data base development, data processing, computer operations, and scientific and technical information services. Ongoing and completed research and development projects are described to identify laboratory capabilities. These projects cover the areas of manpower and personnel, education and training, simulation and training devices, and logistics and human factors. GRA

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A89-52060* California Univ., Davis.
AMPHIPHILIC COMPONENTS OF THE MURCHISON CARBONACEOUS CHONDRITE - SURFACE PROPERTIES AND MEMBRANE FORMATION
D. W. DEAMER (California, University, Davis) and R. M. PASHLEY (Australian National University, Canberra, Australia) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 21-38. refs
(Contract NAGW-1119)

The possibility that the amphiphilic compounds in carbonaceous meteorites whose physicochemical properties are presently studied may represent sources of lipidlike compounds which could have evolved as membrane components in primitive cells is investigated in samples of the Murchison CM2 chondrite. Surface properties and membrane formation are obtained for three fractions isolated by two-dimensional thin-layer chromatography. It is concluded that a small, undefined fraction of Murchison components exhibits amphiphilic properties which allow assembly into boundary membranes. O.C.

A89-52061* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE ROLE OF COMETARY PARTICLE COALESCENCE IN CHEMICAL EVOLUTION
V. R. OBERBECK, C. P. MCKAY, G. C. CARLE, J. R. VALENTIN (NASA, Ames Research Center, Moffett Field, CA), and T. W. SCATTERGOOD (New York, State University, Stony Brook) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 19, no. 1, 1989, p. 39-55. refs

Important prebiotic organic compounds might have been transported to earth in dust or produced in vapor clouds resulting from atmospheric explosions or impacts of comets. These compounds coalesced in the upper atmosphere with particles ejected from craters formed by impacts of large objects. Coalescence during exposure to UV radiation concentrated organic monomers and enhanced formation of oligomers. Continuing coalescence added material to the growing particles and shielded prebiotic compounds from prolonged UV radiation. These particles settled into the lower atmosphere where they were scavenged by rain. Aqueous chemistry and evaporation of raindrops containing monomers in high temperature regions near the earth's surface also promoted continued formation of oligomers. Finally, these oligomers were deposited in the oceans where continued prebiotic evolution led to the most primitive cell. Results of present studies suggest that prebiotic chemical evolution may be an inevitable consequence of impacting comets during the late accretion of planets anywhere in the universe if oceans remained on those planetary surfaces. Author

A89-52345
LINEAR AND CIRCULAR POLARIZATION BY HOLLOW ORGANIC GRAINS
F. HOYLE and N. C. WICKRAMASINGHE (University College, Cardiff, Wales) Astrophysics and Space Science (ISSN 0004-640X), vol. 151, no. 2, Jan. 1989, p. 285-291. refs

The cosmic bacterial model is studied, considering the possibility that interstellar Fe and Si might condense in the form of skins of more or less uniform thickness over the entire distribution of cylinder radii, with the iron condensing mainly in metallic form and the Si mainly as SiO2. In agreement with previous astronomical data,

hollow cylindrical organic particles with a mean refractive index of 1.15, a radius of 0.1 microns, and a SiO2-Fe mantle coating of 0.0006 micron thickness are found to possess wavelength dependences of linear and circular polarization. The Davis-Greenstein mechanism is shown to selectively align such particles endowed with ferromagnetic or superparamagnetic properties. R.R.

A89-52772
NONEQUILIBRIUM REDISTRIBUTION OF IONS IN THE SURFACE FILM OF THE WORLD OCEAN AS THE ORIGIN OF IONIC ASYMMETRY IN PRIMEVAL BIOLOGICAL SYSTEMS [NERAVNOVESNOE PERERASPREDELENIE IONOV V POVERKHNOSTNOI PLENKE MIROVOGO OKEANA KAK OSNOVA VOZNIKNOVENII IONNOI ASIMMETRII V PERVICHNYKH BIOLOGICHESKIKH SISTEMAKH]
V. A. TVERDISLOV, G. G. KHUNDZHUA, and E. V. KARAVAEVA (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Biofizika (ISSN 0006-3029), vol. 34, July-Aug. 1989, p. 701-704. In Russian. refs

This paper examines the role of cation redistribution in the surface film of the world ocean in the formation of primeval biological systems. Data on K/Na and Ca/Mg ratios and potential measurements in 5-micron-thick vs 200-micron-thick samples from the upper surface layers of the White Sea and the Caspian Sea waters are examined. These data provide evidence for asymmetrical and nonequilibrium distributions of cations, leading to the relative enrichment in K+ and Ca(2+) of the upper (cooler) film of these seas. These results support the hypothesis that the redistribution of cations between primeval cells and the sea water could have originated from the spontaneous sealing of lipid-rich vesicles in the cold surface film of the primeval ocean during the formation of aerosol particles. I.S.

A89-52951
EXPERIMENTAL STUDIES IN THE ORIGIN OF LIFE
CYRIL PONNAMPERUMA (Maryland, University, College Park) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 397-400. refs

Modern astronomy suggests that planets are plentiful in the Universe and that the conditions suitable for life are commonplace. Advances in biochemistry have pointed out the unity of the biosphere and lead to the belief that all life had a common chemical origin. Laboratory experiments indicate that almost all the building blocks of life can be synthesized under simulated primitive earth conditions. The analysis of meteorites and the study of the interstellar medium indicate that molecules of biological interest are also commonplace in the Universe, thus leading to the conclusion that the evolutionary process which has taken place on earth may have also occurred elsewhere in the cosmos leading to extraterrestrial civilizations. Author

A89-52952
THE RETENTION BY PLANETS OF LIQUID WATER OVER COSMIC PERIODS - A CRITICAL FACTOR FOR THE DEVELOPMENT OF ADVANCED CIVILISATIONS
MICHAEL D. PAPAGIANNIS (Boston University, MA) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 401-405. refs

Life based on carbon and liquid water seems to be the most likely possibility for planets but advanced technology may appear only after a long biological evolution. Consequently, only planets that can retain liquid water over cosmic periods (billions of years) may develop technological civilizations. The retention of liquid water over cosmic periods is a very complex problem, but significant progress has been made in recent years to comprehend its many intricacies. Author

A89-52953
THE COMPOSITION OF THE ARCHEAN OCEAN AND THE CONSTRAINTS ON THE ORIGIN OF LIFE
PETER BRIMBLECOMBE (East Anglia, University, Norwich, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 407-410. refs

Estimates of the likely composition of the early ocean can be made from mass-balance and equilibrium arguments and steady-state estimates of particle scavenging rates or the role of hydrothermal activity at midocean ridges. Photochemical reactions at the ocean surface are likely to have caused surface water to be out of equilibrium with the rather reduced Archean atmosphere, perhaps even oxidizing. The early ocean may have been slightly more acidic, and the Mg/Ca ratio smaller than at present. The CO2/CO3, SO2/SO4 and biologically relevant phosphorous concentrations may have been lower, while Fe, Mn and Si may have been much larger than today. Author

A89-52954
GAS PHASE ORGANIC SYNTHESIS IN PLANETARY ENVIRONMENTS - THE CASE OF TITAN
F. RAULIN and C. FRERE (Paris XII, Universite, Creteil, France) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 411-422. Research supported by CNRS. refs (Contract CNES-86-1245; CNES-87-1247)

Studies of the atmospheric organic chemistry of the planetary atmospheres are reviewed, focusing on the atmospheric composition of Titan. Consideration is given to thermodynamic calculations, kinetic modeling, and experimental studies of atmospheric organic syntheses. Comparisons are made between theoretical predictions and observations of the oxidized atmospheres of the terrestrial planets, the strongly reducing atmospheres of larger planets, and the reduced N2-CH4 atmosphere of Titan. The possible presence of a CH4-C2H6 ocean on Titan is considered. R.B.

A89-52955
AN EXPERIMENTAL APPROACH TO EXTRATERRESTRIAL LIFE
PETER M. MOLTON British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 423-429. refs

An experimental approach is constructed which, if applied, should greatly increase our understanding of the possible existence of extraterrestrial life and its limits. The concept is based on an extension of present day laboratory developments in computer modelling, analytical instrumentation and genetic engineering. A different set of assumptions to that normally used is suggested which will avoid the problem of 'self-fulfilling' predictions in which the experiment is inadvertently set up to generate results supporting the terrestrial norm as the only possibility. Author

A89-52956
FRONTIERS OF THE EARTH'S BIOSPHERE AND EXTRATERRESTRIALIZATION
S. V. LYSENKO (AN SSSR, Institut Mikrobiologii, Moscow, USSR) and M. D. NUSSINOV British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Sept. 1989, p. 431-435. refs

A new physical mechanism of irreversible ('explosive') damage to vegetative cells and spores of microorganisms under space vacuum conditions around the earth may help to explain the existence of thermophilic microorganisms, discovered recently in the 'black smokers' of the deep-sea bottom, i.e., in regions at high pressures and temperatures. Such mechanism makes it possible to estimate the boundaries of the earth's biosphere and can be applied to problems of the origin of life on earth and to the search for extraterrestrial life. Author

A89-53828*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE EARLY ENVIRONMENT AND ITS EVOLUTION ON MARS - IMPLICATIONS FOR LIFE
CHRISTOPHER P. MCKAY and CAROL R. STOKER (NASA, Ames Research Center, Moffett Field, CA) Reviews of Geophysics (ISSN 8755-1209), vol. 27, May 1989, p. 189-214. refs

There is considerable evidence that the early climate of Mars was very different from the inhospitable conditions there today. This early climate was characterized by liquid water on the surface

and a dense atmosphere composed predominantly of CO2. The duration of these warm initial conditions on the surface of Mars is uncertain, but theoretical models suggest that they could have persisted for hundreds of millions up to a billion years. From studies of the earth's earliest biosphere, it is known that, by 3.5 Gyr ago, life had originated on earth and reached a fair degree of biological sophistication. If Mars did maintain a clement environment for longer than it took for life to originate on earth, then the question of the origin of life on Mars follows naturally. Since over two thirds of the Martian surface is more than 3.5 Gyr old, the possibility exists that Mars may hold the best record of the events that led to the origin of life, even though there may be no life there today. Author

N89-29394# *Joint Publications Research Service, Arlington, VA.*
LIKELIHOOD OF CONTACT WITH EXTRATERRESTRIAL TECHNOLOGICAL CIVILIZATION Abstract Only
V. M. LIPUNOV *In its* JPRS Report: Science and Technology. USSR: Space p 14 18 Jan. 1989 Transl. into ENGLISH from Astronomicheskiy Zhurnal (Moscow, USSR) v. 65, no. 2, Mar. - Apr. 1988 p 433-435 Original language document was announced in IAA as A87-48126
Avail: NTIS HC A04/MF A01

An estimate is given of the likelihood of contact with a terrestrial-type technological civilization. The dependence of the number of civilizations in the Galaxy on the characteristic lifetime is analyzed. Author

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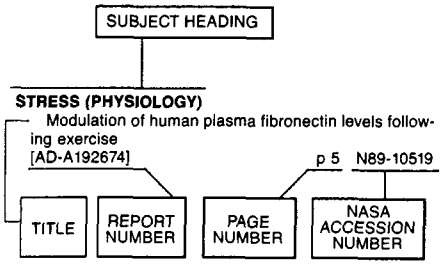

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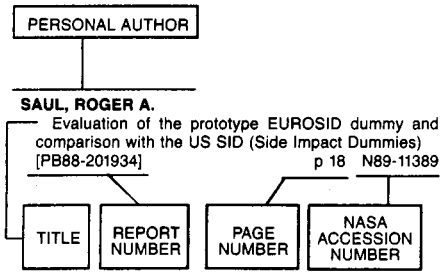

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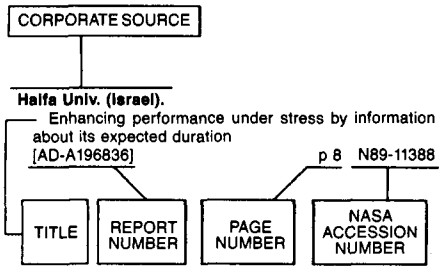

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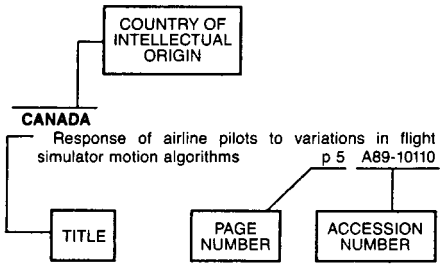

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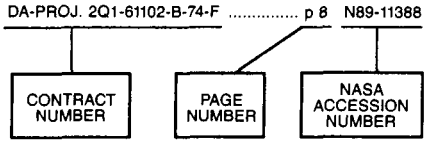

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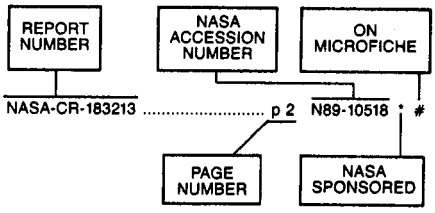

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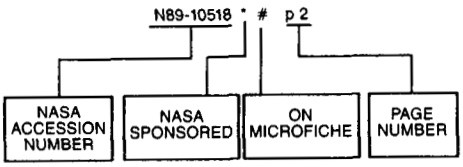

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