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March 1992

P-78

# AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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(NASA-SP-7011(360)) AEROSPACE  
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NASA SP-7011 (360)  
March 1992

# **AEROSPACE MEDICINE AND BIOLOGY**

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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

1992

# INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 217 reports, articles and other documents originally announced in February 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-11966 — N92-13925
IAA (A-10000 Series)	A92-13249 — A92-17254

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

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

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

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

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

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## TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED  
ON MICROFICHE

ACCESSION NUMBER → N92-11637\*# ← CORPORATE SOURCE  
 TITLE → ROBOT GRAPHIC SIMULATION TESTBED Final Report  
 AUTHORS → GEORGE E. COOK, JANOS SZTIPANOVITS, CSABA BIEGL,  
 GABOR KARSAI, and JAMES F. SPRINGFIELD Aug. 1991 ← PUBLICATION DATE  
 CONTRACT NUMBER → (Contract NAG8-690) ← AVAILABILITY SOURCE  
 REPORT NUMBERS → (NASA-CR-188998; NAS 1.26:188998) Avail: NTIS HC/MF A06; ← PRICE CODE  
 12 functional color pages CSCL 06/11 ← COSATI CODE

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

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER → A92-10353  
 TITLE → EFFECTS OF HYPOXIA AND COLD ACCLIMATION ON  
 THERMOREGULATION IN THE RAT  
 AUTHORS → H. GAUTIER, M. BONORA, S. B. M'BAREK, and J. D. SINCLAIR  
 (Paris VI, Universite, France; Auckland, University, New Zealand) ← AUTHORS' AFFILIATION  
 JOURNAL TITLE → Journal of Applied Physiology (ISSN 0161-7567), vol. 71, Oct. 1991, ← PUBLICATION DATE  
 p. 1355-1363. Research supported by Institut National de la Sante  
 et de la Recherche Medicale. refs  
 Copyright

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

## LIFE SCIENCES (GENERAL)

A92-13755

### NONCONTRACTILE ENERGY CONSUMPTION BY STRIATED MUSCULATURE [NESOKRATITEL'NYI RASKHOD ENERGII POPERECHNO-POLOSATOI MYSHECHNOI TKAN'IU]

IU. S. ALIUKHIN (AN SSSR, Institut Fiziologii, St. Petersburg, USSR) *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 22, Oct.-Dec. 1991, p. 3-31. In Russian. refs

Copyright

The paper reviews literature reports concerning measurements of noncontractile energy,  $E(nc)$ , in striated musculature and heart musculature and the significance of these findings. Consideration is given to different methods used in  $E(nc)$  measurements, causes of data variability among different laboratories, and the interpretation of  $E(nc)$  estimates. Particular attention is given to internal causes of  $E(nc)$  variability, such as mechanical factors and variations in oxygen supply; changes in body temperature; chemical causes, including changes in Na, K, Ca, citrate, fatty acids, and hormones; and biological factors, such as the genus of the animal, the type of striated musculature (slow or fast), the muscle mass, the age of the animal, the degree of adaptation to cold or heat, and physical activity. The physiological significance of  $E(nc)$  is discussed. I.S.

A92-13756

### EPIPHYSIS CEREBRI AND THE ORGANIZATION OF BEHAVIOR [EPIFIZ I ORGANIZATSIYA POVEDENIYA]

E. V. ARUSHANIAN (Stavropol'skii Gosudarstvennyi Meditsinskii Institut, Stavropol, USSR) *Uspekhi Fiziologicheskikh Nauk* (ISSN 0301-1798), vol. 22, Oct.-Dec. 1991, p. 122-141. In Russian. refs

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The paper examines the role of the epiphysis cerebri and its hormone melatonin in circadian and seasonal variations of human behavior. Consideration is given to the morphology, innervation, and biochemistry of the epiphysis; the behavioral response to the epiphyseal activity variations; and mechanisms responsible for behavioral changes due to epiphyseal activity variations. Particular attention is given to the role of epiphyseal hypofunction in mental depression and to the mechanism(s) of the effects of antidepressants. I.S.

A92-14021

### TROPIC RESPONSES OF AVENA SEEDLINGS IN SIMULATED HYPOGRAVITY

T. EIDESMO, A. BROWN, D. CHAPMAN, and A. JOHNSON (Trondheim, University, Norway) *Microgravity Science and Technology* (ISSN 0938-0108), vol. 4, Oct. 1991, p. 199-206. refs

Copyright

The *Avena coleoptile* is studied under microgravity conditions in NASA's Gravitational Plant Physiology Facility simulated by using a somersault clinostat. The plants are placed in the centrifuge

and exposed to different g-forces for varying lengths of time, and timelapse photography is used to study the plant before and after the stimulation. An image-analyzing system is used to record data for dose-response curves, and a reciprocity is noted between force and stimulation time. The reciprocity is not valid for doses greater than 5 g min, and the smallest stimulation that the plants detect is less than 30 g s. It is concluded that experimentation under actual weightlessness is required to determine the gravitropic response of the *Avena coleoptile* to microgravity environments. C.C.S.

A92-14024

### AUTOMATIC FIXATION FACILITY FOR PLANT SEEDLINGS IN THE TEXUS SOUNDING ROCKET PROGRAMME

MARTIN TEWINKEL, DIETER VOLKMANN (Bonn, Universitaet, Federal Republic of Germany), JUERGEN BURFEINDT, and PETER RANK (Kayser-Threde GmbH, Munich, Federal Republic of Germany) *Microgravity Science and Technology* (ISSN 0938-0108), vol. 4, Oct. 1991, p. 216-220. Research supported by DLR, BMFT, and Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen. refs

Copyright

Automatic chemical fixation of plant seedlings within a 6 min period of reduced gravity (10 exp -4 g) was performed on three ballistic rocket flights provided by the German Sounding Rocket Programme TEXUS (Technologische Experimente unter Schwerelosigkeit = Technological Experiments in Microgravity). The described TEXUS experiment module consists of a standard experiment housing with batteries, cooling and heating systems, timer, and a data recording unit. Typically, 60 min before launch an experiment plug-in unit containing chambers with the plant material, the fixation system, and the temperature sensors is installed into the module which is already integrated in the payload section of the sounding rocket (late access). During the ballistic flight plant chambers are rapidly filled at pre-selected instants to preserve the cell structure of gravity sensing cells. After landing the plant material is processed for transmission electron microscopy. Up to now three experiments were successfully performed with cress roots (*Lepidium sativum* L.) Detailed improvements resulted in an automatic fixation facility which in principle can be used in unmanned missions. Author

A92-15954\* Lovelace Foundation for Medical Education and Research, Albuquerque, NM.

### CARDIOPULMONARY RESPONSES TO ACUTE HYPOXIA, HEAD-DOWN TILT AND FLUID LOADING IN ANESTHETIZED DOGS

J. A. LOEPPKY, P. SCOTTO, C. RIEDEL, P. AVASTHI, V. KOSHUKOSKY, and T. W. CHICK (Lovelace Medical Foundation, Albuquerque, NM) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1137-1146. Research supported by AHA and CNR. refs (Contract NAG9-375)

Copyright

Cardiopulmonary responses to acute hypoxia (HY), fluid loading by saline infusion (FL), and head-down tilt (HD) of mechanically ventilated anesthetized dogs were investigated by measuring thermodynamics and pulmonary gas exchange. It was found that HD decreased the total respiratory compliance both during HY and normoxia (NO) and that the reduction in compliance by FL

## 51 LIFE SCIENCES (GENERAL)

was twice as large as by HD. Superimposing HD on HY doubled the increase in vascular resistance due to HY alone. In the systemic circulation, HD lowered the resistance to below NO levels. There was a significant positive correlation between the changes in blood volume and in pulmonary artery pressure for experimental transitions, suggesting that a shift in blood volume from systemic to pulmonary circulations and changes in the total blood volume may contribute substantially to these apparent changes in resistance. I.S.

**A92-15955\*** Arizona Univ., Tucson.  
**EFFECT OF 29 DAYS OF SIMULATED MICROGRAVITY ON MAXIMAL OXYGEN CONSUMPTION AND FAT-FREE MASS OF RATS**

CHRISTOPHER R. WOODMAN, CRAIG S. STUMP, JANE A. STUMP, ZIA RAHMAN, and CHARLES M. TIPTON (Arizona, University, Tucson) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1147-1152. refs (Contract NAG2-392)

Copyright

Effects of a 29-days exposure to simulated microgravity on the values of maximal oxygen consumption and fat-free mass (FFM) and on the mechanical efficiency of running were investigated in rats randomly assigned to one of three regimens: head-down suspension (HDS) at 45 deg, horizontal suspension (HS), or cage control (CC). Before suspension and on days 7, 14, 21, and 28, five exercise performance tests were carried out, with measurements related to maximal oxygen consumption, treadmill run time, and mechanical efficiency. It was found that maximal oxygen consumption of both HDS and HS groups decreased significantly at day 7, after which the HDS rats remained decreased while the HS rats returned to presuspension values. Apparent mechanical efficiency in the HDS and HS groups decreased by 22-35 percent during the experimental period, and FFM decreased significantly. I.S.

**A92-15957\*** Arizona Univ., Tucson.  
**VECTOR-AVERAGED GRAVITY ALTERS MYOCYTE AND NEURON PROPERTIES IN CELL CULTURE**

RAPHAEL GRUENER and GLENN HOEGER (Arizona, University, Tucson) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1159-1165. refs (Contract NAGW-539; NAGW-1705)

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The effect of changes in the gravitational field of developing neurons and myocytes on the development of these cells was investigated using observations of rotated cultures of embryonic spinal neurons and myocytes in a horizontal clinostat, in which rotation produces, from the cells' perspective, a 'vector-free' gravity environment by continuous averaging of the vector, thus simulating the microgravity of space. It was found that, at rotation rates between 1 and 50 rpm, cellular and nuclear areas of myocytes become significantly enlarged and the number of presumptive nucleoli increase; in neurons, frequent and large swellings appeared along neuritic shafts. Some of these changes were reversible after the cessation of rotation. I.S.

**A92-16361**  
**THE ORIGIN AND AMPLIFICATION OF BIMOLECULAR CHIRALITY**

WILLIAM A. BONNER (Stanford University, CA) Origins of Life and Evolution of the Biosphere (ISSN 0169-6149), vol. 21, no. 2, 1991, p. 59-111. refs

Copyright

The biotic and abiotic theories on the mechanisms responsible for the origin of molecular chirality are reviewed, with emphasis on the most recent literature reports. It is concluded that, from the viewpoints of either the chance or a determinate mechanism, the basis for the origin of biomolecular chirality still remains obscure. All 'regional or temporal' mechanisms based on electric, magnetic, or gravitational field effects are found to be theoretically unsubstantiated and experimentally unconvincing or refuted. Mechanisms involving circularly polarized light lead to large and

readily verifiable experimental effects (particularly in the case of asymmetric photolysis), but their terrestrial applicability is jeopardized by the questionable availability of sufficiently intense circularly polarized sunlight on the surface of the earth. It is suggested that the source of terrestrial chirality is most likely extraterrestrial. I.S.

**A92-16775**  
**INTERACTION OF CIRCAHOREALIAN AND CIRCADIAN RHYTHMS - A CYBERNETIC MODEL [VZAIMODEISTVIE OKOLOCHASOVOGO I OKOLOSUTOCHNOGO RITMA - KIBERNETICHESKAIA MODEL']**

S. L. ZAGUSKIN, S. N. GRINCHENKO, and V. IA. BRODSKII (Rostovskii Gosudarstvennyi Universitet, Rostov-on-Don; AN SSSR, Institut Problem Informatiki and Institut Biologii Razvitiia, Moscow, USSR) Akademiia Nauk SSSR, Izvestiia, Serii Biologicheskaiia (ISSN 0002-3329), Nov.-Dec. 1991, p. 950-954. In Russian. refs Copyright

Relationships between the parameters of an ideal circadian cycle and those of a circadian cycle composed of circahorealian fluctuations were investigated using a cybernetic model based on the hypothesis of matrix random search of circahorealian rhythms during a shift in a geophysical rhythm. Results of computer calculations revealed a low-efficiency of the search according to fluctuation amplitude, while the search according to phase and frequency was effective in a narrow range of changes and was time-consuming. Examples are presented of interactions between circadian, circahorealian, and shorter cycles. I.S.

**N92-12387#** Kansas State Univ., Manhattan. Dept. of Agronomy.

**RANGELAND-PLANT RESPONSE TO ELEVATED CO2**

C. E. OWENSBY, P. I. COYNE, and L. M. AUEN 1989 42 p (Contract DE-FG02-84ER-60253) (DE90-013702; DOE/ER-60253/8) Avail: NTIS HC/MF A04

Effects of carbon dioxide enrichment on a tallgrass ecosystem were monitored during the 1989 growing season. The experimental site was located in pristine Tallgrass Prairie north of and adjacent to the Kansas State University campus. Vegetation on the site was a mixture of C3 and C4 species and was dominated by big bluestem and indiagrass. Subdominants included Kentucky bluegrass, sideoats grama, and tall dropseed. Principal forbs included western ragweed, Louisiana sagewort, and mayflower scurfpea. The area was ideal for meeting the experimental objectives, in that the mixture of C3 and C4 plants would allow for assessment of competitive relationships among numerous species of both carbon fixation pathways. The objectives of this project were: to characterize the effects of CO2 enrichment on changes in diet selection and diet quality for ruminants, to monitor plant population dynamics under ambient and CO2-enriched atmospheres, and to measure biomass accumulation and leaf area during the growing season under ambient and CO2-enriched atmospheres. During 1989, we developed and tested the system and were able to collect substantial data concerning the effects of CO2 enrichment of tallgrass prairie. In this report, we detail chamber design, data acquisition, control of the chamber environment, biomass and leaf area response to CO2 enrichment, and collection of forage quality samples using esophageally fistulated sheep. DOE

**N92-12388#** National Aeronautics and Space Administration, Washington, DC.

**LIFE SCIENCES REPORT 1987**

Dec. 1987 94 p Original contains color illustrations (NASA-TM-105105; NAS 1.15:105105) Avail: NTIS HC/MF A05; 52 functional color pages CSCL 06B

Highlighted here are the major research efforts of the NASA Life Sciences Division during the past year. Topics covered include remote health care delivery in space, space biomedical research, gravitational biology, biospherics (studying planet Earth), the NASA Closed Ecological Life Support System (CELSS), exobiology, flight programs, international cooperation, and education programs.

Author

**N92-12389\*#** Louisville Univ., KY. Dept. of Microbiology and Immunology.

**COSMOS-1989 IMMUNOLOGY STUDIES Final Report**

GERALD SONNENFELD Oct. 1991 69 p

(Contract NAG2-614)

(NASA-CR-188970; NAS 1.26:188970) Avail: NTIS HC/MF A04 CSCL 06B

Evidence from both human and rodent studies has indicated that alterations in immunological parameters occur after space flight. The number of flight experiments has been small, and the full breadth of immunological alterations occurring after space flight remains to be established. Among the major effects on immune responses after space flight that have been reported are: alterations in lymphocyte blastogenesis and natural killer cell activity, alterations in production of cytokines, changes in leukocyte sub-population distribution, and decreases in the ability of bone marrow cells to respond to colony stimulating factors. Changes have been reported in immunological parameters of both humans and rodents. The significance of these alterations in relation to resistance to infection remains to be established. The current study involved a determination of the effects of flight on *Cosmos mission 2044 on leukocyte subset distribution and the sensitivity of bone marrow cells to colony stimulating factor-GM*. A parallel study with antiorthostatic suspension was also carried out. The study involved repetition and expansion of studies carried out on *Cosmos 1887*. Author

**N92-12390\*#** Louisville Univ., KY. Dept. of Microbiology and Immunology.

**EFFECT OF SPACE FLIGHT ON INTERFERON PRODUCTION - MECHANISTIC STUDIES Final Report**

GERALD SONNENFELD Oct. 1991 68 p

(Contract NAG9-181)

(NASA-CR-188972; NAS 1.26:188972) Avail: NTIS HC/MF A04 CSCL 06B

Ground-based models were studied for the effects of space flight on immune responses. Most time was spent on the model for the antiorthostatic, hypokinetic, hypodynamic suspension model for rats. Results indicate that suspension is useful for modeling the effects of spaceflight on functional immune responses, such as interferon and interleukin production. It does not appear to be useful for modeling shifts in leukocyte sub-populations. Calcium and 1,25-dihydroxyvitamin D sub 3 appear to play a pivotal role in regulating shifts in immune responses due to suspension. The macrophage appears to be an important target cell for the effects of suspension on immune responses. Author

**N92-12391#** Technische Univ., Berlin (Germany, F.R.). Fachbereich Informatik.

**COMPUTER AIDED MODELIZATION OF RIBOSOMIC DATA Ph.D. Thesis [COMPUTERGESTUETZTES MODELLIEREN RIBOSOMALER DATEN]**

DIERK SCHUELER 1990 143 p In GERMAN

(ETN-91-90161) Avail: NTIS HC/MF A07

A formal concept is presented for describing ribosomic data. A reference model allows the integration of various data in a three dimensional model. This reference model is realized by an acyclic graph. The nodes are to be interpreted as atoms, elements of secondary or quaternary structure. A particular process, which is responsible for the conversion of experimental results in the reference model (ribosomic model) corresponds with each experiment. It ensues an interlaced system with distributed semantics. The integration of the reference model and of the system communication is realized by postscript as a programming language. The visualization allows the graphic conversion of three dimensional data. Graphic objects can be associated with each node. ESA

**N92-12392\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena. Advanced Industrial Concepts Div.

**CATALYSIS AND BIOCATALYSIS PROGRAM Annual Report, FY 1990**

Mar. 1991 164 p

(Contract NAS7-918; DE-AI01-86CE-90239)

(NASA-CR-189452; NAS 1.26:189452; JPL-PUBL-91-4;

DOE/CS-66001-14) Avail: NTIS HC/MF A08 CSCL 06C

The annual report presents the fiscal year (FY) 1990 research activities and accomplishments for the Catalysis and Biocatalysis Program of the Advanced Industrial Concepts Division (AICD), Office of Industrial Technologies of the Department of Energy (DOE). The mission of the AICD is to create a balanced program of high risk, long term, directed interdisciplinary research and development that will improve energy efficiency and enhance fuel flexibility in the industrial sector. The Catalysis and Biocatalysis Program's technical activities were organized into five work elements: the Molecular Modeling and Catalysis by Design element; the Applied Microbiology and Genetics element; the Bioprocess Engineering element; the Separations and Novel Chemical Processes element; and the Process Design and Analysis element. Author

**N92-12393#** Umea Univ. (Sweden). Dept. of Microbiology.

**A MOLECULAR ANALYSIS OF BETA-LACTAMASES AND THEIR PROMOTORS IN STREPTOMYCES Ph.D. Thesis**

MATS FORSMAN 1991 116 p

(Contract B90-16X-07171-06A)

(FOA-B-40392-4.4; ISBN-91-7174-574-2; ETN-91-90279) Avail: NTIS HC/MF A06

A molecular analysis of extracellular beta lactamases of *Streptomyces* was undertaken to study transcription and structure of antibiotic resistance genes in *Streptomyces*. Genes encoding the extracellular beta lactamases of *S. badius*, *S. cacaoi*, *S. fradiae* and *S. lavendulae* were cloned into *S. lividans*. Each of the beta lactamases were expressed in and then secreted from *S. lividans*. Results are that: *Streptomyces* beta lactamases belong to the superfamily of class A beta lactamases genes; *S. lividans* contains an RNA polymerase that recognizes the same sequence determinants and chooses the same point of initiation of RNA synthesis as the corresponding *E. coli* enzyme; the *S. fradiae* beta lactamase class of promoters is probably recognized by unidentified sigma factors. ESA

**N92-12394#** National Defence Research Establishment, Umea (Sweden). Dept. of Cell and Microbiology.

**BETA-LACTAMASE GENES OF STREPTOMYCES BADIUS, STREPTOMYCES CACAOI AND STREPTOMYCES FRADIAE: CLONING AND EXPRESSION IN STREPTOMYCES LIVIDANS**

BENGTAKE JAURIN, MATS FORSMAN, and BRITTA HAEGGSTROEM /in Umea Univ., A Molecular Analysis of Beta-Lactamases and Their Promoters in *Streptomyces* p 65-74 1991 Repr. from *Biochimica et Biophysica Acta*, v. 949 (Elsevier Science Publishers B.V.), 1988 p 288-296

(Contract B86-16X-7171-2A)

Avail: NTIS HC/MF A06

Genes encoding extracellular beta lactamases (EC 3.5.2.6) of Gram-positive *Streptomyces badius*, *Streptomyces cacaoi* and *Streptomyces fradiae* have been cloned into *Streptomyces lividans*. The beta lactamase gene of *S. badius* was initially isolated on 7 kb BamHI fragment and further located on a 1300 bp DNA (Deoxyribonucleic Acid) segment. An 11 kb BamHI fragment was isolated encompassing the *S. cacaoi* beta lactamase gene, which was subcloned to a 1250 bp DNA fragment. The beta lactamase gene of *S. fradiae* was cloned on an 8 kb BamHI fragment and mapped to a 4 kb DNA segment. Each of the three BamHI fragments encompassing the beta lactamase genes hybridized to a BamHI fragment of the corresponding size in chromosomal DNA from the respective strain used for cloning. The activities of the three beta lactamases were predominantly found to be extracellular in the *S. lividans* recombinants. The *S. badius* and *S. cacaoi* beta lactamases exhibited a 10 to 100 times lower activity in *S. lividans*, whereas the *S. fradiae* beta lactamase showed an approximately 10 fold higher activity in the cloned state, compared with the activities found in the original strains. ESA

**N92-12395#** National Defence Research Establishment, Umea (Sweden). Dept. of Cell and Microbiology.

**MOLECULAR ANALYSIS OF BETA-LACTAMASES FROM FOUR SPECIES OF STREPTOMYCES: COMPARISON OF AMINO ACID SEQUENCES WITH THOSE OF OTHER BETA-LACTAMASES**

MATS FORSMAN, BRITTA HAEGGSTROEM, LENA LINDGREN, and BENGTAKE JAURIN *In* Umea Univ., A Molecular Analysis of Beta-Lactamases and Their Promoters in Streptomyces p 77-86 1991 Repr. from Journal of General Microbiology, v. 136 (England), 1990 p 589-598

(Contract B88-16X-7171-4A)

Avail: NTIS HC/MF A06

Genes encoding extracellular beta lactamases of Streptomyces badius, Streptomyces cacaoi, Streptomyces fradiae and Streptomyces lavendulae were cloned and mapped in Streptomyces lividans. DNA (Deoxyribonucleic Acid) sequence analysis of the beta lactamase genes revealed a high overall G + C content, ranging from 71 to 75 mol, with a G + C content of 95 mol at the third position of the codons for all four genes. The primary structure of the beta lactamases including their signal peptides was deduced. The four beta lactamases exhibited homology to each other and to class A beta lactamases from other bacterial genera. Streptomyces beta lactamases are suggested as being representatives of a superfamily of genes, from which class A beta lactamases of gram-negative bacteria may have evolved. ESA

**N92-12396#** National Defence Research Establishment, Umea (Sweden). Dept. of Cell and Microbiology.

**TRANSCRIPTIONAL INDUCTION OF STREPTOMYCES CACAOI BETA-LACTAMASE BY A BETA-LACTAM COMPOUND**

MATS FORSMAN, LENA LINDGREN, BRITTA HAEGGSTROEM, and BENGTAKE JAURIN *In* Umea Univ., A Molecular Analysis of Beta-Lactamases and Their Promoters in Streptomyces p 89-96 1991 Repr. from Molecular Microbiology, v. 3, no. 10, 1989 p 1425-1432

(Contract B88-16X-7171-4A)

Avail: NTIS HC/MF A06

The soil bacterium Streptomyces cacaoi produces an extracellular beta lactamase. The beta lactamase expression could be induced by the beta lactam compound 6-Amino Penicillinoic Acid (6-APA). In liquid cultures, a 50 fold increase in beta lactamase expression was observed within the first three hours after addition of 6-APA. Using the cloned beta lactamase gene as probe, it was shown that this increase was mediated at the level of transcriptional initiation. The start point of the induced beta lactamase transcript was determined, and the nucleotide sequence of the promoter region was analyzed. No noticeable homology was found to control regions of inducible beta lactamase genes of other bacteria. A striking feature was the presence of six direct repeats (ten base pairs each) upstream of the promoter region. Thus, an example of an inducible regulatory gene system in the gram-positive microorganism is presented. Also, the primary structure of the beta lactamase was deduced, showing a high degree of homology with class A beta lactamases. ESA

**N92-12397#** National Defence Research Establishment, Umea (Sweden). Div. of Microbiology.

**MUTAGENIC ANALYSIS OF THE S. FRADIAE BETA-LACTAMASE PROMOTER**

MATS FORSMAN and MICHEAL GRANSTROEM *In* Umea Univ., A Molecular Analysis of Beta-Lactamases and Their Promoters in Streptomyces p 99-115 1991 Submitted for publication

(Contract B90-16X-07171-06A)

Avail: NTIS HC/MF A06

The S. fradiae beta lactamase promoter was sequenced and characterized by promoter probing, primer extension, and Exo III nuclease deletions. Transcriptional initiation was directed from the same nucleotide in both S. lividans and S. fradiae. Oligonucleotide directed random mutations and site specific mutations were introduced in the promoter region. The effects of these mutations

on transcription were determined by using a newly developed RNA colony hybridization method. This analysis identified cis-acting sequence determinants located analogous to the -10 and -35 region of a typical E. coli promoter. The S. fradiae beta lactamase promoter was shown not to be recognized by sigma-whiG or by sigma-hrdA, hrdC, or hrdD. Sequence alignment to sigma factor classified Streptomyces promoters revealed little homology. Thus, the S. fradiae beta lactamase promoter is probably recognized by an unidentified sigma factor. ESA

**N92-12398#** National Defence Research Establishment, Umea (Sweden). Dept. of Cell and Microbiology.

**CHROMOGENIC IDENTIFICATION OF PROMOTERS IN STREPTOMYCES LIVIDANS BY USING AN AMP<sup>R</sup> BETA-LACTAMASE PROMOTER-PROBE VECTOR**

MATS FORSMAN and BENGTAKE JAURIN *In* Umea Univ., A Molecular Analysis of Beta-Lactamases and Their Promoters in Streptomyces p 119-128 1991 Repr. from Mol. Gen. Genet., v. 210, 1987 p 23-32

(Contract B86-16X-7171-2A)

Avail: NTIS HC/MF A06

The construction and application of a promoter probe vector in S. lividans is reported. The vector which has the amp<sup>R</sup> beta lactamase gene of E. coli as an indicator of promoter activity, allowed the isolation of promoters by employing the chromogenic compound nitrocefin as a substrate. One promoter, an SEP representative, was shown to direct transcription from the same nucleotide start sites in both S. lividans and E. coli. ESA

**N92-12399#** National Defence Research Establishment, Umea (Sweden). Dept. of NBC-Defence.

**CHARACTERIZATION OF A ROTATING DRUM FOR LONG TERM STUDIES OF AEROSOLS**

INGRID FAENGMARK and LARS-ERIK WIKSTROEM Jun. 1991 22 p *In* SWEDISH; ENGLISH summary

(FOA-C-40261-4.5; ISSN-0347-2124; ETN-91-90280) Avail: NTIS HC/MF A03; National Defence Research Establishment, S-901 82 Umeaa, Sweden, HC 100 Swedish crowns

As a basis for future studies on survival of airborne microorganisms, the coagulation and sedimentation losses in a 66 l rotating drum was investigated. The number of particles that remain within the drum as a function of time was studied during 30 hours, at concentrations between 1000 to 100,000 particles/cu cm. The size distribution of the aerosol was determined as a function of time and methods to fill the drum and take samples from the drum were developed. The results show that the rotating drum is a suitable chamber for long term studies of aerosols. When the initial concentration of bacteria within the drum is kept between 10,000 to 100,000 bacteria/cu cm and the rotation rate is 0.4 rpm, it was possible to study the survival of airborne bacteria during at least 24 hours. ESA

**N92-12400#** National Defence Research Establishment, Umea (Sweden). Dept. of NBC-Defence.

**BIOLOGICAL DOSIMETRY: A REVIEW OF METHODS AVAILABLE FOR DETERMINATION OF IONIZING RADIATION DOSE**

BJOERN SANDSTROEM Apr. 1991 29 p *In* SWEDISH; ENGLISH summary

(FOA-C-40282-4.3; ISSN-0347-2124; ETN-91-90281) Avail: NTIS HC/MF A03; National Defence Research Establishment, S-901 82 Umeaa, HC 100 Swedish crowns

Biological dosimetry is addressed with a short history of work on the subject and a discussion on the symposium of Trends in Biological Dosimetry in Italy, 22 to 27 Oct. 1990. A review of methods of biological dosimetry of ionizing radiation from literature on this subject is presented. ESA

**N92-12401#** Department of Energy, Washington, DC. Energy Biosciences Div.

**DIVISION OF ENERGY BIOSCIENCES: SUMMARIES OF FY 1991 ACTIVITIES Annual Report**

Sep. 1991 114 p

(DE92-000518; DOE/ER-0511P) Avail: NTIS HC/MF A06

As a component of the Department of Energy, the Energy Biosciences (EB) program of the Office of Basic Energy Sciences supports long-term research aimed at addressing energy-related problems utilizing biological systems. There are three main components of the EB program. The first, Primary Biological Energy Conversion, concentrates on research on plant and microbial photosynthesis, but also deals with plant growth control, stress reactions, and interaction with pathogens. The second, Bioconversion of Products, concentrates on utilization of the products of primary energy conversion. Specific examples include biosynthesis of potential fuels or chemicals, biodegradation of lignocellulose into potentially useful compounds, plant/microbe symbiosis, microbial methanogenesis and fermentation. The third main component of the EB program involves providing the basic research infrastructure to support future discoveries. The emphasis here is on investigation of basic genetic mechanisms, both in novel systems and extensively studied systems such as maize; development of critical databases, techniques, and instrumentation; and support of training in areas that are important but underpopulated. Brief descriptions of currently supported research projects are provided. DOE

**N92-13083#** Joint Publications Research Service, Arlington, VA.  
**RESULTS FROM PLANT GROWTH EXPERIMENTS ABOARD ORBITAL STATIONS**

A. VOLKOV, S. KRIKALEV, and G. NECHITAYLO *In its* JPRS Report: Science and Technology. USSR: Space p 28-29 30 Jul. 1990 Transl. into ENGLISH from Pravda, Moscow (USSR), 22 Oct. 1989 p 3

Avail: NTIS HC/MF A04

A general description of research involving plant growth experiments aboard U.S.S.R. orbital space stations is given. Weightlessness effects, gravitational effects, and the plant development cycle in relation to life support systems are briefly discussed. The development of a new polymer material, polyacrylamide gel, is described. Other experiments with animal and plant tissues are described. Author

**N92-13546#** Oak Ridge National Lab., TN.  
**LUMINESCENCE AND RAMAN SPECTROSCOPY FOR BIOLOGICAL ANALYSIS**

VO-DINN TUAN 14 Jun. 1990 5 p

(Contract DE-AC05-84OR-21400)

(DE90-013225; ORNL/FTR-3646) Avail: NTIS HC/MF A01

The traveler was invited to present a seminar on Immunofluorescence and Raman Fiberoptic Chemical Sensors, at the Laboratory FOCAL of CEN-FAR, France. The traveler visited the CEN-FAR laboratories involved in laser-based spectroscopy and remote monitors and conducted scientific discussions with research staff at CEN-FAR. The traveler was also invited to present an invited lecture on Advances in Luminescence and Raman Spectroscopy for Chemical and Biological Analysis, at the Laboratory of Molecular Photophysics and Photochemistry, University of Bordeaux, Talence, France. The traveler visited the laboratories involved in the development of luminescence techniques for the analysis of polyaromatic pollutants and related biomarkers. The traveler conducted discussions on potential research collaboration with scientists at the University of Bordeaux. The traveler was awarded a North Atlantic Treaty Organization (NATO) Collaborative Grant to conduct joint research with Professor P. Viallet, head of the Laboratory of Quantitative Microfluorimetry, University of Perpignan. The traveler was involved in experimental luminescence studies of bioindicators of polyaromatic pollutants (DNA adducts, metabolites). DOE

**N92-13547#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

**NEUROLOGICAL, PSYCHIATRIC AND PSYCHOLOGICAL ASPECTS OF AEROSPACE MEDICINE**

Sep. 1991 80 p Course held in Pensacola, FL, 18-20 Oct.

1989, in Brussels, Belgium, 25-27 Oct. 1989, and in Ankara, Turkey, 30 Oct. - 1 Nov. 1989

(AGARD-AG-324; ISBN-92-835-0631-6) Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

An overview of the neurological, psychiatric, and psychological aspects of aerospace medicine is presented. The purpose is to further the knowledge of the flight surgeon and aeromedical examiner in the issues of neuropsychiatry. Aeromedical information is provided for the neuropsychiatric specialist. The unique application of psychiatry, psychology, and neurology to the aviation environment is described. Topics such as motivation to fly, human performance, stress in aviation, and the failing aviator are discussed. Further psychiatric and neurologic disorders found among aviators are presented. The unique aspects of assessment and decision making about flying status among neuropsychiatric cases are presented. The concepts and information currently available in aeromedical neuropsychiatry are summarized.

**N92-13567#** National Aeronautics and Space Administration, Washington, DC.

**SPACE LIFE SCIENCES: PROGRAMS AND PROJECTS**

Apr. 1989 20 p Original contains color illustrations

(NASA-TM-105459; NAS 1.15:105459) Avail: NTIS HC/MF A03; 18 functional color pages CSCL 06K

NASA space life science activities are outlined. Brief, general descriptions are given of research in the areas of biomedical research, space biology, closed loop life support systems, exobiology, and biospherics. Author

**N92-13568#** Tennessee Univ., Memphis. Dept. of Anatomy and Neurobiology.

**CHANGES IN SOMATOSENSORY RESPONSIVENESS IN BEHAVING MONKEYS AND HUMAN SUB Final Technical Report, 1 Jul. 1988 - 30 Jun. 1991**

RANDALL J. NELSON 30 Aug. 1991 24 p

(Contract AF-AFOSR-0179-88; AF PROJ. 2312)

(AD-A241559) Avail: NTIS HC/MF A03 CSCL 05/8

Two sets of goals were accomplished. (1) Neurophysiological studies were conducted that indicated that sensory input to primary somatosensory (SI) cortical neurons is gated during behavior. This occurs in some regions of SI but not in others. Quantitative estimates of this gating under different behavioral circumstances are provided. Equations are described which predict the magnitude of the premovement activity during vibratory triggered trails from the vibratory responsiveness of the neurons and the amount of premovement activity exhibit in visually cued trails. (2) In psychophysical studies, reaction times (RTs) of monkeys and human subjects were determined for ballistic or targeted wrist flexion and extension movement made in response to visual and vibratory go-cues. The RT experiments indicated that humans and monkeys make ballistic movements more quickly (50-100 msec) in response to vibratory as compared to visual signals. Human subjects also make movements more quickly to a visual target if, in addition to target presentation, a vibratory cue is also given. The psychophysical studies suggest that there is a performance benefit in using tactile in addition to visual cues to control behavior. GRA

**N92-13672#** Arizona State Univ., Tempe. Center for the Study of Early Events in Photosynthesis.

**PHOTOSYNTHETIC REACTION CENTER COMPLEXES FROM HELIOBACTERIA Abstract Only**

J. T. TROST, W. F. J. VERMAAS, and R. E. BLANKENSHIP *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 118 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Photosynthetic reaction centers are pigment-protein complexes that are responsible for the transduction of light energy into chemical energy. Considerable evidence indicates that photosynthetic organisms were present very early in the evolution of life on Earth. The goal of this project is to understand the early evolutionary development of photosynthesis by examining the

properties of reaction centers isolated from certain contemporary organisms that appear to contain the simplest photosynthetic reaction centers. The major focus is on the family of newly discovered strictly anaerobic photosynthetic organisms that are grouped with the gram-positive phylum of bacteria. The properties of these reactions centers suggest that they may be the descendants of an ancestor that also gave rise to Photosystem 1 found in oxygen-evolving photosynthetic organisms. Photoactive reaction center-core antenna complexes were isolated from the photosynthetic bacteria, *Heliobacillus mobilis* and *Heliobacterium gestii*, by extraction of membranes with Deriphat 160C followed by differential centrifugation and sucrose density gradient centrifugation. Other aspects of this investigation are briefly discussed.

Author

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## AEROSPACE MEDICINE

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

## A92-15951

**OXYHEMOGLOBIN SATURATION FOLLOWING RAPID DECOMPRESSION TO 18,288 M PRECEDED BY DILUTED OXYGEN BREATHING**

F. BUICK and J. A. G. PORLIER (Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1119-1126. refs

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This investigation studied oxyhemoglobin saturation (SaO<sub>2</sub>) and cardiovascular indices after rapid decompression (RD). Before RD, fractional inspired O<sub>2</sub> concentration (FIO<sub>2</sub>) simulated the range of product gas from molecular sieve O<sub>2</sub> generating systems (MSOGS). Four subjects breathed 1.0-0.80 FIO<sub>2</sub> at 6858 m. After decompression to 18,288 m, the subject received 1.0 FIO<sub>2</sub> at a positive pressure of 70 mm Hg for 3 min. There were no incidents of severe hypoxia. The mean SaO<sub>2</sub> was 98.0 percent before RD. After RD, SaO<sub>2</sub> was maintained at the pre-RD level for 8 s, decreased rapidly over the next 10 s, and over the rest of the 1st min decreased more gradually to reach approximately 82 percent. Varying FIO<sub>2</sub> before RD had no effect on the alteration in SaO<sub>2</sub>, heart rate, stroke index, and blood pressure after RD. The MSOGS O<sub>2</sub> product range offers adequate protection against hypoxia during RD to 18,288 m.

Author

## A92-15952

**HORMONAL RESPONSES OF PILOTS FLYING HIGH-PERFORMANCE AIRCRAFT DURING SEVEN REPETITIVE FLIGHT MISSIONS**

H. TARUI and A. NAKAMURA (Japan Air Self Defense Force, Aeromedical Laboratory, Tokyo) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1127-1131. refs

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Hormonal responses during seven repetitive flight missions (7RFM) were evaluated on F-4EJ fighter pilots. The following biochemical constituents were measured: (1) cortisol in saliva; (2) 17-OHCS; (3) unbound cortisol; (4) catecholamines in urine; and (5) electrolytes in urine. Samples were collected at about 30 min before the mission, 20 min after each flight, and in a nonflight day for control. The levels of saliva and urine corticosteroids slightly increased during 7RFM when compared with controls. The concentrations of urine catecholamines during 7RFM were significantly higher than those of preflight and control. These data suggest that flight stresses were moderate for the pilots flying 7RFM.

Author

## A92-15953

**EFFECT OF THE PRELAUNCH POSITION ON THE CARDIOVASCULAR RESPONSE TO STANDING**

ROBERT W. GOTSHALL (Wright State University, Dayton, OH; Colorado State University, Fort Collins), SEI YUMIKURA, and LAURIE A. ATEN (Wright State University, Dayton, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1132-1136. refs

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The effect of the prelaunch position on the cardiovascular responses (including heart rate, blood pressure, and cardiac output) to standing were investigated in men and women subjected to the stand test before and after spending 2 hrs in the reclined seated position (prelaunch position, PL), seated position (SIT), or seated immersed to the neck in water (WI). It was found that, while the SIT position did not alter the cardiovascular response to standing, the PL and WI positions resulted in increases in heart rate after 2 h in the position, although only by 4 to 7 beats/min; the increase was the same for PL and WI. There were no differences due to gender.

I.S.

## A92-15956

**EFFECTS OF LONG DURATION SPACEFLIGHT ON HUMAN T LYMPHOCYTE AND MONOCYTE ACTIVITY**

SERGE MANIE, IRINA KONSTANTINOVA, JEAN-PHILIPPE BREITMAYER, BERNARD FERRUA (Nice, Universite, France; Institut Mediko-Biologicheskikh Problem, Moscow, USSR), and LAURENCE SCHAFFAR (Nice, Universite; Toulouse III, Universite, France; Institut Mediko-Biologicheskikh Problem, Moscow, USSR) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1153-1158. refs

(Contract CNES-89-1263)

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Experiments were performed on blood samples from 5 cosmonauts in order to investigate the effects of long duration spaceflight (26 to 166 days) on immune activity. The experiments were performed on cultured mononuclear cells purified from blood samples collected during the preflight period and 24 h after landing. The production of interleukin 2, which is the major cytokine involved in T lymphocyte proliferation, was found to be enhanced after flight in some individuals, whereas the ability of mitogen-stimulated cells to express interleukin 2 receptor was impaired 24 h after flight for two cosmonauts out of five. Normal interleukin 2 receptor expression was obtained in all cases when lymphocytes were directly activated by a protein kinase C activating phorbol ester. On the other hand, no significant changes were observed in interleukin 1 production by cultured peripheral blood mononuclear cells. Lastly, the distribution of T lymphocyte subsets was examined in peripheral blood sampled 24 h after landing and was found to be within normal values.

Author

## A92-15959

**SPINAL X-RAY SCREENING OF HIGH PERFORMANCE FIGHTER PILOTS**

HARALD T. ANDERSEN (Royal Norwegian Air Force, Institute of Aviation Medicine, Oslo, Norway), ANTHONY S. WAGSTAFF (Occupational Health Service Department, Oslo, Norway), and HARALD U. SVERDRUP (Municipal Acute Health Services Department, Oslo, Norway) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1171-1173. refs

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Neck pain and neck injury are common complaints among military aviators flying high performance (HPF) aircraft. Since all candidates for military flying training with the Royal Norwegian Air Force have to meet HPF medical standards, medical selection procedures include a radiological examination of the spine. Nine films of the vertebral column are made with emphasis put on cervical structures. Among 232 applicants, 527 deviations from normal conditions were described (anomalies, degenerative changes and deviations of posture) which average 2.27 diagnoses per spine X-rayed. Of the candidates, 80 were considered entirely within normal limits; 20 were rejected due to the roentgen findings;

and five candidates were excluded on final evaluation, their radiological diagnoses contributing to the decision. Although most changes are slight, many significant conditions are demonstrated among young healthy individuals. Since the population is highly selected, the figures presented may be minimum numbers in a western industrialized society. Author

**A92-15960****ESTIMATE OF REQUIREMENTS FOR DETECTION AND TREATMENT OF HYPERCHOLESTEROLEMIA IN U.S. ARMY AVIATORS**

THOMAS J. BURKE (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1174-1179. refs  
Copyright

**A92-15961****DECOMPRESSION SICKNESS - U.S. NAVY ALTITUDE CHAMBER EXPERIENCE 1 OCTOBER 1981 TO 30 SEPTEMBER 1988**

ROBERT BASON and D. YACAVONE (U.S. Navy, Naval Safety Center, Norfolk, VA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1180-1184. refs  
Copyright

This study reports the incidence of decompression sickness (DCS) occurring in U.S. Navy altitude chambers in association with physiological training of aircrews for the 7-year period from 1 October 1981 to 30 September 1988. There were 140 total cases of DCS in 136,696 chamber exposures, an incidence of 0.10 percent. Among trainees, there were 78 cases in 111,674 exposures, and incidence of 0.07 percent. Among inside observers, there were 62 cases in 25,022 exposures and incidence of 0.25 percent. The incidence of DCS among inside observers was reduced almost two-fold over the last Navy report and is the lowest reported since 1973. Reasons for the reduction are discussed. In addition, analysis of the data includes types of DCS, symptoms, frequency of joint involvement, predisposing factors, altitude and time of onset of DCS, and treatment tables employed. Author

**A92-15963****A COMPARISON OF FLIGHT AND NON-FLIGHT SICK CALL VISITS TO A U.S. ARMY AVIATION MEDICINE CLINIC**

DANIEL T. FITZPATRICK (U.S. Army, Rucker, AL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1189-1191. refs  
Copyright

**A92-16090\*** Georgia State Univ., Atlanta.**CEREBRAL SPECIALIZATION**

ROBIN D. MORRIS, WILLIAM D. HOPKINS, and DUANE M. RUMBAUGH (Georgia State University, Atlanta) IN: Encyclopedia of human biology. Vol. 2. Orlando, FL, Academic Press, Inc., 1991, p. 351-355. refs  
(Contract NAG2-438; NIH-RR-00165; NIH-HD-06016)  
Copyright

The concept of greater performance efficiency for certain mental abilities or processes in one cerebral hemisphere rather than the other is referred to as 'cerebral lateralization'. The experimental paradigm for lateralization research involves the study of patients with one damaged hemisphere, which prevents their performance of a certain task or function; this approach, however, presents many difficulties in extrapolating to brain function in normal patients. Attention is presently given to gender differences in lateralization, cerebral asymmetries in other species, and the evolutionary bases of hemispheric specialization. O.C.

**A92-16401****THE FLIGHTDECK ENVIRONMENT AND PILOT HEALTH**

ALAN H. ROSCOE (Britannia Airways, Ltd., Luton, England) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 46-55. refs  
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The possible effects of various environmental factors presented

in the flightdeck at altitude on pilot health are reviewed. Problems discussed include ultraviolet radiation, ionizing radiation, ozone, air quality, low humidity, and the blue light hazard. O.G.

**A92-16402****THE ROLE OF SUNLIGHT IN THE AETIOLOGY OF MALIGNANT MELANOMA IN AIRLINE PILOTS**

B. L. DIFFEY (Dryburn Hospital, Durham, England) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 56-58. refs  
Copyright

The evidence linking sunlight exposure as an aetiological factor in cutaneous malignant melanoma is reviewed. Airline pilots have approximately a threefold risk of developing melanoma than expected from national rates. It is suggested that their lifestyle involving intermittent recreational sunbathing in hot countries could be an important risk factor. Author

**A92-16403****THE WEIGHTLESS EXPERIENCE**

JOHN F. PADDAY (Kodak, Ltd., Research Div., Harrow, England) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 59-76.  
Copyright

Consideration is given to parabolic flight by a scientist to conduct experiments in short duration microgravity aboard aircraft where weightlessness is achieved for about 20 sec. The preparation, planning, and performance of these parabolic flights are discussed with emphasis placed on the physiological and psychological aspects of the activity. Parabolic flying by the scientist is considered to be a means to acquiring scientific data and technology by enabling him to perform and observe his experiments at first hand. O.G.

**A92-16404****ACUPUNCTURE TREATMENT OF AEROTITIS MEDIA IN AVIATORS**

ZHEN-MING TIAN (Air Force, General Hospital, Beijing, People's Republic of China) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 77-80. refs  
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Aerotitis media occurs frequently amongst flyers. 140 cases have been treated with acupuncture with satisfactory results. The acupuncture points selected were: Ermen, Tinggong, Tinghui, and Yifeng around the ear (local points) and Hegu, Zhongzhu, Yemen, and Waiguan on the hand (distant points along the corresponding meridian). Each day, two points, one local one distant were selected for acupuncture treatment. The patients were needed once a day or every other day with the needle retained for 10 to 20 minutes for acute or chronic aerotitis media respectively. 77.9 percent of patients improved. The mechanism of treatment is explained by traditional Chinese medicine theory. Author

**A92-16405****NON-INVASIVE DETECTION OF SILENT MYOCARDIAL ISCHEMIA - A BAYESIAN APPROACH**

PER ARVA (Civil Aviation Administration, Oslo, Norway), C. MULLER, and O. MULLER (Oslo City Hospital, Norway) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 81-85. refs  
Copyright

The yearly incidence of silent ischemia have been calculated in the Norwegian pilot population by means of clinical history, clinical examination and exercise-ECG. Pilots who had abnormal findings on exercise-ECG were referred for thallium myocardial scintigraphy and radionuclide ventriculography. The risk of coronary artery disease was calculated by using Bayes theorem of conditional probability. It is concluded that noninvasive criteria for silent ischemia are infrequently observed in Norwegian pilots. When an exercise-ECG shows abnormal changes noninvasive tests provide useful diagnostic information. Conditional probability analysis has proved to be helpful in the aeromedical decision making procedure. Author

A92-16406

**CARDIOLOGICAL ASPECTS OF PILOT'S FITNESS TO FLY**

R. MAIRE, S. IKRAM, and L. KAPPENBERGER (Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 86-90. refs

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The most common causes of sudden incapacitation leading to accidents in aviation are of cardiovascular nature. Hence, cardiovascular aspects of the medical examination have to be considered carefully when assessing a pilot's fitness to fly. In this brief overview the commonest cardiological problems are considered in respect of their potential for sudden incapacitation. Some guidelines are suggested to distinguish the more serious of these problems which may justify withholding a pilot's license, from the trivial ones carrying a minor risk. Author

A92-16407

**LOW BACK PAIN IN PILOTS OF VARIOUS AIRCRAFT - A COMPARATIVE STUDY**

PAUL FROOM, RON HANEGBI, IGAL SHOCHAT, ARNON TAMIR, and JOSEPH RIBAK (Israel Aeromedical Center, Ramat Gan) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 91-94. refs

Copyright

A questionnaire on low back pain (LBP) was administered to 233 fighter pilots, 74 helicopter pilots, and 60 age matched ground personnel. Pain during flight was significantly greater in helicopter pilots and in those who fly the A4 compared to other pilot groups and controls. Pilots who fly the Bell 212 had significantly more pain during flight than those pilots who fly the CH53 helicopter. The prevalence of LBP temporally unrelated to flight was similar in the various pilot groups and in the ground personnel. In addition the prevalence of LBP temporally unrelated to flight did not increase with increased flight time. This suggests that flying the various aircraft did not lead to any cumulative symptomatic damage to the lower back. Author

A92-16408

**EEG AS SCREENING METHOD IN AEROMEDICAL SELECTION OF AIR CREW**

CLAUS CURDT-CHRISTIANSEN Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 95-98. refs

Copyright

Results of a survey on EEG as a screening tool in aeromedical aircrew selection are briefly reviewed. Particular attention is given to the relation between EEG findings in 282 pilots and air crashes due to pilot error, and to the relation between incidence of crashes/episodes of unconsciousness and paroxysmal/non-paroxysmal EEG findings. O.G.

A92-16409

**RADIATION EXPOSURE OF AIRCREW**

K. B. SHAW (National Radiological Protection Board, Didcot, England) Aviation Medicine Quarterly (ISSN 0951-3949), vol. 111, no. 2, 1991, p. 99-102. refs

Copyright

The International Commission on Radiological Protection recommends that cosmic-ray exposure of crew in jet aircraft should be part of occupational exposure. The Commission's recommendations also include lower occupational dose limits and changes in neutron dosimetry. Radiological surveillance of aircrew is considered in the light of these new recommendations. Doses to crew members can be calculated using data on dose rates together with information on flying hours, altitudes, and routes. Individual radiation monitors are unlikely to be required but aircraft could carry an in-flight monitor to provide confidence in the prediction of worker exposure. Author

N92-12402# Midwest Research Inst., Golden, CO.

**IMMUNOLOGICAL AND BIOCHEMICAL EFFECTS OF 60 HZ ELECTRIC AND MAGNETIC FIELDS IN HUMANS**

CHARLES GRAHAM and SOPHIA S. FOTOPOULOS 1990

5 p

(Contract DE-FC01-84CE-76246)

(DE90-012546; DOE/CE-76246/T5) Avail: NTIS HC/MF A01

In order to meet rising energy demands, utility companies have increased both the number and the voltages employed in their overhead power transmission lines. Public concern has been expressed about possible risks to human health and function arising from the resulting increase in exposure to the electric and magnetic fields generated by such line. The present project is addressing these concerns by conducting a comprehensive research program to evaluate the effects of relevant electric and magnetic field exposure conditions on multiple measures of human function. This project is being conducted in two phases. Phase 1 was performed in cooperation with the New York State Department of Health (NYS DH). Its purpose was to collect and analyze biochemical data from human subjects participating in the first comprehensive double-blind study of the effects of, exposure to combined 60 Hz electric and magnetic fields. Phase 2 is designed to accomplish three major tasks: perform additional statistical analysis of the data collected in the double-blind study; develop procedures to measure human physiology in active 60 Hz fields under double-blind control conditions; and conduct a study to validate the physiological measurement procedures, and to partially replicate the findings of the previous study. DOE

N92-12403# Midwest Research Inst., Kansas City, MO.

**IMMUNOLOGICAL AND BIOCHEMICAL EFFECTS OF 60 HZ ELECTRIC AND MAGNETIC FIELDS IN HUMANS**

SOPHIA S. FOTOPOULOS and CHARLES GRAHAM 1990

20 p

(Contract DE-FC01-84CE-76246)

(DE90-012547; DOE/CE-76246/T6) Avail: NTIS HC/MF A03

Demand for electric energy increased at an annual average rate of 7.5 pct. between 1912 and 1971. In order to meet this demand, utility companies have increased the number and size of their generating units and the operating voltages employed in overhead transmission lines. Recently public concern has been expressed about possible risks to human health, function, and well-being arising from exposure to the electric and magnetic fields associated with overhead transmission line voltage. The Department of Energy funded the present project to investigate the effects of 60-Hz electric and magnetic fields on critically important immunological, biochemical, and hematological variables. Inclusion of such variables will be of great value in assessing the effects of 60-Hz fields on human health and welfare, and will provide results comparable to ongoing animal studies. The scope of this project includes six major goals: development of systems for incorporating biochemistry, hematology, and immunology data collection into the procedures already developed for the performance and physiology study funded by the New York State Overhead Power Lines Project; development of sample tracking and quality assurance procedures for project data; methods development and setting up of all procedures for performing assays; collecting data; carrying out assays according to the procedures defined; and statistically evaluating and interpreting the effects of 60-Hz exposure on hematological, biochemical, and immunological parameters. DOE

N92-12404\* National Aeronautics and Space Administration, Washington, DC.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 354)**

Oct. 1991 86 p

(NASA-SP-7011(354); NAS 1.21:7011(354)) Avail: NTIS HC A05; NTIS standing order as PB91-912300, \$15.00 domestic, \$30.00 foreign CSDL 06E

This bibliography lists 225 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during September, 1991. 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

**N92-12405#** Ecole Nationale Supérieure des  
Telecommunications, Paris (France). Groupe Images.

**MATHEMATICAL MORPHOLOGY AND ACTIVE CONTOUR  
MODEL: A COOPERATIVE APPROACH OF LUNG CONTOURS  
IN CT**

FRANCOISE PRETEUX and Y. HEL-OR (Hebrew Univ., Jerusalem,  
Israel) Mar. 1991 10 p Presented at the Computer Assisted  
Radiology, Berlin, Fed. Republic of Germany, 3-6 Jul. 1991  
Submitted for publication  
(TELECOM-PARIS-91-C-004; ISSN-0751-1337; ETN-91-90118)  
Copyright Avail: NTIS HC/MF A02

An energy formulation for solving the problem of lung contour  
detection based on mathematical morphology and active contour  
models is proposed. The novelty of this contribution is to express  
the external energy functional as a combination of conditional  
gradient and atomical a priori knowledge expressed in terms of  
distance functions. The aspect of sensitivity to the initialization  
step is overcome by combining expanding and shrinking  
deformation processes. It results in an automatic and parameter  
independent algorithm yielding the lungs' contours under either of  
three following complex cases: overinflated, close together, or with  
hyperattenuated areas located close to the peripheral pleura.

ESA

**N92-12406#** Ecole Nationale Supérieure des  
Telecommunications, Paris (France).

**THREE DIMENSIONAL RECONSTRUCTION OF VASCULAR  
NETWORKS IN TRINOCULAR VISION Ph.D. Thesis  
[RECONSTRUCTION TRIDIMENSIONNELLE DE RESEAUX  
VASCULAIRES EN VISION TRINOCULAIRE]**

CHRISTOPHE VENAILLE 1990 169 p In FRENCH; ENGLISH  
summary  
(TELECOM-PARIS-90-E-022; ISSN-0751-1353; ETN-91-90119)  
Copyright Avail: NTIS HC/MF A08

An algorithm for three dimensional reconstruction of vascular  
networks requiring only three projections of the network is  
described. The methodology of the technique is based on work  
carried out on artificial vision and especially computer stereovision.  
A bibliography of work carried out on vascular imagery and three  
dimensional vision is presented. The correspondence algorithm  
proposed uses primitive curved branches, total cooperation  
between the three images used and an overall management of  
the network overlaps by means of a combined optimization  
algorithm. The medical applications of the technique are  
discussed.

ESA

**N92-12407#** Technische Univ., Berlin (Germany, F.R.).  
Fachbereich Informatik.

**PATTERN RECOGNITION IN BIOSIGNALS. APPLICATION TO  
THE SIGMA SPINDLES IN SLEEP  
ELECTROENCEPHALOGRAMS Ph.D. Thesis  
[MUSTERERKENNUNG IN BIOSIGNALEN ANWENDUNG AUF  
DIE SIGMA-SPINDELN IM  
SCHLAF-ELEKTROENZEPHALOGRAMM]**

JUTTA GAMPE 1991 104 p In GERMAN  
(ETN-91-90166) Avail: NTIS HC/MF A06

A great quantity of data can be obtained from a sleep derivation  
of several hours. Sigma spindles are electroencephalogram  
patterns, which are to be found essentially in number two sleep  
stage and which are of particular importance for the analysis of  
sleep microstructures, with regard to their diagnostical and  
pharmacological significance. A process for automatic spindle  
recognition is realized by adaptive segmentation of the  
electroencephalogram signal and classification of segments  
produced on the basis of a learning sampling tests. This process  
enables a flexible analysis of spindles to be found.

ESA

**N92-12408#** Center for Mathematics and Computer Science,  
Amsterdam (Netherlands). Dept. of Analysis, Algebra and  
Geometry.

**CARDIAC MAGNETIC RESONANCE IMAGING BY  
RETROSPECTIVE GATING: MATHEMATICAL MODELLING  
AND RECONSTRUCTION ALGORITHMS**

J. B. T. M. ROERDINK and M. ZWAAN Dec. 1990 47 p  
Sponsored by Netherlands Organization for the Advancement of  
Research

(CWI-AM-R9024; ETN-91-90223) Copyright Avail: NTIS HC/MF  
A03

Some mathematical aspects of Magnetic Resonance Imaging  
(MRI) of the beating human heart are considered. In particular  
the so called retrospective gating technique which is a nontriggered  
technique for data acquisition and reconstruction of (approximately)  
periodically changing organs like the heart is investigated. The  
reconstruction problem is formulated as a moment problem in a  
Hilbert space and the solution method is given. The stability of  
the solution is investigated and various error estimates are given.  
The reconstruction method consists of temporal interpolation  
followed by spatial Fourier inversion. Different choices for the  
Hilbert space H of interpolating functions are possible. In particular,  
the case where H is the space of bandlimited functions, or the  
space of spline functions of odd degree is studied. The theory is  
applied to reconstructions from synthetic data as well as real MRI  
data.

ESA

**N92-12409#** Brookhaven National Lab., Upton, NY.  
**WHEN IS A DOSE NOT A DOSE?**

V. P. BOND 1991 34 p Presented at the National Council on  
Radiation Protection and Measurements (NCRP) Annual Meeting,  
Washington, DC, 2-3 Apr. 1991  
(Contract DE-AC02-76CH-00016)  
(DE92-000132; BNL-46568; CONF-9104298-1) Avail: NTIS  
HC/MF A03

Although an enormous amount of progress has been made in  
the fields of radiation protection and risk assessment, a number  
of significant problems remain. The one problem which transcends  
all the rest, and which has been subject to considerable  
misunderstanding, involves what has come to be known as the  
linear non-threshold hypothesis, or linear hypothesis. Particularly  
troublesome has been the interpretation that any amount of  
radiation can cause an increase in the excess incidence of cancer.  
The linear hypothesis has dominated radiation protection  
philosophy for more than three decades, with enormous financial,  
societal and political impacts and has engendered an almost morbid  
fear of low-level exposure to ionizing radiation in large segments  
of the population. This document presents a different interpretation  
of the linear hypothesis. The basis for this view lies in the evolution  
of dose-response functions, particularly with respect to their use  
initially in the context of early acute effects, and then for the late  
effects, carcinogenesis and mutagenesis.

DOE

**N92-12410#** Argonne National Lab., IL. Biological and Medical  
Research Div.

**HISTORY OF THE DETERMINATION OF RADIUM IN MAN  
SINCE 1915**

J. RUNDO 1991 27 p Presented at the International Workshop  
on Radium, Uranium, Thorium and Related Nuclides in Industry  
and Medicine: History and Current Use, Badgastein, Austria, 1-3  
Oct. 1991  
(Contract W-31-109-ENG-38)  
(DE92-000355; ANL/CP-74386; CONF-911011-1) Avail: NTIS  
HC/MF A03

The determination of radium in man can be traced back to  
experiments in 1915 when volunteers were injected with, or  
ingested, solutions of a radium salt, and the excreta were analyzed  
for radium. However, the first direct demonstrations of the presence  
of radium in vivo years after exposure were reported in 1925 by  
Martland et al. A few years later, Schlundt et al. repeated Martland's  
types of measurements with a Wulf-Hess electroscope, in an  
attempt to be quantitative. Data on the excretion rate of radium  
were published by Schlundt and Failla in 1931. The results of an  
investigation by the US Public Health Service of the health aspects  
of radium dial painting were published in three papers in 1933. In  
the second of these, Ives et al. reported results for 40 subjects  
who showed gamma-ray results of 1 micro-g radium (i.e., retained  
radon) or more. There was a major improvement in sensitivity in  
1937 when Evans described the use of a Geiger-Mueller detector

and the metre-arc geometry. Ten years later, Hess and McNiff published details of an ionization chamber method that did permit such levels to be determined. In the early 1950s, three groups described the first equipments for the assay of radioactivity in the human body that could detect the radiation from the naturally radioactive potassium content. In 1955, the introduction by Marinelli et al. of the sodium iodide crystal as gamma-ray detector revolutionized the assay of radium (and all other gamma-ray emitters) in vivo. These factors have all contributed to a steady decrease in the lower limit of detection of radium in man that was roughly exponential from 1929 to the mid-1950s with a half-period of a little over 3 years. DOE

**N92-12411#** Oak Ridge National Lab., TN. Health and Safety Research Div.

**NUCLEAR MEDICINE PROGRAM Quarterly Progress Report, 30 Jun. 1991**

F. F. KNAPP, JR., K. R. AMBROSE, A. P. CALLAHAN, D. W. MCPHERSON, S. MIRZADEH, P. C. SRIVASTAVA, A. HASAN, C. R. LAMBERT, S. J. LAMBERT, and D. E. RICE Sep. 1991 20 p

(Contract DE-AC05-84OR-21400)

(DE92-000383; ORNL/TM-11881) Avail: NTIS HC/MF A03

In this report the excitation functions for production of Ga-66 via alpha-induced nuclear reactions on enriched Zn-66 have been measured with E(sub alpha) less than or equal to 27.3 MeV and E(sub alpha) less than or equal to 43.7 MeV employing the stack thin-target technique. In addition, the induced activity of Ga-67 in the same sets of targets allowed an evaluation of the excitation functions of the corresponding nuclear reactions. These preliminary studies have demonstrated that sufficient levels of Ga-66 can be produced by alpha-induced reactions on enriched Zn targets. A series of radiiodinated analogues of 1-azabicyclo (2.2.2) oct-3-yl alpha-hydroxy-alpha, alpha diphenylacetate (QNB) have been prepared. These new analogues include 1-azabicyclo (2.2.2) oct-3yl alpha-hydroxy-alpha (4-iodophenyl)-alpha-methylacetate(2,1-QNA), 1-azabicyclo (2.2.2) oct-3-yl (3-iodo) xanthene-9-carboxylate (3,1-QNX), and 1-azabicyclo (2.2.2) oct-3-yl alpha-hydroxy-alpha (E-1-iodo-1-propen-3-yl) alpha-phenylacetate (4,1-QNP), which have also been radiolabeled with I-125 with high specific activity. The biodistribution, brain uptake, and receptor specificity of these new analogues are currently being studied. Shipments of radioactive agents made to collaborators during this period included: One shipment of 1-125-labeled 15-(p-iodophenyl) 3-R, S-methylpentadecanoic acid (BMIPP) and W-188/Re-188 generator. DOE

**N92-12412\*** National Aeronautics and Space Administration, Washington, DC.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 355)**

Nov. 1991 59 p

(NASA-SP-7011(355); NAS 1.21:7011(355)) Avail: NTIS HC A03; NTIS standing order as PB91-912300, \$15.00 domestic, \$30.00 foreign CSCL 06E

This bibliography lists 147 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during October, 1991. 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

**N92-13549#** School of Aerospace Medicine, Brooks AFB, TX.

**INTRODUCTION TO AEROSPACE NEUROLOGY**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991

Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The bottom line in aerospace neurology is the evaluation for the: (1) potential of sudden incapacitation, e.g., post traumatic seizures; (2) possibility of a sudden neurological deficit which would

prevent the aircrew member from performing their job and thereby affect mission completion, flight or personal safety, e.g., neurologic deficits with headaches; and (3) risk of any neurologic or neuropsychological deficit which would persist after the initial injury, e.g., post traumatic syndrome. Reasonable criteria for making an aeromedical decision in specific neurological syndromes are presented, and some work up guidelines are established. Areas of controversy are identified, and the aeromedical issues involved are raised. Author

**N92-13553#** School of Aerospace Medicine, Brooks AFB, TX.

**UNEXPLAINED LOSS OF CONSCIOUSNESS**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991

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The unexplained loss of consciousness in aircraft crews is discussed, with emphasis on diagnosis. The several reasons for loss of consciousness are surveyed. The evaluation of unexplained loss of consciousness requires a detailed history from the subject and eye witnesses, and evaluation of vital signs and a physical and neurological examination, along with both detailed cardiovascular and neurological workups. Author

**N92-13560#** School of Aerospace Medicine, Brooks AFB, TX.

**SEQUELAE OF HEAD INJURY**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991

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Closed head injury is discussed. The Aeromedical questions, after closed head injury, can be divided into three categories: (1) the risk of permanent neurological deficit; (2) the risk of sudden incapacitation; and (3) transient neurologic and neuro-psychological deficits. Author

**N92-13562#** School of Aerospace Medicine, Brooks AFB, TX.

**SELECTED CONCERNS/EXCESSIVE DAYTIME SLEEPINESS**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991

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A retrospective study was performed involving all patients referred for the diagnosis of excessive daytime sleepiness between 1958 and 1987. A review of the literature was also performed, and the findings were compared with those reported from United States Sleep Laboratories. The evaluation of sleep disorders and the growth of sleep medicine are discussed. Author

**N92-13563#** School of Aerospace Medicine, Brooks AFB, TX.

**MULTIPLE SCLEROSIS AND OPTIC NEURITIS**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 10 p Sep. 1991

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The literature review of the relationship of optic neuritis (ON) in multiple sclerosis (MS) is presented. It is our goal to review the world's literature to: (1) see what subpopulation of ON was identified to be at high risk for MS; (2) present a standard for working up and diagnosing MS; and (3) suggest a policy or establish research guidelines for handling ON in the aircrew population. In addition, we reviewed the cases of ON and MS evaluated at USAFSAM over the past 15 years to look for the patterns and effects on retention and flight safety. Author

**N92-13564#** School of Aerospace Medicine, Brooks AFB, TX.

**HEADACHE**

MARC S. KATCHEN *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991

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Headaches of some type were reported to occur in up to 70 percent of the population of the United States at some point in

their lifetime. Vascular headaches are reported in up to 20 percent of this population. Our task is to properly classify the headache, discover any triggers or unique circumstances of the headache and decide if it is aeromedically significant. Author

**N92-13565#** School of Aerospace Medicine, Brooks AFB, TX. Aerospace Clinical Psychology Function.

**MISHAP AFTERCARE**

JOHN C. PATTERSON *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991  
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Of primary concern after a mishap are physical and somatic matters. Secondly, however, evidence is mounting that emotional and psychological adjustments to a mishap can be very important to various categories of victims who may be involved in a mishap. Relatively simple and straightforward psychological mishap aftercare principles are available and were tested in a variety of disaster scenarios. Victim identification and intervention are key concepts in mishap psychological aftercare. Author

**N92-13569#** Texas Univ. Health Science Center, San Antonio.

**BRAINMAP: A DATABASE OF FUNCTIONAL NEUROANATOMY DERIVED FROM HUMAN BRAIN IMAGES**

26 Aug. 1991 24 p  
(Contract N00014-91-J-1903)

(AD-A241263) Avail: NTIS HC/MF A03 CSCL 12/5

The goal of the BrainMap project is to promote efficient compilation, analysis, and dissemination of the rapidly growing body of information about the functional organization of the human brain which can be provided by medical imaging techniques such as PET and MRI. We have developed highly quantitative image analysis tools for PET which provide spatial localization of brain function in a standardized spatial frame (AC-PC reference frame). Database strategies have been developed to specifically address the needs of brain mapping. Most of our efforts during this quarter were devoted to the Macintosh version of BrainMap. Software development is proceeding in a timely fashion, and at present we see no major problems with completing this portion of the project on time. GRA

**N92-13570#** Wright State Univ., Dayton, OH.

**PHYSIOLOGIC EVALUATION OF THE L1/M1 ANTI-G**

**STRAINING MANEUVER Final Report, Sep. 1988 - Sep. 1989**

ROGER M. GLASER, BERTRAM EZENNA, and STEPHEN POPPER Dec. 1990 15 p  
(Contract AF PROJ. 7231)

(AD-A241293; AAMRL-TR-90-083) Avail: NTIS HC/MF A03 CSCL 14/2

The primary objective of this investigation was to test the use of a relatively simple (non-invasive) system to enable continuous monitoring of human muscle performance and reserve capability, as well as prediction of physical competence during repetitive execution of the L1/M1 anti-G straining maneuver (AGSM). Ten healthy volunteers tested this system while seated in a special mockup of an F-16 pilot seat. They were instructed to perform repetitive AGSM's, each at their maximal force capability. By comparing the initial force output and electromyograph magnitudes with subsequent values, an index of muscle fatigue and reserve capability can be derived. Both Fo and EMG were found able to predict physical competence for performing AGSM's. Some subjects perceived their Fo to be maintained at the original maximum voluntary contraction (MVC) level due to their maximal effort contractions. However, it was clearly seen that Fo progressively deteriorated with muscle fatigue. GRA

**N92-13571#** Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.

**CIVILIAN TRAINING IN HIGH-ALTITUDE FLIGHT**

**PHYSIOLOGY Final Report, 1 Jan. - 31 Mar. 1991**

JOHN W. TURNER and STEPHEN HUNTLEY, JR. Aug. 1991 50 p

(AD-A241296; DTS-45) Avail: NTIS HC/MF A03 CSCL 06/5

A survey was conducted to determine if training in high-altitude physiology should be required for civilian pilots; what the current status of such training was; and, if required, what should be included in an ideal curriculum. The survey included a review of ASRS and NTSB accidents/incidents where high altitude was a contributing factor, current FARs, the Airman's Information Manual, and military training courses. In addition, representatives of pilot and flight attendant unions, airlines, airframe manufacturers, the armed services, NBAA, AOPA, flight schools, and universities were interviewed. And, an expert in the field was identified and asked to write a discussion paper for inclusion in the report. The survey determined that there is a need for such training. It was also found that current training practices are not uniform and sometimes do not even address those subjects required by Federal Aviation Regulations. GRA

**N92-13572#** Naval Aerospace Medical Research Lab., Pensacola, FL.

**BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS 1978-1990**

K. S. MAYER Sep. 1991 38 p  
(AD-A241297) Avail: NTIS HC/MF A03 CSCL 05/2

This publication lists citations of all unclassified research reports, special reports, monographs, joint reports, journal articles, and proceedings that were published by the Naval Aerospace Medical Laboratory during calendar years 1978 through 1990. GRA

**N92-13573#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Armstrong Lab.

**REAL-EAR ATTENUATION TESTING SYSTEM (RATS) Final Report, Dec. 1989 - Dec. 1990**

NANCY K. ALLEN Jan. 1991 55 p  
(AD-A241475; AL-TR-1991-0073) Avail: NTIS HC/MF A04 CSCL 06/5

Air Force personnel are often exposed to high levels of noise. One of the hazards of working in an intense noise environment is the risk of hearing impairment. To minimize the adverse effects of high noise levels, the Air Force has set policies outlined in AF Regulation 161-35, Hazardous Noise Exposure (1), to implement a hearing conservation and monitoring program for personnel working in hazardous noise environments. There are three methods of protecting individuals from hazardous noise: providing engineering controls, administrative controls, and hearing protectors. Engineering controls provide noise control measures in the design of buildings, facilities, and weapon systems. When engineering controls are not feasible or do not provide the complete solution, administrative controls can be implemented to limit the work time in the noise environment. GRA

**N92-13574#** Army Research Inst. of Environmental Medicine, Natick, MA.

**VOLUNTARY CONSUMPTION OF A LIQUID CARBOHYDRATE SUPPLEMENT BY SPECIAL OPERATIONS FORCES DURING A HIGH ALTITUDE COLD WEATHER FIELD TRAINING EXERCISE Final Report, 19 Mar. 1989 - 1 Sep. 1990**

T. E. JONES, R. W. HOYT, C. J. BAKER, C. B. HINTLIAN, and P. S. WALCZAK 1 Sep. 1990 123 p  
(AD-A241769; USARIEM-T20-90) Avail: NTIS HC/MF A06 CSCL 06/8

A six day field test was conducted to measure the energy expenditures, activity levels and nutrient intakes of unsupported soldiers consuming the Ration, Lightweight (RLW) with a liquid carbohydrate (CHO) supplement during a strenuous field training exercise at high altitude. Ten soldiers (+/- SD; age 32 +/- 5yrs, wt 81.2 +/- 9.7 kg, and body fat 18.9 +/- 8.3 percent) were required to consume the RLW and a liquid CHO supplement exclusively for six days. Body comparison measurements (anthropometry and hydrostatic weighing), activity levels (ambulatory monitors), food and water intakes (log book technique), and ration acceptability (post study questionnaire) were recorded. Mean caloric intake for the six day study was 2467 +/- 384 kcal/day (12 percent protein, 34 percent fat and 54 percent CHO). Mean energy expenditure using the intake/balance method was 4294 +/- 1276 kcal/day. Body weight loss averaged 1.7 +/- 7

kg with 35 percent from fat free mass and 65 percent from fat mass. Total fluid intake was 3.6 L/day. Carbohydrate intakes from the RLW and CHO supplement were 229 +/- 55(916 kcal/day) and 103 +/- 44 g/day (412 kcal/day), respectively. GRA

**N92-13575#** Army Research Inst. of Environmental Medicine, Natick, MA.

**THE USE OF HYPOXIC AND CARBON DIOXIDE SENSITIVITY TESTS TO PREDICT THE INCIDENCE AND SEVERITY OF ACUTE MOUNTAIN SICKNESS IN SOLDIERS EXPOSED TO AN ELEVATION OF 3800 METERS Final Report, Apr. - Aug. 1990**

CHARLES S. FULCO, LAURIE A. TRAD, VINCENT A. FORTE, JR., JULIO GONZALEZ, and EUGENE J. IWANYK 20 Feb. 1991 32 p  
(AD-A241792; USARIEM-T7-91) Avail: NTIS HC/MF A03  
CSCL 06/5

Acute mountain sickness (AMS) is characterized by headache, nausea, and dizziness with individual differences occurring susceptibility. At any altitude, there will be individuals who will show little or no symptoms while others will be severely incapacitated. Previous studies have shown that individuals with no symptoms of AMS tend to ventilate more than those who develop severe symptoms. The main objective of this study was to determine if susceptibility to AMS can be predicted from ventilatory responses to breathing hypoxic and carbon dioxide gas mixtures for 7 to 10 minutes prior to an altitude exposure. Another objective was to determine if there was a difference between cigarette smokers and nonsmokers in susceptibility. Forty-seven soldiers (25 smokers and 22 nonsmokers) performed an isocapnic hypoxic ventilatory response (HVR) test and a hypercapnic ventilatory response (HCVR) test at Ft. Riley, KS (450 m) prior to being deployed to the Santa Lucia Base Camp, Potosi Bolivia (3500 to 4050 m). AMS symptoms were assessed in Bolivia by the self-administered Environmental Symptoms Questionnaire during the first two days of exposure. GRA

## 53

## BEHAVIORAL SCIENCES

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

**A92-13837**

**HUMAN RESOURCE MANAGEMENT IN AVIATION**

ERIC FARMER, ED. (RAF, Institute of Aviation Medicine, Farnborough, England) Aldershot, England and Brookfield, VT, Avebury Technical, 1991, 205 p. For individual items see A92-13838 to A92-13849.

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The present conference on human-resource management in aviation encompasses the fields of selection and training of pilot candidates, the use and effects of incorporating simulation into pilot training, and issues related to the operation of aircraft. Specific issues addressed include a validation study of a pilot-selection process, a system for selecting ab initio pilot candidates, the use of computer-aided testing, psychological testing in aviation, the Defense Mechanism Test, the simulation of obstacle avoidance, and the simulation of cognitive load in a two-man helicopter. Also addressed are a microcomputer flight-decision simulator, the effectiveness of providing a pilot with two sources of information, a no-smoking trial for chartered flights, a flight-training program, and a conceptualization of aviation psychology on the civil flight deck. C.C.S.

**A92-13838**

**A VALIDATION STUDY OF THE QANTAS PILOT SELECTION PROCESS**

GREG STEAD (Saville & Holdsworth Pty., Ltd., Balmain, Australia)

IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 3-18.

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The selection process for pilot recruitment is evaluated in terms of individual components of the procedure including a coordinator/skills tester and personality testing. The original test process included a flight check and a B747 simulation, and subsequent additions are described including tests of ability, critical reasoning, and personality, and the Pilot Aptitude and Skills Tester (PAT). Emphasizing the psychological assessments, the elements of the selection process are evaluated in terms of the performance of selected pilots. Examinations of the results in simulator and flight training show that the PAT combined with psychological testing can effectively predict pilot performance. Psychological data are found to be of significant value in selecting pilots that can perform optimally in commercial aircraft. C.C.S.

**A92-13839**

**SELECTION OF AB INITIO PILOT CANDIDATES - THE SAS SYSTEM**

HANS GORDON (Scandinavian Institute of Aviation Psychology, Stockholm, Sweden) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 19-27.

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The pilot-evaluation system used by SAS airlines is described with attention given to the required number of initial candidates and the drop-out rate associated with each selection step. Traditional and standardized testing procedures are combined with psychometric and psychotechnical tests, and the predicted outcome is given by participating psychologists. The process of ab initio pilot selection is detailed in terms of steps including: (1) written tests for screening; (2) psychological personality testing via interview; (3) a second psychological test to back up the first; and (4) a week-long precourse in which the ability to learn new data and adapt to the SAS environment are assessed. A primary conclusion of the program is that 299 candidates are required for the first screening procedure to insure 20 ab initio pilots. C.C.S.

**A92-13840**

**DLR SELECTION OF AIR TRAFFIC CONTROL APPLICANTS - PREDICTIVE VALIDITY**

HINNERK EISSFELDT (DLR, Hamburg, Federal Republic of Germany) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 37-44. refs

Copyright

The German selection process for air traffic control (ATC) personnel is based on methods developed for ab initio pilot selection, and its effectiveness for predicting ATC performance is assessed. Operational skills are evaluated, but the focus of the testing is multimodal evaluation of interpersonal behavior and emotional stability. The data are based on biographical data and performance and personality tests that are examined for psychometric quality criteria for measurement reliability and predictive validity. Five training criteria are compared to 20 unweighted test results for 201 ATC applicants, and the results of the discriminant analysis suggest that training success can be predicted better for the theoretical phases than for the practical periods. The multiple-correlation coefficient shows that the level of the final grade can be predicted by the test battery to a high degree of accuracy. C.C.S.

**A92-13841**

**THE DEFENCE MECHANISM TEST AND SUCCESS IN FLYING TRAINING**

MENNO HARSVELD (Royal Netherlands Air Force, The Hague) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 51-65. refs

Copyright

A test is described and evaluated which is designed to identify negative influences on the quality of flight performance, and the results are found to be inconclusive. The Defense Mechanism

Test (DMT) is a projective technique designed to identify misinterpretations of various stimuli by the pilot trainees that signal dangerous tendencies. A maximum of 22 stimulus exposures are provided to the trainees, and the trainee responses are reduced to a behavioral report. Cross-tabulation and Chi-square statistics are employed to evaluate the reliability of the data and the continuous measure, and the results show that the data are poor measures of flight-trainee potentials. Instruments that characterize traits and behavioral tendencies which have solid foundation in psychological theory are therefore found to be poor predictors of behavior in applied settings. C.C.S.

**A92-13842****PSYCHOLOGICAL TESTING IN AVIATION - AN OVERVIEW**

PAUL KLINE (Exeter, University, England) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 75-79. refs  
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Testing procedures in the field are discussed in terms of the psychometric models used, the choice of variables and tests, and gaging by means of factor loading. Also addressed are the specific problems of selection for personality and motivation testing including the objective treatment of projective tests and the problems of the Defense Mechanism Test. The testing procedures in the aviation field are based on logical concepts and are to varying degrees effective, but more powerful tools are required to improve predictive success. C.C.S.

**A92-13846****SELECTION BY FLIGHT SIMULATION - EFFECTS OF ANXIETY ON PERFORMANCE**

PETER G. A. M. JORNA and R. T. B. VISSER (TNO, Institute for Perception, Soesterberg, Netherlands) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 123-136. refs  
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Situational anxiety can be produced by task demands during the flight simulations employed to test training pilots, and the consequences of such anxious states are examined with respect to pilot selection. The occurrence of anxiety is evaluated in pilot-candidate subjects using two dependent measures including the state anxiety inventory and the 'tension' subscale of a mood-state profile. The occurrence of anxiety and its effects on high- and low-anxiety subjects in terms of simulation performance is examined by considering instructor ratings and objective flight-control measures. Heading and altitude are maintained regardless of state anxiety, although aileron is affected; the removal of feedback also causes a differential response in the subjects increasing the level of anxiety. Objective performance indicators show that the performance of low state-anxious subjects is better than that of high state-anxious subjects, although instructor ratings tend to favor the more state-anxious candidates. C.C.S.

**A92-13847****ATTITUDES TOWARDS A NO SMOKING TRIAL ON MOD CHARTERED FLIGHTS**

SUSAN E. DALE, PADDY G. C. TAPSFIELD (Ministry of Defence, London, England), and JAMES L. WILBOURN (USAF, Military Training Center, Lackland AFB, TX) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 149-155.  
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An increase in complaints about smoking on charter flights led to a trial smoking ban on flights between the UK and Germany or Gibraltar. The trial ran initially for six months, beginning May 1988, but was later extended to 31 March 1989. To gauge passenger opinion, a questionnaire was administered to all 1648 passengers on the trial services during July 1988. The questionnaire was designed to investigate three topics: (1) attitudes toward the ban; (2) opinions as to the effectiveness of various strategies that could be employed in an attempt to reduce nonsmoker discomfort; and (3) smoking habits of passengers. This paper reports the major

findings of the survey and considers implications for passenger comfort and safety. Briefly, 67.7 percent agreed with the smoking ban, including a large minority (35.7 percent) of smokers. Author

**A92-13848****AN INTEGRATED PRIVATE AND INSTRUMENT PILOT FLIGHT TRAINING PROGRAMME IN A UNIVERSITY**

HENRY L. TAYLOR, ROBERT H. KAISER, SYBIL PHILLIPS, RICKY A. WEINBERG, and OMER BENN (Illinois, University, Savoy) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 157-175. refs  
Copyright

A comparison of several flight-instruction techniques is conducted with groups of pilots using integrated contact/instrument training, accelerated instrument flight training, and traditional training methods. The groups of students are given the Instrument Rating Practical Test, and the control group using the traditional method is given a standard test. The two experimental groups are found to have similar test scores, and all three groups are then tested in terms of VOR and ADF navigation and VOR/DME and NDB approach. It is shown that the integrated contact/instrument flight training program is effective when instrument procedures are emphasized early in the program. The integrated contact/instrument group is not significantly different from the accelerated instrument group, however, which is attributed to the sequence of training. C.C.S.

**A92-13849****A CONCEPTUALIZATION OF AVIATION PSYCHOLOGY ON THE CIVIL FLIGHT DECK**

JOHN B. LONG (University College, London, England) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 177-189. refs  
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Conceptions for human-factors engineering and human-computer interaction form the basis for a conceptual interpretation of aviation psychology for the commercial transport flight deck. The flight deck and the air crew are considered as an interactive worksystem for aircraft that supports transportation services. The requirements for a conceptualization of the interactive worksystem are set forth with attention given to supporting data and hypotheses from aviation psychology studies. The conceptualization is applied to aviation concerns including the relationship between efficiency and well-being, functionality, and usability. The conceptualization is of a general nature and can be applied to other areas of work and to other worksystems. C.C.S.

**A92-14047****TRANSFER OF SIMULATED INSTRUMENT TRAINING TO INSTRUMENT AND CONTACT FLIGHT**

MARK G. PFEIFFER, JEFFREY D. HOREY, and STEVEN K. BUTRIMAS (U.S. Navy, Naval Training Systems Center, Orlando, FL) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 3, 1991, p. 219-229. refs  
Copyright

Consideration is given to the transfer of simulated instrument training from Device 2F101, the operational flight trainer for the T-2C aircraft, as well as to actual instrument and contact flight for level speed change and standard-rate turn maneuvers. Trainees were randomly assigned to one of three training levels and to one of two aircraft flight conditions following training (contact or basic instruments) in a counterbalanced sequence. It is found that there is a significant and equal transfer of instrument training to contact and instrument flight for the maneuvers selected. Training mix for aircraft or simulator training trial was found to have no effect on student performance after eight trials. O.G.

**A92-14049****ATTITUDE CHANGES IN NAVY/MARINE FLIGHT INSTRUCTORS FOLLOWING AN AIRCREW COORDINATION TRAINING COURSE**

ROBERT A. ALKOV and JOHN A. GAYNOR (U.S. Navy, Naval Safety Center, Norfolk, VA) International Journal of Aviation

Psychology (ISSN 1050-8414), vol. 1, no. 3, 1991, p. 245-253. refs

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In an attempt to reduce the number of aircrew-caused aircraft mishaps in naval aviation, a trial aircrew training program was initiated in Navy and Marine Corps aviation training squadrons. Considerable resistance to change was encountered at the outset. The attitudes of flight instructors who were trained to teach the course were surveyed before and after the instructor training using Helmreich's (1984) Cockpit Management Attitudes Questionnaire modified for use by naval aviators. Shifts in attitudes following training were measured using a one-tailed Wilcoxon signed rank test. Significant shifts in the expected direction were detected. The implications of these attitudinal shifts are discussed. Author

**A92-14050\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**PERCEPTUAL STYLE AND TRACKING PERFORMANCE**

PAUL ATCHLEY (NASA, Ames Research Center, Moffett Field, CA) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 3, 1991, p. 255-259. refs

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The relationship between perceptual style and tracking of a target was examined. Four pilots were given the Embedded Figures Test to assess their degrees of field dependence or independence. Then they flew in a helicopter simulator and attempted to track an airborne target. A high negative correlation was found between perceptual style and tracking performance. Field-independent subjects were able to track the target for longer periods than field-dependent subjects. Author

**A92-14434**

**ENHANCED TRAINING TO REDUCE PILOT ERROR ACCIDENTS**

RICHARD J. ADAMS (Advanced Aviation Concepts, Inc., Jupiter, FL) and RICHARD A. WEISS (FAA, Office of Safety Oversight, Washington, DC) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1467-1474. refs

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The paper addresses the historical problem that a very high percentage of helicopter accidents are related to 'pilot error'. Through extensive research since 1977, the Federal Aviation Administration determined that the predominant underlying cause of these types of accidents involved decisional problems. To attack these problems, Aeronautical Decision Making (ADM) training materials were developed and tested for ten years. Since the publication of the ADM training manuals in 1987, significant reductions in helicopter human error accidents have been documented both in the U.S. and worldwide. However, shortcomings have been observed in the use of these materials for recurrency training and in their relevance to more experienced pilots. The discussion defines the differences between expert and novice decision makers from a cognitive-information-processing perspective, provides training and accident scenarios which exemplify those differences and proposes pilot-training innovations designed to expedite the development of expert-decision-making skills. Author

**A92-14989**

**VISUAL PERCEPTION OF INFRARED IMAGERY**

JEFFREY S. SANDERS, MICHAEL S. CURRIN, and CARL E. HALFORD (Memphis State University, TN) Optical Engineering (ISSN 0091-3286), vol. 30, Nov. 1991, p. 1674-1681. refs

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The visual threshold criteria for the psychophysical tasks of identification (ID) and identification friend or foe (IFF) for use with infrared imaging systems are presented, including the previously unused approach of signal detection theory (SDT) for determining visual thresholds for the Johnson task of identification. The results are also interpreted using the standard high-threshold theory methods and the two methods are compared. The original task of identification friend or foe is presented and compared to the

standard identification task. The experiment presented used a much larger set of stimuli than other reported contemporary experiments and the effects of set size are discussed. Author

**A92-15958**

**BRIEF REACTIVE PSYCHOSIS IN NAVAL AVIATION**

JAMES C. BAGGETT (U.S. Navy, Naval Aerospace Medical Institute, Pensacola, FL), DENNIS E. DEAKINS, and BRUCE K. BOHNER Aviation, Space, and Environmental Medicine (ISSN 0095-6562); vol. 62, Dec. 1991, p. 1166-1170. refs

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Five naval aviation personnel diagnosed with brief reactive psychosis have appeared before the Special Board of Flight Surgeons at the Naval Aerospace Medical Institute. These cases demonstrate the challenges in diagnosis and disposition that face the clinical aeromedical specialist in evaluating the aviator who develops psychiatric symptoms. The paper discusses the aeromedical factors that must be considered when contemplating returning aviators with psychiatric diagnoses to flying duties. Sudden behavioral changes in aviation personnel require a systematic assessment, thorough documentation, and continuing reevaluation. The differentiation between organic and functional etiologies may be difficult. Final disposition may require consultation with experienced physicians skilled in both aviation psychiatry and neurology. Author

**A92-15962**

**FLIGHT PSYCHOLOGY AT SHEPPARD AIR FORCE BASE**

RAYMOND E. KING (USAF, Sheppard AFB; USAF, Armstrong Aerospace Medical Research Laboratory, Brooks AFB, TX) and G. KRESS LOCHRIDGE (USAF, Sheppard AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 62, Dec. 1991, p. 1185-1188. refs

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Flight psychology is the application of psychological principles to the unique environment of the aviator in order to enhance training, flight safety, and mission accomplishment. At Sheppard Air Force Base, Texas, flight psychology is a cooperative effort between a clinical psychologist and the aeromedical services, with the former acting as a consultant to the latter. The primary focus of the flight psychology program is stress management, including managing the stress response of airsickness, for students in the Euro-NATO Joint Jet Pilot Training program. Psychological assessments of flying personnel, air traffic controllers, and individuals being considered for special duties constitute a valuable contribution to aeromedical services. This paper presents clinical vignettes to illustrate the interaction of the flight psychologist and aeromedical services, and the effect on flying training and flight safety. Author

**A92-16075**

**TRAINING TRANSFER - CAN WE TRUST FLIGHT SIMULATION?: PROCEEDINGS OF THE CONFERENCE, LONDON, ENGLAND, NOV. 13, 1991**

Conference sponsored by Royal Aeronautical Society. London, Royal Aeronautical Society, 1991, 103 p. No individual items are abstracted in this volume.

Copyright

The present conference on the use of flight simulations to train pilots encompasses issues regarding the transfer of skills learned in the simulation setting to other situations including in-flight training and performance. Papers are presented on training transfer which address the question of quality, the efficacy of simulation results, the use of simulators in pilot selection, the evaluation of a part-task trainer for ab initio pilot training, the lack of evidence regarding the value of air-combat simulation, and the use of zero-time flight training. Also addressed are rotary-wing simulator transfer of training in aviation skills acquisition and sustainment, transfer of training and quasitransfer of scene detail and visual augmentation guidance in landing training, an informational perspective on skill transfer in flight training, and use of the simulator in Qantas cockpit resource-management training.

C.C.S.

**N92-12413#** Technische Univ., Eindhoven (Netherlands).  
**PERCEIVED SHARPNESS IN STATIC AND MOVING IMAGES**  
 Ph.D. Thesis

JOANNE HENRIETTE DES WESTERINK 1991 129 p Prepared in cooperation with Institute for Perception Research, Eindhoven, Netherlands  
 (ETN-91-90138) Avail: NTIS HC/MF A07

The perceptual impression made by complex images on their viewers is addressed. Effects are interpreted in relation to what is known about the human visual system wherever possible. A method of scaling is used. Experiments with slide projections as stimuli and variations of viewing distance, resolution and picture size are described. Results are interpreted in terms of consequence for high quality television systems such as high definition television. The influence of human visual acuity on subjective quality is investigated. The influence of image motion on the sharpness percept is examined for horizontal object velocities below approximately 6 degrees/s, and the findings are extended to a larger velocity range to examine possible effects of the distance covered on the screen by the object. ESA

**N92-12414#** Centre d'Etudes et de Recherches de Medecine  
 Aerospatiale, Paris (France). Lab. Central de Biologie  
 Aerospatiale.

**USE OF A STANDARDIZED TEST BATTERY FOR THE  
 EVALUATION OF PSYCHOMOTOR PERFORMANCES**

DIDIER LAGARDE, SYLVIANE PRADELLA, OLIVIER GAPENNE,  
 and DENISE BATEJAT Oct. 1990 66 p In FRENCH; ENGLISH  
 summary  
 (Contract DRET-89-1054)

(CERMA-90-44(LCBA); ETN-91-90105) Avail: NTIS HC/MF A04  
 The development of a common psychomotor performance testing strategy by all members of NATO is described. The standardized tests developed are devised such that results can be compared from one laboratory to the next. The seven tests involved in the psychomotor performance testing process are described in detail. Their specific use is outlined. The design of the software involved in the tests, and the choices made in implementing the software are discussed. ESA

**N92-13548#** Centre Medical de Psychologie Clinique de l'Armee  
 de l'Air, Paris (France).

**THE PILOT FLIGHT SURGEON BOND**

J. R. GALLE-TESSONNEAU *In* AGARD, Neurological, Psychiatric  
 and Psychological Aspects of Aerospace Medicine 5 p Sep.  
 1991  
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To become a physician it is necessary to learn medicine and to know diseases, but it is also necessary to have some notions about medicine psychology. To become a flight surgeon, it is necessary to know medicine and aeronautic medicine, but it is also necessary to have some notions about pilot psychology and pilot-flight surgeon relationships. Pilots are not ordinary patients; pilots present some particularities about health, diseases, medicine, and physicians. In the psychological cause, an initiation in theoretical notions and practical attitudes likely to clarify and make understandable phenomena which would otherwise risk appearing unintelligible is presented for the benefit of flight surgeons. As an introduction, three specific and important aspects in the psychology of a pilot are presented: his body, his motivation, and his environment. Author

**N92-13550#** Institute of Aviation Medicine, Oslo (Norway).

**AVIATION PSYCHOLOGY IN THE OPERATIONAL SETTING**

GRETE MYHRE *In* AGARD, Neurological, Psychiatric and  
 Psychological Aspects of Aerospace Medicine 4 p Sep. 1991  
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Being an aviation psychologist in a small airforce has its advantages, since one has to cover a wide spectrum of tasks, compared to the aviation psychologist in a large airforce who has to specialize in one or two fields. The main tasks of an aviation

psychologist are discussed and include the following: (1) teaching flying personnel aviation psychology; (2) acting as a consultant to the aviators on personal matters; (3) performing surveys on the flying personnel's social and working conditions; (4) assisting the flight surgeons on medical boards; (5) acting as a member on aviation accident boards where human factors are involved; and (6) acting as a consultant in an operational setting. Two case histories are discussed that involve fighter pilots who ejected from their aircraft. Author

**N92-13551#** Jones (David R.), San Antonio, TX.

**PSYCHIATRIC DISORDERS IN AEROSPACE MEDICINE:  
 SIGNS, SYMPTOMS, AND DISPOSITION**

DAVID R. JONES *In* AGARD, Neurological, Psychiatric and  
 Psychological Aspects of Aerospace Medicine 3 p Sep. 1991  
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The major categories of psychiatric diagnosis and how a few that are more commonly seen in aviators may affect flying duties are considered. Major psychotic disorders are always disqualifying, as are affective disorders, manic or depressive. Lesser depressive disorders may not be so, depending on the depth of symptoms, the reaction of the flyer, and his/her insight into the condition. Neurotic disorders may or may not require grounding, again depending on the degree of symptoms. Organic mental disorders are generally cause for permanent grounding, unless the cause is reversible and not likely to occur again (e.g., acute toxic reactions). Personality disorders are always troublesome, and are likely to be handled through administrative rather than medical channels. The general symptoms involved in these disorders are discussed in a later presentation. Psychiatric disorders are frequently underdiagnosed, both because operational personnel may not recognize these ailments for what they are and because of the tendency of some non-flying psychiatrists and psychologists to shield the flier from grounding by not accurately diagnosing what they see; by avoiding its proper name. This dangerous practice may allow possible dysfunctional fliers to fly, and deny them adequate treatment, specifically, medications. Author

**N92-13552#** Letterman Army Inst. of Research, San Francisco,  
 CA.

**PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE  
 AND AVIATION SAFETY, 1**

JAMES J. PICANO *In* AGARD, Neurological, Psychiatric and  
 Psychological Aspects of Aerospace Medicine 3 p Sep. 1991  
 Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests  
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Two major psychological factors which can adversely affect health, flight performance, and decision making in aviation personal are discussed: stress and hazardous thought patterns. A model for understanding stress and appraising its effects on human performance in aviation is presented. Understanding the effects of stress on health and performance is essential to designing and implementing proactive preventive programs aimed at promoting and preserving the health and welfare of pilots and enhancing aviation safety. Author

**N92-13554#** Letterman Army Inst. of Research, San Francisco,  
 CA.

**ASSESSING ADAPTABILITY FOR MILITARY AERONAUTICS**

JAMES J. PICANO *In* AGARD, Neurological, Psychiatric and  
 Psychological Aspects of Aerospace Medicine 3 p Sep. 1991  
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It is said that the most important sources of information regarding the potential adaptability of a pilot candidate is the flight surgeon's own response and impression regarding the individual. While this is a valid and important source of information, the flight surgeon must be careful not to rely on stereotyped or idiosyncratic ideas of what constitutes adaptability. As of yet, there is no convenient or accurate way of assessing adaptability for military aeronautics either psychometrically or by life history criteria. The information presented here serves as a guideline for the

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aeromedical examiner. If there is any doubt about the psychological suitability of an individual for military aeronautics, a consultation with a psychiatrist or psychologist familiar with aviation is recommended. Author

**N92-13555#** Institute of Aviation Medicine, Oslo (Norway).  
**DOMESTIC PROBLEMS AND AVIATOR FAMILY SUPPORT**  
GRETE MYHRE *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 3 p Sep. 1991  
Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The usefulness of wives' squadron groups in helping the wives of military pilots deal with their unique family situations is discussed. General psychology in relation to crisis situations is discussed, especially dealing with the feelings of grieving, loss, and mourning following an accident. Case studies are presented. Author

**N92-13556#** Centre Medical de Psychologie Clinique de l'Armee de l'Air, Paris (France).

### **FEAR OF FLYING**

J. R. GALLE-TESSONNEAU *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 6 p Sep. 1991

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When a flyer talks about his apprehension about flying, it becomes a source of concern for his fellow pilots and leaders. Clinical aspects of the fear of flying are reviewed. Clinical forms with predominantly somatic expressions, forms with anxious expression, and neuritic disorders after an accident are discussed. Predisposing factors, promoting factors, triggering factors and prognosis are covered, as well as treatment. Author

**N92-13557#** School of Aerospace Medicine, Brooks AFB, TX. Aerospace Clinical Psychology Function.

### **PSYCHOMETRIC EVALUATION TECHNIQUES IN AEROSPACE MEDICINE**

JOHN C. PATTERSON *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991  
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The role of psychometric evaluation techniques in aerospace medicine is discussed, with emphasis on the use of psychological evaluation in making the decision of whether a pilot should return to flying after an illness. Aspects of the clinical review and psychological testing are discussed. It is argued that psychological testing should result in relevant recommendations about flying status based on the examiner's experience and the specific evaluation of the aviator. Author

**N92-13558#** Letterman Army Inst. of Research, San Francisco, CA.

### **PSYCHOLOGICAL FACTORS INFLUENCING PERFORMANCE AND AVIATION SAFETY, 2**

JAMES J. PICANO *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991  
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The psychological status of the pilot as it relates to performance is discussed. Two constructs related to this issue are explored: pilot judgment and hazardous thought patterns. The five basic hazardous thought patterns of anti-authority, impulsiveness, invulnerability, macho, and resignation are seen as precursors to faulty judgment. The five hazardous thought patterns represent an interesting exploration into pilot-centered processes which may mediate between an event and a pilot's decision making outcome. These constructs are in need of further validation, but education about hazardous thought patterns and the individual's appraisal of his own decision making processes could be easily incorporated into an aviator's continuing aeromedical education and training. Author

**N92-13559#** Jones (David R.), San Antonio, TX.

### **PSYCHIATRIC REACTIONS TO COMMON MEDICATIONS**

DAVID R. JONES *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991  
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The somatic effects of most non-prescription medications that are available to pilots usually well-known to flight surgeons, but some of the effects on mental processes may not be as well understood. Some of these are reviewed. Trifluoperazine, diazepam, chlorthalidone, flurazepam, triazolam, and temazepam are discussed. Author

**N92-13561#** School of Aerospace Medicine, Brooks AFB, TX.  
**THE FAILING AVIATOR**

JOHN C. PATTERSON *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 2 p Sep. 1991  
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The purpose is to increase the awareness and alertness in those who work with aviators about the early signs and symptoms of failure. Solutions can start by addressing the failure process early, by providing training in these areas of psychological functioning as parenting and marriage communication, by changing the selection process to include not only competitiveness and achievement, but also openness to emotional experience, and finally by improving the relationship between mental health providers, flight surgeons, and aviators. Author

**N92-13566#** Jones (David R.), San Antonio, TX.

### **MEDICAL OR ADMINISTRATIVE? PERSONALITY DISORDERS AND MALADAPTIVE PERSONALITY TRAITS IN AEROSPACE MEDICAL PRACTICE**

DAVID R. JONES and JOHN C. PATTERSON (School of Aerospace Medicine, Brooks AFB, TX.) *In* AGARD, Neurological, Psychiatric and Psychological Aspects of Aerospace Medicine 4 p Sep. 1991 Submitted for publication

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Aeromedical/occupational decisions are hard enough to make when there is concrete evidence of disease, and they are even more difficult when the evidence consists of abstract symptoms rather than physical signs, as in the case of most psychiatric disorders. The behavior which is described concerns personality problems, which present as traits or as overt disorders. Author

**N92-13576\*#** Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.

### **ACQUISITION AND PRODUCTION OF SKILLED BEHAVIOR IN DYNAMIC DECISION-MAKING TASKS: MODELING STRATEGIC BEHAVIOR IN HUMAN-AUTOMATION INTERACTION: WHY AND AID CAN (AND SHOULD) GO UNUSED Semiannual Status Report**

ALEX KIRLIK Sep. 1991 35 p

(Contract NAG2-656; NAG2-195)

(NASA-CR-188962; NAS 1.26:188962; TR-91-5) Avail: NTIS HC/MF A03 CSCL 05/9

Advances in computer and control technology offer the opportunity for task-offload aiding in human-machine systems. A task-offload aid (e.g., an autopilot, an intelligent assistant) can be selectively engaged by the human operator to dynamically delegate tasks to an automated system. Successful design and performance prediction in such systems requires knowledge of the factors influencing the strategy the operator develops and uses for managing interaction with the task-offload aid. A model is presented that shows how such strategies can be predicted as a function of three task context properties (frequency and duration of secondary tasks and costs of delaying secondary tasks) and three aid design properties (aid engagement and disengagement times, aid performance relative to human performance). Sensitivity analysis indicates how each of these contextual and design factors affect the optimal aid usage strategy and attainable system performance. The model is applied to understanding

human-automation interaction in laboratory experiments on human supervisory control behavior. The laboratory task allowed subjects freedom to determine strategies for using an autopilot in a dynamic, multi-task environment. Modeling results suggested that many subjects may indeed have been acting appropriately by not using the autopilot in the way its designers intended. Although autopilot function was technically sound, this aid was not designed with due regard to the overall task context in which it was placed. These results demonstrate the need for additional research on how people may strategically manage their own resources, as well as those provided by automation, in an effort to keep workload and performance at acceptable levels. Author

**N92-13577#** Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

**UNALERTED AIR-TO-AIR VISUAL ACQUISITION**

J. W. ANDREWS 26 Nov. 1991 39 p  
(Contract DTFA01-85-Z-02015; F19628-90-C-0002)  
(ATC-152; DOT/FAA/PM-87/34) Avail: NTIS HC/MF A03

A series of flight tests were flown to measure pilot air-to-air visual acquisition performance for pilots employing unalerted visual search. Twenty-four general aviation subject pilots flew a cross-country route while an intercepting aircraft was controlled to produce three intercepts with altitude separation of 500 feet. Pilots received no traffic advisory information to alert them to the possible presence of the intercepting aircraft. Results were analyzed to estimate the instantaneous rate of visual acquisition that can be used to predict pilot performance under a range of conditions.

Author

**N92-13578#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

**SPATIAL DISORIENTATION RESEARCH ON THE DYNAMIC ENVIRONMENTAL SIMULATOR (DES) Final Report, Oct. 1988 - Dec. 1989**

WILLIAM B. ALBERY Oct. 1990 10 p  
(AD-A241203; AAMRL-SR-90-513) Avail: NTIS HC/MF A02  
CSCL 06/5

Spatial Disorientation (SD) is a serious human factors problem in both the Air Force and Navy. Over 70 Class A mishaps involving nearly total loss of an aircraft or death of the pilot have been attributed to SD in the U.S. Air Force alone since 1980. Many of these SD related fatalities involve low-level turning mishaps in which the pilot is moving his head and the aircraft is at greater than 1G. The G excess illusion, and altered perception of one's attitude when G 1, is a potential player in many of these low-level turning mishaps. The purpose of this study was to assess the potential of the Dynamic Environment Simulators, a 20 ft radius, dual-gimballed, human centrifuge to generate vestibular related SD illusions, especially, the G-excess illusion. GRA

**N92-13579#** Navy Personnel Research and Development Center, San Diego, CA.

**A COMPARISON OF FOUR TYPES OF FEEDBACK DURING COMPUTER-BASED TRAINING (CBT)**

MICHAEL COWEN Oct. 1991 60 p  
(AD-A241626; NPRDC-TR-92-2) Avail: NTIS HC/MF A04  
CSCL 12/5

Navy personnel often have difficulty operating the state-of-the-art programmable equipment employed in radar systems, communication systems, and transportation systems. These types of devices tend to be designed without adequate consideration of the user interface. Computer-based training (CBT) systems have been developed to help users overcome difficulties associated with learning how to operate complex devices. An important capability of CBT is feedback that informs users about the correctness of their knowledge of device procedures. Current research in CBT provides little guidance as to when feedback should be provided and how to design feedback content. An experimental CBT lesson on how to operate a military phone system was administered to 80 Navy students. The lesson was presented individually on a microcomputer and consisted of an introduction, a practice, and performance test. During practice, each treatment

group received one of four types of feedback. The computer provided feedback either immediately following an error or at the end of the button-pushing of the to-be-learned sequence. Feedback consisted of the correct response or a wrong indication. All the CBT treatment groups outperformed a no-treatment control group. The treatment group who received delayed feedback performed significantly better on the performance test than those who received immediate feedback. Delaying the feedback was beneficial during CBT because it aids in the development of a usable device schema. GRA

**N92-13580#** University of Southern California, Los Angeles. Dept. of Psychology.

**A BIOLOGICAL NEURAL NETWORK ANALYSIS OF LEARNING AND MEMORY Final Report, 1 Feb. 1988 - 31 Jan. 1991**

RICHARD F. THOMPSON 9 Oct. 1991 6 p  
(Contract N00014-88-K-0112)  
(AD-A241837) Avail: NTIS HC/MF A02 CSCL 05/8

The basic goal of our research program is to localize and analyze processes and mechanisms of memory formation, storage, and retrieval in the mammalian brain. We focus on associative learning and memory of elementary adaptive, skilled movements, using classical conditioning of discrete movement (e.g., eyeblink, limb flexion). In this contract period we have developed extensive evidence for the following: (1) using a tone conditioned stimulus (CS)- the CS pathway involves the pontine nuclei and their mossy fiber projections to the cerebellum, (2) the unconditioned stimulus (US) reinforcing pathway involves the dorsal accessory olive and its climbing fiber projections to the cerebellum, (3) the CR pathway projects from the interpositus nucleus of the cerebellum to the red nucleus, and (4) the memory trace appears to be formed in the cerebellum. Our computational/mathematical work involves a neural network model of the cerebellum and its associated brain stem circuitry, constrained by the biological properties of this neural system, and is increasingly successful in accounting for the properties of learning and memory of skilled movements. GRA

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### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

**A92-13801**

**MEASUREMENT OF THE RADIATION DOSE ON THE MIR STATION DURING SOLAR PROTON EVENTS IN SEPTEMBER-OCTOBER 1989 [IZMERENIE DOZY RADIATSII NA STANTSII 'MIR' VO VREMIA SOLNECHNYKH PROTONNYKH SOBYTII V SENTIABRE-OKTIABRE 1989 G.]**

L. V. TVERSKAIA, M. V. TEL'TSOV, and V. I. SHUMSHUROV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) *Geomagnetizm i Aeronomiia* (ISSN 0016-7940), vol. 31, Sept.-Oct. 1991, p. 928-930. In Russian. refs  
Copyright

An analysis is made of variations of the radiation dose of the Mir orbital station under exposure to solar cosmic rays during September-October 1989. It is shown that increases in the dose which represent a significant radiation hazard are associated with approach of the solar-proton penetration boundary toward the earth during strong magnetic disturbances. L.M.

**A92-13843**

**SIMULATING OBSTACLE AVOIDANCE CUES FOR LOW-LEVEL FLIGHT**

HELEN J. DUDFIELD (Royal Aerospace Establishment, Flight Systems Dept., Farnborough, England) IN: Human resource

management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 87-99. refs  
Copyright

An obstacle-cueing display for experienced aircrew is evaluated as a training tool for a part-task simulation of a typical flying task. The simulation facility uses an enhanced graphics workstation, and the aircrew fly a head-up display projected on the background with a course map presented on a head-down display. Pylons, power cables, radio masts, and bridges are cued as obstacles around waypoints in positions selected by the mission controller. Subjective evaluations and rms data are studied to determine how the obstacle-cueing display's parameters affect performance including display clutter and lag, symbology, and depth cueing. Results suggest that improvement is required in the areas of head-up display clutter, cue drift, and the accuracy of obstruction data. The obstacle-cueing system is found to provide sufficient information and reduce subjective workload, but enhancements of the display can improve its effectiveness. C.C.S.

**A92-13844**  
**ULTRA-CHEAP SIMULATION OF COGNITIVE LOAD IN A TWO-MAN HELICOPTER**

A. W. MACRAE and S. E. PATTISON (Birmingham, University, England) IN: Human resource management in aviation. Aldershot, England and Brookfield, VT, Avebury Technical, 1991, p. 101-105. Research supported by Westland Helicopters, Ltd.  
Copyright

A commercially available computer game is modified to simulate the cognitive demands of helicopter flight and is employed to examine the effects of spatial position on the crew. The games and verbal interactions between crew members are recorded and analyzed, and the results suggest that the verbal interactions are highly variable. A relationship is proposed between the verbal interactions and the occurrence of accidents which merits continued analysis. C.C.S.

**A92-14046\*** Illinois Univ., Savoy.  
**DISPLAY FORMATTING TECHNIQUES FOR IMPROVING SITUATION AWARENESS IN THE AIRCRAFT COCKPIT**

ANTHONY D. ANDRE, CHRISTOPHER D. WICKENS (Illinois, University, Savoy), LAURA MOORMAN (Eagle Technology, Inc., Dayton, OH), and MARIANNE M. BOSCHELLI (California State University, Northridge) International Journal of Aviation Psychology (ISSN 1050-8414), vol. 1, no. 3, 1991, p. 205-218. refs  
(Contract NAG2-308)  
Copyright

Possible modifications of primary flight instruments for attitude control and navigation were examined including a display perspective, frames of reference, and the incorporation of directional color to enhance visual momentum. A low-fidelity fixed-wing flight simulation was evaluated. It is concluded that situation awareness measured by flight performance and recovery from disorientation events, was best maintained with the planar outside-in display, whereas color coding improved the performance on the planar inside-out display. O.G.

**A92-14401**  
**DESIGN CONSIDERATIONS FOR A HELICOPTER HELMET-MOUNTED DISPLAY**

JAMES ELIA (Sikorsky Aircraft, Stratford, CT) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1047-1055.  
Copyright

Through the Army's Advanced Rotorcraft Technology Integration (ARTI), LH Risk Reduction, LH Risk Reduction Follow-on, and Demonstration/Validation (DEM/VAL) programs, several helmet-mounted display (HMD) design iterations were investigated to tailor the HMD design to the LH mission requirements. Several HMD systems were fabricated and tested, demonstrating a reduction in the overall level of development risk. This paper discusses the development of the HMD design concept for the LH aircraft as depicted in the design methodology and HMD requirements definition. The culmination of these design

efforts, the DEM/VAL HMD configuration, is presented with the rationale for design decisions which affected key performance characteristics, such as weight, center of gravity, field of view, eye relief, exit pupil, and resolution. Author

**A92-14430**  
**ARCHITECTURAL IMPACT OF BLENDING MACHINE INTELLIGENCE TECHNOLOGY WITH FULL SPECTRUM ROTORCRAFT OPERATIONS**

F. HUBER (IBM Corp., Owego, NY) and K. WROBLEWSKI (McDonnell Douglas Helicopter Co., Mesa, AZ) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1433-1436.  
Copyright

The U.S. Army Day/Night Adverse Weather Pilotage System (D/NAPS), a Rotorcraft Pilot's Associate (RPA) Advanced Technology Transition Demonstration Program, is developing an intelligent pilotage system which aids pilots in accomplishing these missions. The next step in the application of machine intelligence to the rotorcraft cockpit is to expand the scope of the D/NAPS cognitive decision aiding (CDA) system to include the offensive aspects of the mission. Developing an intelligent system to operate over such broad requirements can become too complex if not well planned. Joint research projects are investigating architectural design concepts to accomplish this integration. Author

**A92-14431**  
**INCREASING MISSION EFFECTIVENESS WITH AN INTELLIGENT PILOT-VEHICLE INTERFACE**

PATRICIA A. CASPER, SCOTT R. SMITH (Sikorsky Aircraft, Stratford, CT), HOWARD R. SMITH (United Technologies Research Center, East Hartford, CT), and BRUCE HUBANKS (Texas Instruments, Inc., Defense Systems and Electronics Group, Dallas) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1437-1442. refs  
Copyright

The application of artificial intelligence technology to single-pilot, day/night adverse weather combat helicopter operations is examined. A program, called D/NAPS (Day/Night Adverse weather Pilotage System), also involves the integration of available advanced technology pilotage sensors, and controls and displays to increase mission effectiveness and survivability. The D/NAPS program is focused on five expert system domains: mission planning, tactical planning, situation assessment, system status assessment, and pilot-vehicle interface (PVI). A sixth domain is the mission executive, which resolves conflicts and executes plans. These six domains are collectively referred to as the Cognitive Decision Aiding System. Unique PVI challenges presented by the D/NAPS mission are described. The attributes of an intelligent PVI are also discussed. Author

**A92-14432**  
**ADVANCED WORKLOAD ASSESSMENT TECHNIQUES FOR ENGINEERING FLIGHT SIMULATION**

JAMES F. GRENELL (Boeing Defense and Space Group, Helicopters Div., Philadelphia, PA), ARTHUR F. KRAMER, ERIK J. SIREVAAG, and CHRISTOPHER D. WICKENS (Illinois, University, Urbana) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1443-1454. refs  
Copyright

A series of experiments is conducted to examine operator workload in a high-fidelity simulation of an advanced rotorcraft cockpit. The experiments focused on the mental workload imposed by the type and magnitude of specific flight, communication, and navigation-related tasks. As part of this experimental effort, a multidimensional methodology for the assessment of operator workload employing a battery of subjective, performance, secondary task, and physiological measures was developed and applied. An overview of this methodology is given including data collection and analysis procedures. Lessons learned from this experience are also presented to provide guidance to future

simulation-based experimental efforts. A brief discussion of operator workload assessment is provided to enhanced the reader's understanding of the topic. Author

**A92-14433**

**COMPARISON OF SOM-LA AND ATB PROGRAMS FOR PREDICTION OF OCCUPANT MOTIONS IN ENERGY-ABSORBING SEATING SYSTEMS**

LINDLEY W. BARK and KEN-AN LOU (Simula, Inc., Phoenix, AZ) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1455-1465. refs  
Copyright

A stroking seat analysis capability was developed for the Articulated Total Body (ATB) model because of a need to analytically assess energy-absorbing seating and restraint system performance; and to account for forces imposed on an occupant when the occupant impacts aircraft structure and components within the flailing envelope. To develop initial confidence in the ATB model to represent stroking seat behavior, side-by-side comparisons between SOM-LA and ATB were conducted. SOM-LA was chosen for the comparison because it has been validated against experimental data and shown to be effective for prediction of dynamic responses of energy-absorbing seating systems and their occupants. In the comparisons, similar dynamic environments were imposed on similar models of a seat and occupant. The results of the comparisons indicated that the ATB stroking seat model yields results approaching those given by SOM-LA.

Author

**A92-14440**

**LH-EMBEDDED TRAINING - THE FIRST TEAM'S APPROACH**

WILLIAM E. HACKETT, JR., GEORGE M. STULB, JR. (Boeing Defense and Space Group, Philadelphia, PA), and ROBERT J. COLEMAN, JR. (Kollsman, Military Systems Div., Saint Petersburg, FL) IN: AHS, Annual Forum, 47th, Phoenix, AZ, May 6-8, 1991, Proceedings. Vol. 2. Alexandria, VA, American Helicopter Society, 1991, p. 1527-1538.

Copyright

The First Team approach to the Light Helicopter's (LH) embedded training (ET) objectives is presented. The approach provides capabilities for an on board simulation (OBS) and a multiple integrated laser engagement system/air to ground engagement system (MILES/AGES). It is concluded that the First Team approach achieves significant advances in the state of the art due to in-flight boresighting, collateral damage assessment, and realistic HELLFIRE missile simulation. These OBS and MILES/AGES systems substantially enhance the effectiveness of the LH weapon system through unique capabilities for individual, crew, team, and collective training. O.G.

**A92-14728**

**ROBOTIC ASSEMBLY OF TRUSS BEAMS FOR LARGE SPACE STRUCTURES**

ANTHONY P. COPPA (General Electric Co., Astro Space Div., Philadelphia, PA) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. refs  
(IAF PAPER 91-312) Copyright

The paper describes a robotic process and apparatus for constructing truss beams of square and equilateral triangular cross section within the context of the general Coppatruss erectable space structure system. The assembly system consists of: (1) a frame feeder (FF) which continuously feeds protoframes (the basic beam building block); (2) an IDSF feeder which feeds internal diagonal struts (IDS, required for square-section beams only); (3) a robot assembler (RA) which selects protoframes and IDSs from the FF and IDSF respectively and transfers and assembles them to the beam; and (4) a frame holding fixture (FHF) which fastens protoframes to the truss beam, holds the beams securely during construction, and advances it upon completion of the current beam bay. The construction of a square-section beam is described.

Author

**A92-14737**

**ON THE CONTROL OF A CLASS OF FLEXIBLE MANIPULATORS USING FEEDBACK LINEARIZATION APPROACH**

V. J. MODI, F. KARRAY, and J. K. CHAN (British Columbia, University, Vancouver, Canada) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 11 p. Research supported by Centers of Excellence Program. refs  
(Contract NSERC-A-2181)  
(IAF PAPER 91-324) Copyright

The paper studies nonlinear dynamics and control of the Space Station based mobile, flexible, two-linked manipulators accounting for elastic character of the joints. The governing highly nonlinear, nonautonomous and coupled equations of motion are described first followed by the modal discretization procedure. A parametric response study suggests situations with unacceptable levels of deflections and accelerations for certain proposed missions, as well as station libration and payload positioning errors. An inverse control technique is suggested to achieve high tracking accuracy of the MSS in presence of maneuver induced as well as other external and internal disturbances. The control strategy is so designed as to regulate the libration of the Space Station and to insure joints tracking of prescribed trajectories, while limiting the effect of the structural vibration during large slewing maneuvers of the MSS. Two different control schemes, both based on the feedback linearization technique, are developed and their relative merit assessed. Author

**A92-15025**

**CHARACTERISTICS OF SYSTEMS FOR THE ASSESSMENT AND REGULATION OF THE FUNCTIONAL WORK CAPACITY OF OPERATORS [OSOBENNSTI SISTEM OTSENKI I UPRAVLENIIA FUNKSIONAL'NYMI RABOCHIMI I SOSTOIANIAMI OPERATOROV]**

IU. P. GORGO (Kievskii Gosudarstvennyi Universitet, Kiev, Ukrainian SSR) Bionika (ISSN 0374-6569), no. 24, 1991, p. 105-108. In Russian. refs

Copyright

The problem of optimally correlating the human and the mechanical links of a man-machine system is examined, with special attention given to criteria used in assessing the state of the functional work-capacity of the operator, the methods for modeling psychoemotional and physical-work loads, and the methods for regulating these effects on operators. An information-input system is developed for obtaining accurate information related to the variations of functional work-capacity of an operator due to different psychoemotional and work-related factors. I.S.

**A92-15260\*** Howard Univ., Washington, DC.

**CENTRALIZED, DECENTRALIZED, AND INDEPENDENT CONTROL OF A FLEXIBLE MANIPULATOR ON A FLEXIBLE BASE**

FEIYUE LI, PETER M. BAINUM, and JIANKE XU (Howard University, Washington, DC) IAF, International Astronautical Congress, 42nd, Montreal, Canada, Oct. 5-11, 1991. 12 p. refs  
(Contract NSG-1414)  
(IAF PAPER 91-357) Copyright

The dynamics and control of a flexible manipulator arm with payload mass on a flexible base in space are considered. The controllers are provided by one torquer at the center of the base and one torquer at the connection joint of the robot and the base. The nonlinear dynamics of the system is modeled by applying the finite element method and Lagrangian formula. Three control strategies are considered and compared, i.e., centralized control, decentralized control, and independent control. All these control designs are based on the linear quadratic regulator theory. A mathematical decomposition is used in the decentralization process so that the coupling between the subsystems is weak, while a physical decomposition is used in the independent control design process. For both the decentralized and the independent controls, the stability of the overall linear system is checked before a numerical simulations is initiated. Two numerical examples show

that the response of the independent control system are close to those of the centralized control system, while the responses of the decentralized control system are not. Author

A92-17251

**A WAY OF GREAT PROMISE FOR ADVANCED AIRCREW EQUIPMENT**

RALPH KOCH and ANDREAS FREY Dornier Post (ISSN 0012-5563), no. 3, 1991, p. 66, 67.

Copyright

An account is given of the design features and operational capabilities of a proprietary military aircraft crew full-coverage suit/helmet life-support system. This aircrew equipment concept makes use of the body's natural thermal regulation through evaporation by applying temperature-conditioned, moisture-controlled air. By pressurizing the suit's 'air layer', the conventional G-suit bladders are obviated. Attention is given to national technology-development programs from which the present technology can benefit. O.C.

N92-12415 Colorado Univ., Boulder.

**ULTRASONIC APPLICATIONS FOR SPACE-BASED LIFE SUPPORT SYSTEMS Ph.D. Thesis**

AMOS STEVE JOHNSON 1990 218 p

Avail: Univ. Microfilms Order No. DA9122615

The reduction of gravitational acceleration forces in spaceborne environments allows the behavior of fluids to be dominated by forces normally masked by gravity. This behavior presents challenges and opportunities in the design of systems expected to operate in space. The dependence of life support systems on such fluid interactions to accomplish various processes can not be overlooked. For example, phase separation is one of the major fluid handling difficulties routinely faced in space technology, including life support systems. A vigorous manned space program demands the recycling of life support materials. Ultrasound is investigated as a potential technology to specifically address these problems. Earthbound applications for ultrasound are varied, which leads the investigation toward a multipurpose operational component of life support systems. Investigations have shown that the acoustic intensity gradients generated by ultrasound can be effectively used for multiphase fluid pumping, fluid mixing, gas transfer across membranes, and cleaving complex biological compounds into smaller biologically digestible units. Investigations suggest that in addition to pumping fluids, acoustic gradients can further accelerate gas liquid phase separations. The physical arrangement, geometries, and limits of such uses are suggested by the tests done here. The critical parameters of sound frequencies and amplitudes are highlighted with regard to the noted applications. The capacity to perform many functions in microgravity is a particular asset further enhanced by the simplicity and compactness of such hardware. These characteristics will trade favorably in terms of the mass and volume committed to an ultrasonic system compared to conventional technologies.

Dissert. Abstr.

N92-12416\*# Lockheed Engineering and Sciences Co., Houston, TX.

**THE EFFECT OF ON/OFF INDICATOR DESIGN ON STATE CONFUSION, PREFERENCE, AND RESPONSE TIME PERFORMANCE, EXECUTIVE SUMMARY**

KIMBERLY A. DONNER, KRITINA L. HOLDEN, and MEERA K. MANAHAN Mar. 1991 36 p Original contains color illustrations

(Contract NAS9-17900)

(NASA-CR-185662; NAS 1.26:185662; LESC-29239) Avail: NTIS HC/MF A03; 2 functional color pages CSCL 05H

Investigated are five designs of software-based ON/OFF indicators in a hypothetical Space Station Power System monitoring task. The hardware equivalent of the indicators used in the present study is the traditional indicator light that illuminates an ON label or an OFF label. Coding methods used to represent the active state were reverse video, color, frame, check, or reverse video with check. Display background color was also varied. Subjects

made judgments concerning the state of indicators that resulted in very low error rates and high percentages of agreement across indicator designs. Response time measures for each of the five indicator designs did not differ significantly, although subjects reported that color was the best communicator. The impact of these results on indicator design is discussed. Author

**N92-12417# Mining and Metallurgical Inst., Hokkaido (Japan). SURVEY ON POSSIBILITY TO UTILIZE EFFECTIVELY UNDERGROUND SPACE**

Mar. 1991 55 p In JAPANESE

(DE92-703044; ETDE/JP-MF-2703044) Avail: NTIS HC/MF A04

Taking into account the circumstances that underground spaces are utilized effectively for energy and material storage, and as research facilities, a survey was made on the possibility to utilize old mines in closed mines remaining in depopulated areas in Hokkaido. This is a report of the survey carried out by Hokkaido Mine Association on a possibility of effective utilization of underground spaces, to provide a guideline to discussions of regional activation and development of underground spaces in large depths. The report first summarizes the current state of underground space utilization within and without Japan, and provides examples of underground space utilization in Japan. The report then describes the current state of underground space utilization in Hokkaido (closed mines) of metal mines and coal mines. The report further indicates the outlook and problems in effective utilization of the underground spaces (closed mines) in Hokkaido, which could include the use as energy storage, material storage, wastes storage, research facilities, underground factories, mine work training and rescue training center, and for sightseeing. DOE

N92-12418# National Research Council of Canada, Ottawa (Ontario). Systems Lab.

**ERGONOMICS APPLIED TO OPERATIONAL SYSTEMS IN SPACE STATIONS**

BETTY ANN M. TURPIN Feb. 1988 21 p

(NRC-28710; NRC-TR-SYS-016; CTN-91-60293) Avail: NTIS HC/MF A03

The aim of the ergonomist is to analyze the complete system, including the operator, the machine, and the environment, and to design it in a manner which maximizes its efficiency and safety. The ergonomic approach to the design of jobs, equipment, tasks, and operating procedures is that of fitting the task to the operator. The operator should be considered as operating in parallel with other system operations, rather than as a component operating in series with other system operations. An ergonomic approach to the development of any system requires task analysis, necessitates inclusion of the operator in development, implementation, and test phases, and requires critical evaluation of existing technologies. The unique environment of zero gravity in space poses a unique challenge for space station ergonomics. Major questions in space operation systems focus on feedback and errors, their integration with technology, design of workstations for activities within and outside of a space station with specific reference to generic prescription needs, and the pros and cons of automation and computerization. CISTI

N92-12419# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Lab. de Medecine Aerospatiale.

**EVALUATION OF THE AERAZUR MULTIFUNCTIONAL FLIGHT SUIT IN CENTRIFUGAL TESTS [VETEMENT MULTIFONCTIONS AERAZUR EVALUATION EN CENTRIFUGEUSE]**

G. OSSARD, J. M. CLERE, and D. LEJEUNE 17 Oct. 1991 31 p In FRENCH Sponsored by Service Techniques des Programmes Aeronautiques

(REPT-38/CEV/SE/LAMAS; ETN-91-90099) Avail: NTIS HC/MF A03

A multifunctional flight suit designed to be water and air tight, fire resistant, and capable of protecting the body from acceleration and gravity overloads, is tested in a centrifuge. Its performance is compared with other protection outfits such as the ARZ-820 and

the P-90. In terms of anti-G protection, the suit is found to provide no more protection than ARZ-820 despite larger air pockets. Anti-G protection with respiratory over pressure is inferior by 1.7 G to that of the GP-90. The need to tailor the flight suit to the specific morphology and needs of an individual is stressed. ESA

**N92-12420#** Centre d'Essais en Vol, Bretigny-sur-Orge (France). Lab. de Medecine Aerospatiale.

**EVALUATION OF THE PHYSIOLOGICAL EFFECTS OF AN ADDITIONAL DEAD SPACE INVOLVED IN WEARING AN ANTI-SMOKE MASK [EVALUATION DES EFFETS PHYSIOLOGIQUES D'UN ESPACE MORT ADDITIONNEL DU AU PORT D'UNE CAGOLE ANTI-FUMES]**

MAROTTE, BEAUMONT, CANOT, and DELPLANCQ 9 Mar. 1990 39 p In FRENCH Sponsored by Service Technique des Programmes Aeronautiques (REPT-9/CEV/SE/LAMAS; ETN-91-90113) Avail: NTIS HC/MF A03

Respiratory effects due to an additional dead air space in anti-smoke outfits equipping flight personnel is studied. Gas exchange at rest and during exercise at ground level and at high altitudes is studied. The physiological effects are quantified in order to help design an anti-smoke mask system. The results show an almost immediate increase in dead volume to compensate for the increase in dead space in the anti-smoke mask system. Respiratory imbalance is shown to be very slight. ESA

**N92-12421#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Helicopter Div.

**HELMET MOUNTED SIGHT AND DISPLAY TESTING**

HANS-DIETER VONBOEHM, HERBERT SCHREYER, and RUDOLF SCHRANNER 26 Feb. 1991 31 p Presented at the SPIE Conference 1456 HMD III, San Jose, CA, 26-28 Feb. 1991 (MBB-UD-0594-91-PUB; ETN-91-90196) Avail: NTIS HC/MF A03

The results of conducted tests of Helmet Mounted Sights (HMS) and Helmet Mounted Displays (HMD) are presented. To compare the accuracy of the different HMS Systems (on magnetic, acoustic or optical basis) it is intended to find and unify a test procedure for verification. The test conditions vary, dependent on the principle of the HMS system. Magnetic systems should be tested with the influence of magnetic disturbances, ultrasonic systems under occurrence of noise and changing characteristics of the dispersion medium air, optical systems under high luminance to check saturation effects of the sensors. Modern Integrated Helmets (IH) consist of Cathode Ray Tubes (CRTs) for displaying binocular images of television or infrared cameras and superimposed symbology and a second channel with Image Intensifier Tubes (IIT). Important points for checking CRTs are the resolution, distortion, homogeneity and brightness in day and night time. The most important test for the IIT channel is the resolution measured as a function of luminance of the test pattern. Tests of the basic helmet regarding head fit, earphone, center of gravity, weight etc. are also necessary because these properties have an influence on the performance of the complete man machine system. ESA

**N92-12422#** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Helicopter Div.

**HELICOPTER INTEGRATED HELMET REQUIREMENTS AND TEST RESULTS**

HANS-DIETER VONBOEHM and HERBERT SCHREYER May 1991 19 p Presented at the AGARD Aerospace Medical Panel Symposium, Pensacola, FL, 2 May 1991 (MBB-UD-0595-91-PUB; ETN-91-90197) Avail: NTIS HC/MF A03

Integrated Helmet (IH) requirements for helicopter applications and some test results are given. A modern IH consists of two Image Intensifier Tubes (IIT) and two Cathode Ray Tubes (CRT) with an optical system including combiners to present binocular images. Additional symbology can be superimposed on the CRT or IIT image. An IH is a further development of a Helmet Mounted Display (HMD). A Helmet Mounted Sight (HS) can steer a sensor

platform with a thermal camera or an air to air missile system. The main helicopter requirements of such a system are given. ESA

**N92-12423#** Atomic Energy of Canada Ltd., Pinawa (Manitoba). Nuclear Research Establishment.

**AN EVALUATION OF THE POTENTIAL OF COMBINATION PROCESSES INVOLVING HEAT AND IRRADIATION FOR FOOD PRESERVATION**

K. SHAMSUZZAMAN, B. PAYNE, L. COLE, M. GOODWIN, and J. BORSA Nov. 1989 26 p (DE91-638734; AECL-10087) Avail: NTIS HC/MF A03

Effects of combined heating and gamma radiation on Clostridium sporogenes spores and Salmonella seftenberg were examined. The order in which irradiation and heat were applied had a profound effect on the survival of the organisms. Heating of C.sporogenes spores at 95 C had very little effect on their sensitivity to subsequent irradiation, but irradiation of the spores at 0 C increased their sensitivity to subsequent heat treatment and thus reduced their heat D(sub 10) values (time required to activate the spores to 10 percent of their initial number). This radiation-induced heat sensitivity increased with the increase in radiation dose. The Z values (change in temperature required for a tenfold change in D(sub 10) values) of the spores were found to increase with the increase in pre-irradiation dose. Radiation-induced heat sensitivity was found to persist for at least 35 days in spores irradiated in frozen or freeze-dried states in distilled water or in phosphate buffer suspensions, and for at least 14 days in a number of food slurries. In phosphate buffer and nutrient broth suspensions, the radiation-heat synergism decreased with increasing pH of the media from pH 4.7 to pH 7.5. However, the effect of pH on synergism was less pronounced in spores suspended in some food slurries. Preliminary results indicate that pre-irradiation of S. senftenberg at 0.5 kGy did not change the heat sensitivity of this organism at 52 C, but when radiation and heat were applied simultaneously, synergistic inactivation was observed even at 50 C. Practical implications of these results are discussed. DOE

**N92-12424#** California Univ., Berkeley. Lawrence Berkeley Lab. Applied Science Div.

**AIR MOVEMENT, COMFORT AND VENTILATION IN WORKSTATIONS**

F. S. BAUMAN, D. FAULKNER, E. A. ARENS, W. J. FISK, L. P. JOHNSTON, P. J. MCNEEL, D. PIH, and H. ZHANG (California Univ., Berkeley.) Apr. 1991 66 p (Contract DE-AC03-76SF-00098) (DE92-000667; LBL-30574) Avail: NTIS HC/MF A04

This report presents findings from a research project to investigate the effects of office partition design on air movement, worker comfort, and ventilation in workstations. The objectives of the study were to evaluate the comfort and ventilation conditions produced by a conventional ceiling supply-and-return air distribution system in workstations separated by (1) solid partitions of different height (75 in., 65 in., 42 in., and 0 in.) and (2) prototype Steelcase airflow partitions, containing a gap positioned at the bottom of the partition. The project consisted primarily of experiments performed in a full-scale Controlled Environment Chamber (CEC) located in the Building Science Laboratory, Department of Architecture, University of California, Berkeley. DOE

**N92-12533#** Royal Aerospace Establishment, Farnborough (England). Mission Management Aid Project.

**INTEGRATING MACHINE INTELLIGENCE INTO THE COCKPIT TO AID THE PILOT**

E. J. LOVESEY and R. I. DAVIS In AGARD, Machine Intelligence for Aerospace Electronic Systems 8 p Sep. 1991 Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Combat aircraft of the 21st Century will have to be increasingly well-equipped to counter the future threat, which itself will have become far more potent. This spiralling system complexity will result in unacceptably high cockpit workloads unless some form

of automation is provided to aid the pilot. United Kingdom industry and government combined to form a joint venture team to develop a Mission Management Aid which will assist the aircrew throughout the mission. Outlined here are some of the problems to be overcome and some suggestions regarding the major functional areas which will constitute the Mission Management Aid. Author

**N92-13581\*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

**RISKS, DESIGNS, AND RESEARCH FOR FIRE SAFETY IN SPACECRAFT**

ROBERT FRIEDMAN, KURT R. SACKSTEDER, and DAVID URBAN (Sverdrup Technology, Inc., Brook Park, OH.) 1991 22 p Presented at the Fall Meeting of the National Fire Protection Association, Inc., Montreal, Quebec, 19 Nov. 1991 (Contract NAS3-25266) (NASA-TM-105317; E-6672; NAS 1.15:105317) Avail: NTIS HC/MF A03 CSCL 05/8

Current fire protection for spacecraft relies mainly on fire prevention through the use of nonflammable materials and strict storage controls of other materials. The Shuttle also has smoke detectors and fire extinguishers, using technology similar to aircraft practices. While experience has shown that the current fire protection is adequate, future improvements in fire safety technology to meet the challenges of long duration space missions, such as the Space Station Freedom, are essential. All spacecraft fire protection systems, however, must deal with the unusual combustion characteristics and operational problems in the low gravity environment. The features of low gravity combustion that affect spacecraft fire safety, and the issues in fire protection for Freedom that must be addressed eventually to provide effective and conservative fire protection systems are discussed. Author

**N92-13582#** University of North Texas, Denton. Dept. of Computer Information Systems and Management Sciences.

**SURVIVAL ANALYSIS: A TRAINING DECISION APPLICATION Interim Technical Report, Jun. 1990 - Mar. 1991**

JULIA A. STEPHENSON Aug. 1991 18 p (AD-A240808; AL-TP-1991-0003) Avail: NTIS HC/MF A03 CSCL 05/9

The life of a task in an airman's inventory of tasks performed has not been investigated. How long a task remains (survives) in an individual's task inventory is of interest for training purposes. Survival analysis can possibly be used to measure task survivability. However, survival analysis uses longitudinal data whereas the USAF Occupational Survey Program captures vertical data (i.e., a snapshot is taken of the work force at one moment in time). Nonetheless, because survival analysis can incorporate both time and censored data, it could provide useful information about task survivability. In this effort, a task survival data base was modeled by combining both occupational survey data and known attribution data. Survival analysis functions were then generated. Results show both that survival analysis can be used to study task survivability and that this approach produces accurate estimates of task life.

GRA

**N92-13583#** Anacapa Sciences, Inc., Fort Rucker, AL. **TASK ANALYSIS AND WORKLOAD PREDICTION MODEL OF THE MH-60K MISSION AND A COMPARISON WITH UH-60A WORKLOAD PREDICTIONS. VOLUME 1: SUMMARY REPORT Interim Report, Dec. 1988 - Apr. 1990**

CARL R. BIERBAUM and DAVID B. HAMILTON Oct. 1990 56 p (Contract MDA903-87-C-0523) (AD-A241204; ASI90-328-90-II-VOL-1; ARI-RR-1576-VOL-1) Avail: NTIS HC/MF A04 CSCL 05/8

A mission scenario was used to conduct a comprehensive task analysis for MH-60K operations. The analysis used a top-down approach to identify the phases, functions, and tasks for the mission. Five phases, 15 segments, 71 functions, and 230 tasks were identified. Researchers identified the crewmember performing each task, and derived estimates of the sensory, cognitive, and psychomotor workload associated with each task. Estimates of

the task durations also were derived. The mission/task/workload analysis data were used to develop a computer model of workload for MH-60K crewmembers. The model used a bottom-up approach to build mission functions from tasks and mission segments from functions. Decision rules were written to specify the procedure for combining the tasks into functions and the functions into segments. The model permitted an analysis of total workload experienced by the pilot and copilot in the performance of both sequential and concurrent tasks. The predicted workload for the MH-60K pilot and copilot was compared to the UH-60A baseline workload prediction to determine the impact of the MH-60K advanced technology. The comparison indicated very little difference in the predicted workload for the pilot and indicated a lower predicted workload for the copilot in the MH-60K. GRA

**N92-13584#** Massachusetts Inst. of Tech., Cambridge. **HUMAN FACTORS ENGINEERING IN SONAR VISUAL DISPLAYS M.S. Thesis**

LAWRENCE F. GALVIN Aug. 1991 136 p (Contract N00123-89-G-0580) (AD-A241327) Avail: NTIS HC/MF A07 CSCL 13/2

Undersea technology is on the verge of equipping remotely operated vehicle (ROV) pilots with a three-dimensional (3-D), real-time display incorporating data from a wide variety of sensors including sonar (sound navigation and ranging), cameras, and lasers. Effective collection, computation, and presentation of this data to the pilot in a single display presents hardware, software and human factors problems. This thesis focuses on human factors issues associated with the display of information which could enhance the pilot's efficiency of performance. Background information on human factors engineering, 3-D computer graphics displays, and application of the 3-D perspective display precede the details of the experiment. Five specific display enhancements tested include altering the displayed field of view, providing a screen grid, displaying the current range to the target of interest, using a vertical color scheme, and controlling the display update rate. Seven tests measure the effects of these display enhancements on the simulated piloting of an ROV. The effects of the ROV simulation and operator learning curves are removed to compare performance change due to the various enhancements directly. Operator comments during and after testing as well as test monitor/author observations provide insight into the experiment. Test result implications for system design trade-offs are discussed in detail. GRA

**N92-13585#** Army Natick Research and Development Command, MA.

**PROCEEDINGS OF THE 1ST INTERNATIONAL SYMPOSIUM ON NONLINEAR OPTICAL POLYMERS FOR SOLDIER SURVIVABILITY Final Report**

Sep. 1990 117 p Symposium held in Natick, MA, 13-14 Jun. 1989 (AD-A241335; NATICK/TR-90/028) Avail: NTIS HC/MF A06 CSCL 06/5

Thirteen abstracts and 9 papers were presented at the First International Symposium on Nonlinear Optical Polymers, held 13-14 June 1989 at the U.S. Army Natick Research Development and Engineering Center, Natick, MA. The mission of the U.S. Army Natick Research Development and Engineering Center is to provide personal protection for the soldier against battlefield threats or those encountered in training. Recently a new threat has developed through the use of low power lasers in rangefinders and target designators and potential tunable weapons systems. Coherent radiation from these devices is capable of inflicting severe damage to the retina of the eye. One mode of protecting against such threats involves the development of nonlinear optical polymers which permit the transmission of visible light at ambient intensities but will reversibly block visible and near infrared radiation at intensities harmful to the eye. GRA

**N92-13586#** Wright State Univ., Dayton, OH. Human Factors Engineering.

**TOWARD A MODEL OF KNOWLEDGE REPRESENTATION AND A COMPARATIVE ANALYSIS OF KNOWLEDGE REPRESENTATION MEASUREMENT TECHNIQUES Interim Report, 1 Jul. 1990 - 1 Jun. 1991**

RICHARD J. KOUBEK and DANIEL N. MOUNTJOY 1 Sep. 1991 54 p

(Contract N00014-90-J-1256)

(AD-A241400) Avail: NTIS HC/MF A04 CSCL 05/8

This research attempts to develop and validate a proposed model of human knowledge representation. Based on an extensive literature review, a battery of available knowledge representation measurement techniques was selected to detect the representation differences between two experience level groups in the domain of clerical work. The techniques employed were card sorting, hierarchical clustering analysis, repertory grid, multidimensional scaling, Pathfinder, and pairwise similarity ratings. Results validate the existence of all model dimensions. Two dimensions were determined to be affected by experience level. Post-hoc analysis revealed that an additional dimension, Representation Complexity, is a function of experience level differences, and should therefore be included in future model development. Furthermore, the capabilities of the various measurement techniques differed. Specifically, hierarchical clustering analysis was the most effective technique for detecting differences in representations between experience level groups. GRA

**N92-13587#** EEG Systems Lab., San Francisco, CA.

**NEURO-TRIGGERED TRAINING Interim Report, 1 Apr. 1990 - 30 Mar. 1991**

ALAN S. GEVINS and BRIAN A. CUTILLO 30 Apr. 1991 15 p

(Contract F49620-90-C-0026)

(AD-A241511; AFOSR-91-0784TR) Avail: NTIS HC/MF A03

CSCL 05/8

Cortical neuroelectric patterns during a working memory task differed from a control task during two of four split-second intervals when access to the contents of working memory is assumed to take place. Prefrontal cortical areas were prominent among those differentially activated by working memory in these two intervals, which included a prestimulus preparatory interval and a late poststimulus response-inhibition interval. By contrast, patterns were similar between conditions during an early poststimulus interval and during a response interval, when the predominant activity was related to stimulus encoding or response execution. These results suggest that working memory is a dynamic process embodied in neuroelectric activity patterns distributed across the neural areas involved in performing a particular task. The active aspect of short-term memory, termed working memory by A. Baddeley and co-workers, provides the basis for consciously directed perception, cognition and action, attentional programs, and extended logical and linguistic operations. GRA

**N92-13845\*#** Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.

**ANALYSIS OF SIMULATED IMAGE SEQUENCES FROM SENSORS FOR RESTRICTED-VISIBILITY OPERATIONS**

RANGACHAR KASTURI In Old Dominion Univ., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1991 p 125-128 Sep. 1991

Avail: NTIS HC/MF A12 CSCL 05/8

A real time model of the visible output from a 94 GHz sensor, based on a radiometric simulation of the sensor, was developed. A sequence of images as seen from an aircraft as it approaches for landing was simulated using this model. Thirty frames from this sequence of 200 x 200 pixel images were analyzed to identify and track objects in the image using the Cantata image processing package within the visual programming environment provided by the Khoros software system. The image analysis operations are described. Author

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## SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

**N92-13588\*#** National Aeronautics and Space Administration, Washington, DC.

**FOURTH SYMPOSIUM ON CHEMICAL EVOLUTION AND THE ORIGIN AND EVOLUTION OF LIFE Abstracts Only**

ROBERT A. WHARTON, JR., ed., DALE T. ANDERSEN, ed., SARA E. BZIK, ed. (National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.), and JOHN D. RUMMEL, ed. Oct. 1991 129 p Symposium held at Moffett Field, CA, 24-27 Jul. 1990

(NASA-CP-3129; NAS 1.55:3129) Avail: NTIS HC/MF A07 CSCL 06/3

This symposium was held at the NASA Ames Research Center, Moffett Field, California, July 24-27, 1990. The NASA exobiology investigators reported their recent research findings. Scientific papers were presented in the following areas: cosmic evolution of biogenic compounds, prebiotic evolution (planetary and molecular), early evolution of life (biological and geochemical), evolution of advanced life, solar system exploration, and the Search for Extraterrestrial Intelligence (SETI).

**N92-13589\*#** Massachusetts Univ., Amherst.

**THE CHEMISTRY OF DENSE INTERSTELLAR CLOUDS**

**Abstract Only**

W. M. IRVINE In NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 15 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The basic theme of this program is the study of molecular complexity and evolution in interstellar and circumstellar clouds incorporating the biogenic elements. Recent results include the identification of a new astronomical carbon-chain molecule, C<sub>4</sub>Si. This species was detected in the envelope expelled from the evolved star IRC+10216 in observations at the Nobeyama Radio Observatory in Japan. C<sub>4</sub>Si is the carrier of six unidentified lines which had previously been observed. This detection reveals the existence of a new series of carbon-chain molecules, C<sub>n</sub>Si (n equals 1, 2, 4). Such molecules may well be formed from the reaction of Si(+) with acetylene and acetylene derivatives. Other recent research has concentrated on the chemical composition of the cold, dark interstellar clouds, the nearest dense molecular clouds to the solar system. Such regions have very low kinetic temperatures, on the order of 10 K, and are known to be formation sites for solar-type stars. We have recently identified for the first time in such regions the species of H<sub>2</sub>S, NO, HCOOH (formic acid). The H<sub>2</sub>S abundance appears to exceed that predicted by gas-phase models of ion-molecule chemistry, perhaps suggesting the importance of synthesis on grain surfaces. Additional observations in dark clouds have studied the ratio of ortho- to para-thioformaldehyde. Since this ratio is expected to be unaffected by both radiative and ordinary collisional processes in the cloud, it may well reflect the formation conditions for this molecule. The ratio is observed to depart from that expected under conditions of chemical equilibrium at formation, perhaps reflecting efficient interchange between cold dust grains in the gas phase. Author

**N92-13590\*#** Molecular Research Inst., Palo Alto, CA.

**THEORETICAL STUDIES OF THE EXTRATERRESTRIAL CHEMISTRY OF BIOGENIC ELEMENTS AND COMPOUNDS**

**Abstract Only**

D. J. DEFREES In NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 16 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Organic compounds, molecules related to those in living systems, are found in many different extraterrestrial environments.

The study of organic astrochemistry is important to exobiology both because it demonstrates the ubiquity of processes which led to life on Earth and because the dust clouds where molecules are found are analogs of the solar nebula from which the Earth formed. In the long chain of events leading from the Big Bang, and a universe composed of atomic hydrogen and helium, to the emergence of life on Earth, molecular interstellar clouds are an early link, the most primitive objects which display any significant organic chemistry. One such cloud was the direct precursor to the solar system and to all objects which it contains. Theoretical methods are ideally suited to studying interstellar cloud chemistry. They have been applied to determine spectroscopic constants of candidate interstellar molecules, mechanisms of ion-molecule reactions, and composition of dust grains. Accurate predictions of rotational constants and dipole moments of long-chain carbon molecules HC13N, HC15N, and C5O have been made to aid in determining the size limit of gas-phase interstellar molecules. Models of gas-phase interstellar chemistry use reaction rate constants measured at room temperature and extrapolated to interstellar temperatures. The temperature dependence of  $\text{NH}_3(+)+\text{H}_2$  yields  $\text{NH}_4(+)+\text{H}$  is anomalous, however, with a minimum rate at about 100K, casting doubt on the extrapolation procedures. The temperature dependence has now been explained. Author

**N92-13591\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**MEASUREMENT OF THE SPECTRAL SIGNATURE OF SMALL CARBON CLUSTERS AT NEAR AND FAR INFRARED WAVELENGTHS Abstract Only**

J. TARTER and R. SAYKALLY (California Univ., Berkeley. Lawrence Berkeley Lab.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 17 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

A significant percentage of the carbon inventory of the circumstellar and interstellar media may be in the form of large refractory molecules (or small grains) referred to as carbon clusters. At the small end, uneven numbers of carbon atoms seem to be preferred, whereas above 12 atoms, clusters containing an even number of carbon atoms appear to be preferred in laboratory chemistry. In the lab, the cluster C-60 appears to be a particularly stable form and has been nicknamed Bucky Balls because of its resemblance to a soccer ball and to geodesic domes designed by Buckminster Fuller. In order to investigate the prevalence of these clusters, and their relationship to the polycyclic aromatic hydrocarbons (PAHs) that have become the newest focus of IR astronomy, it is necessary to determine the spectroscopic characteristics of these clusters at near and far infrared wavelengths. Described here is the construction of a near to far IR laser magnetic resonance spectrometer that has been built at the University of California Berkeley in order to detect and characterize these spectra. The equipment produces carbon clusters by laser evaporation of a graphitic target. The clusters are then cooled in a supersonic expansion beam in order to simulate conditions in the interstellar medium (ISM). The expansion beam feeds into the spectrometer chamber and permits concentrations of clusters sufficiently high as to permit ultra-high resolution spectroscopy at near and far IR wavelengths. The first successful demonstration of this apparatus occurred last year when the laboratory studies permitted the observational detection of C-5 in the stellar outflow surrounding IRC+10216 in the near-IR. Current efforts focus on reducing the temperature of the supersonic expansion beam that transport the C clusters evaporated from a graphite target into the spectrometer down to temperatures as low as 1 K. Author

**N92-13592\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**LABORATORY AND OBSERVATIONAL STUDY OF THE INTERRELATION OF THE CARBONACEOUS COMPONENT OF INTERSTELLAR DUST AND SOLAR SYSTEM MATERIALS Abstract Only**

L. J. ALLAMANDOLA, S. A. SANFORD, W. A. SCHUTTE, and A. G. G. M. TIELENS *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 18 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

By studying the chemical and isotopic composition of interstellar ice and dust, one gains insight into the composition and chemical evolution of the solid bodies in the solar nebula and the nature of the material subsequently brought into the inner part of the solar system by comets and meteorites. It is now possible to spectroscopically probe the composition of interstellar ice and dust in the mid-infrared, the spectral range which is most diagnostic of fundamental molecular vibrations. We can compare these spectra of various astronomical objects (including the diffuse and dense interstellar medium, comets, and the icy outer planets and their satellites) with the spectra of analogs we produce in the laboratory under conditions which mimic those in these different objects. In this way one can determine the composition and abundances of the major constituents of the various ices and place general constraints on the types of organics coating the grains in the diffuse interstellar medium. In particular we have shown the ices in the dense clouds contain  $\text{H}_2\text{O}$ ,  $\text{CH}_3\text{OH}$ ,  $\text{CO}$ , perhaps some  $\text{NH}_3$  and  $\text{H}_2\text{CO}$ , we well as nitriles and ketones or esters. Furthermore, by studying the photochemistry of these ice analogs in the laboratory, one gains insight into the chemistry which takes place in interstellar/precometary ices. Chemical and spectroscopic studies of photolyzed analogs (including deuterated species) are now underway. The results of some of these studies will be presented and implications for the evolution of the biogenic elements in interstellar dust and comets will be discussed. Author

**N92-13593\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**QUANTIFICATION OF UV STIMULATED ICE CHEMISTRY: CO AND CO<sub>2</sub> Abstract Only**

V. G. ANICICH, T. ARAKELIAN, and M. S. HANNER *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 19 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Recent laboratory experiments are presented that show that during photolysis of the pure ices there is evidence of the interconversion of CO to CO<sub>2</sub> and CO<sub>2</sub> to CO using Lyman alpha (1216A) radiation. In addition, there is a substantial amount of another substance being produced. This substance is evident by its infrared absorption peak at 2235 cm<sup>-1</sup>. It is believed that this new peak is due to carbon suboxide, C<sub>3</sub>O<sub>2</sub>. CO and CO<sub>2</sub> have already been detected in comets, and C<sub>3</sub>O<sub>2</sub> has been suggested as a cometary from radiation of CO. Comparisons are made between our results at 1215A and proton radiation experiments and radiation at other wavelengths. The suggestion is that the processing of ices is energy dependent, i.e., dependent on the type of radiation. Several difficult problems have to be solved before these radiation conversions can be quantified. The steps that we are taking to quantify the kinetics are discussed. Author

**N92-13594\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**VOLATILES IN INTERPLANETARY DUST PARTICLES AND AEROGELS Abstract Only**

E. K. GIBSON, JR. and C. P. HARMETZ *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 20 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Volatiles measured in 25 interplanetary dust particles (IDPs) are a mixture of both indigenous materials and contaminants associated with the collection and processing of the ODPs prior to analysis. Most IDPs have been collected in the stratosphere using a silicone oil/freon mixture (20:1 ratio) coated on collector plates. Studies have shown that silicone oil, freon and hexane residues remain with the ODPs, despite attempts to clean the IDPs. Analysis of the IDPs with the LMMS-technique produces spectra with a mixture of indigeneous and contaminants

components. The contamination signal can be identified and removed; however, the contamination signal may obscure some of the indigenous component's signal. Employing spectra stripping techniques, the indigenous volatile constituents associated with the IDPs can be identified. Volatiles are similar to those measured in CI or CM carbonaceous chondrites. Collection of IDPs in low-Earth orbit utilizing a Cosmic Dust Collection Facility attached to Space Station Freedom has been proposed. The low-density material aerogel has been proposed as a collection substrate for IDPs. Our studies have concentrated on identifying volatile contaminants that are associated with aerogel. We have found that solvents used for the preparation of aerogel remain in aerogel and methods must be developed for removing the entrapped solvents before aerogels can be used for an IDP collection substrate.

Author

**N92-13595\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ISOTOPIC COMPOSITION OF MURCHISON ORGANIC COMPOUNDS: INTRAMOLECULAR CARBON ISOTOPE FRACTIONATION OF ACETIC ACID. SIMULATION STUDIES OF COSMOCHEMICAL ORGANIC SYNTHESIS Abstract Only**

G. U. YUEN, J. R. CRONIN, N. E. BLAIR (North Carolina State Univ., Raleigh.), D. J. DESMARAIS, and S. CHANG *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 21 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Recently, in our laboratories, samples of Murchison acetic acid were decarboxylated successfully and the carbon isotopic composition was measured for the methane released by this procedure. These analyses showed significant differences in C-13/C-12 ratios for the methyl and carboxyl carbons of the acetic acid molecule, strongly suggesting that more than one carbon source may be involved in the synthesis of the Murchison organic compounds. On the basis of this finding, laboratory model systems simulating cosmochemical synthesis are being studied, especially those processes capable of involving two or more starting carbon sources.

Author

**N92-13596\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**INTACT CAPTURE OF COSMIC DUST Abstract Only**

P. TSOU *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 25 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The focus of this development effort is to capture dust particles at hypervelocities intact and unmelted in order to preserve volatile organics. At the same time, the capture process must minimize any organic elemental or compound contamination to prevent any compromise of exobiological analyses. Inorganic silicate aerogel has been developed as a successful capture medium to satisfy both requirements of intact capture and minimal organic contamination. Up to 6 km/s, silicate projectiles from a few microns up to 100 microns have been captured intact without any melting and with minimal loss of mass. Carbon in silicate aerogel can be reduced to less than 1 part in 1000 and hydrogen 3 parts in 1000 when baked in air. Under controlled inert gas environments, additional hydrocarbon reduction can be achieved.

Author

**N92-13597\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**EXOBIOLICAL IMPLICATIONS OF DUST AGGREGATION IN PLANETARY ATMOSPHERES: AN EXPERIMENT FOR THE GAS-GRAIN SIMULATION FACILITY Abstract Only**

J. L. HUNTINGTON, D. E. SCHWARTZ, and J. R. MARSHALL (Arizona State Univ., Tempe.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 26 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The Gas-Grain Simulation Facility (GGSF) will provide a microgravity environment where undesirable environmental effects are reduced, and thus, experiments involving interactions between small particles and grains can be more suitably performed. Slated

for flight aboard the Shuttle in 1992, the ESA glovebox will serve as a scientific and technological testbed for GGSF exobiology experiments as well as generating some basic scientific data. Initial glovebox experiments will test a method of generating a stable, mono-dispersed cloud of fine particles using a vibrating sprinkler system. In the absence of gravity and atmospheric turbulence, it will be possible to determine the influence of interparticle forces in controlling the rate and mode of aggregation. The experimental chamber can be purged of suspended matter to enable multiple repetitions of the experiments. Of particular interest will be the number of particles per unit volume of the chamber, because it is suspected that aggregation will occur extremely rapidly if the number exceeds a critical value. All aggregation events will be recorded on high-resolution video film. Changes in the experimental procedure as a result of surprise events will be accompanied by real-time interaction with the mission specialist during the Shuttle flight.

Author

**N92-13598\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**STABLE CARBON ISOTOPE MEASUREMENTS USING LASER SPECTROSCOPY Abstract Only**

T. B. SAUKE and J. F. BECKER (San Jose State Univ., CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 27 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The 2300 cm<sup>-1</sup> spectral region is especially interesting because (12)CO<sub>2</sub> and (13)CO<sub>2</sub> bands overlap in such a way that their rotational lines have approximately equal absorbance at the anticipated isotopic ratio (approximately 90) of carbon on Earth and Mars. Pairs of rotational lines we have studied are separated by as little as 0.050 cm<sup>-1</sup>, but are well resolved with a tunable diode laser. Using sophisticated sweep integration and signal averaging techniques, we have measured the stable isotope ratio in carbon dioxide to a precision of better than 1 percent.

Author

**N92-13599\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**PALEOLAKES AND LIFE ON EARLY MARS Abstract Only**

M. A. MEYER, ROBERT A. WHARTON, JR. (Desert Research Inst., Reno, NV.), and C. P. MCKAY *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 28 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Two distinct directions have begun to elucidate key parameters in the search for extinct life on Mars. Carbonate sediments, deposited about 10,000 years ago in association with biological activity, have been sampled from the paleolake beds of Lake Vanda and Meirs in the McMurdo Dry Valleys in Antarctica. These samples are being analyzed for simple biological signatures that remain in cold and dry paleolake sediments, namely microfossils, percent carbonate, and total organic carbon. Our second initiative is the study of Colour Lake, in the Canadian Arctic, that periodically maintains a perennial ice cover. Physical measurements started this year will be used to determine one end point for ice covered lake environments and will be compared to continuous measurements from Antarctic lakes started in November 1985. Interestingly, Colour Lake also supports benthic mat communities, but the low pH precludes carbonate deposition. This research will broaden our knowledge base for what conditions are necessary for ice covered lake formation and what biological signatures will remain in paleolake deposits.

Author

**N92-13600\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**SUBSURFACE MICROBIAL HABITATS ON MARS Abstract Only**

P. J. BOSTON (Complex Systems Research, Inc., Boulder, CO.) and C. P. MCKAY *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 29 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

We developed scenarios for shallow and deep subsurface cryptic niches for microbial life on Mars. Such habitats could have considerably prolonged the persistence of life on Mars as surface conditions became increasingly inhospitable. The scenarios rely on geothermal hot spots existing below the near or deep subsurface of Mars. Recent advances in the comparatively new field of deep subsurface microbiology have revealed previously unsuspected rich aerobic and anaerobic microbial communities far below the surface of the Earth. Such habitats, protected from the grim surface conditions on Mars, could receive warmth from below and maintain water in its liquid state. In addition, geothermally or volcanically reduced gases percolating from below through a microbiologically active zone could provide the reducing power needed for a closed or semi-closed microbial ecosystem to thrive. Author

**N92-13601\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**PALEOBIOMARKERS AND DEFINING EXOBIOLGY  
EXPERIMENTS FOR FUTURE MARS EXPERIMENTS Abstract  
Only**

R. L. MANCINELLI, L. J. ROTHSCHILD, and M. R. WHITE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 30 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Mars is a cold, dry planet with an oxidizing surface bombarded by ultraviolet and ionizing radiation, making prospects for an extant Mars biota bleak. Yet, it is suggested that early Earth and early Mars were similar enough that life may have evolved on Mars. If life did evolve on Mars, what evidence for its existence might we find? What constitutes a Martian paleobiomarker, and how can we distinguish such a marker from abiotically produced substances? The topics studied to answer this question include carbon and nitrogen cycling, as well as the stability and relative abundance of their intermediates in microbially dominated ecosystems. The microbially dominated ecosystems studied are the cryoendolithic microbial community living within sand rocks, the endoevaporite microbial community living inside salt crystals, and the microbial communities living beneath perennially ice-covered lakes and hypersaline ponds. The nitrogen cycle of these communities ranges from simple, where only assimilation occurs, to the more complex, where a complete cycle occurs. The carbon cycle of these communities appears to be complete. Author

**N92-13602\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**CONCEPTUAL DESIGNS FOR IN SITU ANALYSIS OF MARS  
SOIL Abstract Only**

C. P. MCKAY, A. P. ZENT, and H. HARTMAN (California Univ., Berkeley.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 31 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

A goal of this research is to develop conceptual designs for instrumentation to perform in situ measurements of the Martian soil in order to determine the existence and nature of any reactive chemicals. Our approach involves assessment and critical review of the Viking biology results which indicated the presence of a soil oxidant, an investigation of the possible application of standard soil science techniques to the analysis of Martian soil, and a preliminary consideration of non-standard methods that may be necessary for use in the highly oxidizing Martian soil. Based on our preliminary analysis, we have developed strawman concepts for standard soil analysis on Mars, including pH, suitable for use on a Mars rover mission. In addition, we have devised a method for the determination of the possible strong oxidants on Mars. Author

**N92-13603\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**SPECTROSCOPY AND REACTIVITY OF MINERAL ANALOGS  
OF THE MARTIAN SOIL Abstract Only**

A. BANIN, J. OREBERG (San Francisco State Univ., CA.), and T. ROUSH *In* NASA, Washington, Fourth Symposium on Chemical

Evolution and the Origin and Evolution of Life p 32 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

To answer the question of why life occurred on Earth but not on Mars requires a study of the geochemical and physical aspects of the soil have been prepared and justified according to known constraints of chemical composition, reflectance spectroscopy, and chemical reactivity. Detailed laboratory reflectance spectra in the ultraviolet, visible, and near infrared (.30 to 2.5 microns) and the infrared (2.5 to 25 microns) regions have been obtained for the pure candidate minerals and some analog mixtures and compared to Mars reflectance spectra. Modeling of the reflectance spectra from optical constraints determined for the analog minerals has begun and will be interpreted in terms of the effects of particle size variation, component mixing, and soil packing upon remotely sensed reflectance spectra. This has implications not only for Mars, but for other planets and planetoids. The ratio of Fe(II)/Fe(III) in the Martian soil analog materials on spectral reflectance in the visible range has begun, and the results will be evaluated according to conformity with the visible Mars reflectance spectrum. Some initial LR and GEX data have been collected for the mineral samples and their mixtures, which can be compared with the Viking data and interpreted in terms of the redox (Fe(II)/Fe(III) environment. Author

**N92-13604\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**MIDINFRARED SPECTRAL INVESTIGATIONS OF  
CARBONATES: ANALYSIS OF REMOTELY SENSED DATA  
Abstract Only**

T. ROUSH, J. B. POLLACK, and C. P. MCKAY *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 33 Oct. 1991 Prepared in cooperation with San Francisco State Univ., CA  
Avail: NTIS HC/MF A07 CSCL 06/3

Recent airborne thermal infrared observations of Mars from the Kuiper Airborne Observatory (KAO) have provided evidence for the presence of carbonates, sulfates, and hydrates. Using the optical properties of calcite and anhydrite, it was estimated that CO<sub>3</sub>'s and SO<sub>4</sub>'s constituted about 1 to 3 and 10 to 15 wt. percent, respectively of the materials composing the atmospheric dust. Using the derived value as an estimate of total CO<sub>3</sub> abundance, and making an assumption that the CO<sub>3</sub>'s were uniformly distributed within the Martian regolith, it was estimated that such a CO<sub>3</sub> reservoir could contain roughly 2 to 5 bars of CO<sub>2</sub>. While the results indicate that several volatile-bearing materials are present on Mars, the observations from the KAO are inherently limited in their ability to determine the spatial distributions of these materials. However, previous spacecraft observations of Mars provide both the spectral coverage necessary to identify these materials, as well as the potential for investigating their spatial variability. This has prompted us to pursue a reinvestigation of the Mariner 6 and 7 infrared spectrometer and Mariner 9 infrared interferometer spectrometer observations. The former data have been recently made available in digital format and calibration of wavelengths and intensities are almost complete. Additionally, we are pursuing the derivation of optical constants of more appropriate carbonates and sulfates. Author

**N92-13605\*#** California Univ., Los Angeles.  
**ISOTOPIC CONSTRAINTS ON THE ORIGIN OF METEORITIC  
ORGANIC MATTER Abstract Only**

J. F. KERRIDGE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 37 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Salient features of the isotopic distribution of H, C and N in the organic material found in carbonaceous meteorites are noted. Most organic fractions are strongly enriched in D with respect to the D/H ratio characteristic of H<sub>2</sub> in the protosolar system; substantial variations in C-13/C-12 ratio are found among different molecular species, with oxidised species tending to be C-13 enriched relative to reduced species; some homologous series

reveal systematic decrease in C-13/C-12 with increasing C number; considerable variation in N-15/N-14 ratio is observed within organic matter, though no systematic pattern to its distribution has yet emerged; no interelement correlations have been observed between isotope enrichments for the different biogenic elements. The isotopic complexity echoes the molecular diversity observed in meteoritic organic matter and suggests that the organic matter was formed by multiple processes and/or from multiple sources. However, existence of a few systematic patterns points towards survival of isotopic signatures characteristic of one or more specific processes. The widespread D enrichment implies either survival of many species of interstellar molecule or synthesis from a reservoir containing a significant interstellar component. Several of the questions raised above can be addressed by more detailed determination of the distribution of the H, C and N isotopes among different well-characterized molecular fractions. Thus, the present study is aimed at discovering whether the different amino acids have comparable D enrichments, which would imply local synthesis from a D-enriched reservoir, or very viable D enrichments, which would imply survival of some interstellar amino acids. The same approach is also being applied to polycyclic aromatic hydrocarbons. Because the analytical technique employed (secondary ion mass spectrometry) can acquire data for all three isotopic systems from each molecular fraction, any presently obscured interelement isotopic correlation should also be revealed, which will aid in identifying pertinent synthetic processes. Author

**N92-13606\*#** California Inst. of Tech., Pasadena.

**KINETIC CONVERSION OF CO TO CH<sub>4</sub> IN THE SOLAR SYSTEM Abstract Only**

Y. L. YUNG, M. ALLEN, and J. P. PINTO /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 38 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Some of the most interesting chemistry in the Solar System involves changes in the oxidation state of the simple carbon species. The chemical pathways for the conversion of CH<sub>4</sub> to CO and CO<sub>2</sub> are for the most part known. The reverse process, the reduction of CO to CH<sub>4</sub>, is, however, poorly understood. This is surprising in view of the importance of the reduction process in the chemistry of the Solar System. Recently we investigated the chemical kinetics of a hitherto unsuspected reaction. It is argued that the formation of the methoxy radical (CH<sub>3</sub>O) from H+H<sub>2</sub>CO may play an essential role in the reduction of CO to CH<sub>4</sub>. The rate coefficient for this reaction has been estimated using the approximate theory of J. Troe and transition state theory. We will discuss the implications of this reaction for the chemistry of CO on Jupiter, in the solar nebula, for interpreting the laboratory experiments of A. Bar-Nun and A. Shaviv and A. Bar-Nun and S. Chang, and for organic synthesis in the prebiotic terrestrial atmosphere. The possible relation of CO reduction in the solar nebula and polyoxymethylene observed in comet Halley will be discussed. Author

**N92-13607\*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

**PRODUCTION OF ORGANIC COMPOUNDS IN PLASMAS: A COMPARISON AMONG ELECTRIC SPARKS, LASER-INDUCED PLASMAS AND UV LIGHT Abstract Only**

T. W. SCATTERGOOD, C. P. MCKAY, W. J. BORUCKI, L. P. GIVER, H. VANGHYSEGHEM, J. E. PARRIS, and S. L. MILLER (California Univ., San Diego.) /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 39 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

In order to study the production of organic compounds in plasmas (and shocks), various mixtures of N<sub>2</sub>, CH<sub>4</sub>, and H<sub>2</sub>, modeling the atmosphere of Titan, were exposed to discrete sparks, laser-induced plasmas (LIP) and ultraviolet light. The yields of HCN and simple hydrocarbons were measured and compared to those calculated from a simple quenched thermodynamic equilibrium model. The agreement between experiment and theory was fair for HCN and C<sub>2</sub>H<sub>2</sub>. However, the yields of C<sub>2</sub>H<sub>6</sub> and other

hydrocarbons were much higher than those predicted by the model. Our experiments suggest that photolysis by ultraviolet light from the plasma is an important process in the synthesis. This was confirmed by the photolysis of gas samples exposed to the light, but not to the plasma or shock waves. The results of these experiments demonstrate that, in addition to the well-known efficient synthesis of organic compounds in plasmas, the yields of saturated species, e.g., ethane, may be higher than predicted by theory and that LIP provide a convenient and clean way of simulating planetary lightning and impact plasmas in the laboratory. Author

**N92-13608\*#** Cornell Univ., Ithaca, NY. Lab. for Planetary Studies.

**ORGANIC SYNTHESIS IN THE OUTER SOLAR SYSTEM: RECENT LABORATORY SIMULATIONS FOR TITAN, THE JOVIAN PLANETS, TRITON AND COMETS Abstract Only**

C. SAGAN, W. R. THOMPSON, B. N. KHARE, and C. F. CHYBA /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 40-41 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

We tabulate the most abundant gases and their radiation yields, for two experimental pressures: 0.24 mb, more relevant to upper atmosphere excitation, and 17 mb, more relevant to tropospheric, cosmic ray excitation. The yields computed in the 0.24 mb experiment combined with measured electronic fluxes and a simple, eddy diffusion model of Titan's atmosphere predict abundances of detected molecules in agreement with those found by Voyager and for heavier products, in somewhat better agreement with observation than photochemical absolute reaction rate kinetics models. All Voyager organics are accounted for and no detectable products are found that Voyager did not detect. A striking increase of products with multiple bonds is found with decreasing pressure. Hydrocarbon abundances decline slowly with increasing carbon number. Additionally, we list preliminary estimates for the yield of the heteropolymer, which seems to be produced in a quantity comparable (in moles of C+N consumed) to the total amount of gaseous product. The production rate required to sustain Titan's haze against sedimentation also indicates yields of this order. As can be seen from the table, over 10(exp 9) years substantial amounts of these products can accumulate on the surface -- ranging from cm thickness for the (C+N equals 4) species to a meter or more for HCN and C<sub>2</sub>H<sub>2</sub>; we also expect a meter or more of tholins. Similar analyses have been or are being done for the Jovian planets and Triton. Charged particle irradiation of hydrocarbon clathrates or mixed hydrocarbon/water ices produces a range of organic products, reddening and darkening of the ices and characteristic infrared spectra. From such spectra, the predicted emission by fine particles in cometary comae well-matches the observed 3.4 micron emission spectra of Comet Halley and other recent comets. Heliocentric evolution of organic emission features in comets is predicted. Organic products of such ice irradiation may account for colors and albedos on some of the satellites in the outer solar system, especially Triton and Pluto, where solid methane is known to exist. Author

**N92-13609\*#** Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry.

**PHOTOCHEMICAL REACTIONS OF CYANOACETYLENE AND DICYANOACETYLENE: POSSIBLE PROCESSES IN TITAN'S ATMOSPHERE**

J. P. FERRIS and J. C. GUILLEMIN /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 42 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Titan has an atmosphere which is subject to dramatic chemical evolution due mainly to the dramatic effect of the UV flux from the Sun. The energetic solar photons and other particles are converting the methane-nitrogen atmosphere into the unsaturated carbon compounds observed by the Voyager probes. These same solar photons are also converting some of these unsaturated reaction products into the aerosols observed in the atmosphere which obscure the view of the surface of Titan. In particular, the

photochemical reactions of cyanoacetylene, dicyanoacetylene, acetylene and ethylene may result in the formation of the higher hydrocarbons and polymers which result in the aerosols observed in Titan's atmosphere. Polymers are the principal reaction products formed by irradiation of cyanoacetylene and dicyanoacetylene. Irradiation of cyanoacetylene with 185 nm of light also yields 1,3,5-tricyanobenzene while irradiation at 254 nm yields 1,2,4-tricyanobenzene and tetracyano cyclooctatetraenes. Photolyses of mixtures of cyanoacetylene and acetylene yields mono- and di-cyanobenzenes. The 1-Cyanocyclobutene is formed from the photochemical addition of cyanoacetylene with ethylene. The photolysis of dicyanoacetylene with acetylene yields 2,3-dicyano-1,3-butadiene and 1,2-dicyanobenzene. Tetracyano cyclooctatetraene products were also observed in the photolysis of mixtures of dicyanoacetylene and acetylene with 254 nm light. The 1,2-Dicyano cyclobutene is obtained from the photolysis dicyanoacetylene and ethylene. Reaction mechanisms will be proposed to explain the observed photoproducts. Author

**N92-13610\*#** Scripps Clinic and Research Foundation, La Jolla, CA. Dept. of Chemistry.

**CONTROLLED EVOLUTION OF AN RNA ENZYME Abstract Only**

G. F. JOYCE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 43 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

It is generally thought that prior to the origin of protein synthesis, life on earth was based on self-replicating RNA molecules. This idea has become especially popular recently due to the discovery of catalytic RNA (ribozymes). RNA has both genotypic and phenotypic properties, suggesting that it is capable of undergoing Darwinian evolution. RNA evolution is likely to have played a critical role in the early history of life on earth, and thus is important in considering the possibility of life elsewhere in the solar system. We have constructed an RNA-based evolving system in the laboratory, combining amplification and mutation of an RNA genotype with selection of a corresponding RNA phenotype. This system serves as a functional model of a primitive organism. It can also be used as a tool to explore the catalytic potential of RNA. By altering the selection constraints, we are attempting to modify the substrate specificity of an existing ribozyme in order to develop ribozymes with novel catalytic function. In this way, we hope to gain a better understanding of RNA's catalytic versatility and to assess its suitability for the role of primordial catalyst. All of the RNA enzymes that are known to exist in contemporary biology carry out cleavage/ligation reactions involving RNA substrates. The *Tetrahymena* ribozyme, for example, catalyzes phosphoester transfer between a guanosine containing and an oligopyrimidine containing substrate. We tested the ability of mutant forms of the *Tetrahymena* ribozyme to carry out a comparable reaction using DNA, rather than RNA substrate. An ensemble of structural variants of the ribozyme was prepared and tested for their ability to specifically cleave d(GGCCCTCT-A3TA3TA) at the phosphodiester bond following the sequence CCCTCT. We recovered a mutant form of the enzyme that cleaves DNA more efficiently than does the wild-type. Beginning with this selected mutant we have now scattered random mutations throughout the ribozyme and have begun an evolutionary search to further expand the catalytic repertoire of RNA. Author

**N92-13611\*#** Scripps Institution of Oceanography, La Jolla, CA. **SOURCES AND GEOCHEMICAL EVOLUTION OF CYANIDE AND FORMALDEHYDE Abstract Only**

G. ARRHENIUS *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 44 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The major source of cyanide has, in current paleoatmospheric models, been assumed to be the reaction of photodissociated thermospheric nitrogen with a limiting supply of stratospheric methane. Formaldehyde may be produced with more ease from an atmosphere of carbon dioxide as the dominant carbon species,

and from carbonate in solution or sorbed in double layer hydroxide minerals. Potentially more important sources for cyanide and other carbon containing molecules are the partially photoprotected northern and southern auroral ovals where continuous currents reaching several mega-amperes induce ion-molecule reactions, extending into the lower stratosphere. In simulated environments of this kind, the cyanide ion is known to be produced from oxidized carbon species potentially more abundant than methane. Rainout of cyanide and formaldehyde place them in two different geochemical reaction reservoirs. In the anoxic Archean hydrosphere, about 1mM in Fe<sub>2</sub>(+), the cyanide ion would have been efficiently converted to the stable ferrocyanide complex Fe(CN)<sub>6</sub>(4-), protecting it from the commonly considered fate of decomposition by hydrolysis, and eventually incorporating it in pyroaurite type minerals, most efficiently in green rust where it converts to insoluble ferriferrocyanide, prussian blue: Author

**N92-13612\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**KAOLINITE-CATALYZED AIR OXIDATION OF HYDRAZINE: CONSIDERATION OF SEVERAL COMPOSITIONAL, STRUCTURAL AND ENERGETIC FACTORS IN SURFACE ACTIVATION Abstract Only**

L. M. COYNE, R. MARINER, and A. RICE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 45 Oct. 1991 Prepared in cooperation with San Jose State Univ., CA

Avail: NTIS HC/MF A07 CSCL 06/3

Clay minerals have been shown to have numerous, curious, energetic properties by virtue of ultra-violet light release which can be triggered by gentle environmental changes such as wetting and dewetting by a variety of liquids, unique among them water and hydrazine. Since both water and hydrazine play multiple key roles in the air-oxidation of hydrazine on kaolinite surfaces, this reaction would seem to have prime potential for studying interrelationships of energy storage, release and chemical reactivity of clay surfaces, capacities basic to either the Bernal or Cairns-Smith roles of minerals in the origin of life. Establishment of the capacity for stored electronic energy to significantly alter surface chemistry is important, regardless of the reaction chosen to demonstrate it. Hydrazine air oxidation is overwhelmingly complex, given the possibilities for step-wise control and monitoring of parameters. In the light of recently extended characterization of the kaolinite and model sheet catalysts we used to study hydrazine oxidation and gamma-irradiated silica, previous studies of hydrazine air-oxidation on aluminosilicate surfaces have been reevaluated. Our former conclusion remains intact that, whereas trace structural and surface contaminants do play some role in the catalysis of oxidation, they are not the only, nor even the dominant, catalytic centers. Initial intermediates in the oxidation can now be proposed which are consistent with production via O(-)-centers as well as ferric iron centers. The greater than square dependence of the initial reaction rate on the weight of the clay is discussed in the light of these various mechanistic possibilities. Author

**N92-13613\*#** Cornell Univ., Ithaca, NY.

**TERRESTRIAL PRODUCTION VS. EXTRATERRESTRIAL DELIVERY OF PREBIOTIC ORGANICS TO THE EARLY EARTH Abstract Only**

C. F. CHYBA, C. SAGAN, P. J. THOMAS, and L. BROOKSHAW (Lawrence Livermore National Lab., CA.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 46 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

A comprehensive treatment of comet/asteroid interaction with the atmosphere, ensuring surface impact, and resulting organic pyrolysis is required to determine whether more than a negligible fraction of the organics in incident comets and asteroids actually survived collision with Earth. Results of such an investigation, using a smoothed particle hydrodynamic simulation of cometary and asteroidal impacts into both oceans and rock, demonstrate that organics will not survive impacts at velocities approx. greater than 10 km s<sup>-1</sup>, and that even comets and asteroids as small as

100m in radius cannot be aerobraked to below this velocity in 1 bar atmospheres. However, for plausible dense (10 bar CO<sub>2</sub>) early atmospheres, there will be sufficient aerobraking during atmospheric passage for some organics to survive the ensuing impact. Combining these results with analytical fits to the lunar impact record shows that 4.5 Gyr ago Earth was accreting at least approx. 10(exp 6) kg yr(exp 1) of intact cometary organics, a flux which thereafter declined with a approx. 100 Myr half-life. The extent to which this influx was augmented by asteroid impacts, as well as the effect of more careful modelling of a variety of conservative approximations, is currently being quantified. These results may be placed in context by comparison with in situ organic production from a variety of terrestrial energy sources, as well as organic delivery by interplanetary dust. Which source dominated the early terrestrial prebiotic inventory is found to depend on the nature of the early terrestrial atmosphere. However, there is an intriguing symmetry: it is exactly those dense CO<sub>2</sub> atmospheres where in situ atmospheric production of organic molecules should be the most difficult, in which intact cometary organics would be delivered in large amounts. Author

**N92-13614\*#** California Univ., Davis.

**SELF ASSEMBLY PROPERTIES OF PRIMITIVE ORGANIC COMPOUNDS Abstract Only**

D. W. DEAMER *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 47 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

A central event in the origin of life was the self-assembly of amphiphilic, lipid-like compounds into closed microenvironments. If a primitive macromolecular replicating system could be encapsulated within a vesicular membrane, the components of the system would share the same microenvironment, and the result would be a step toward true cellular function. The goal of our research has been to determine what amphiphilic molecules might plausibly have been available on the early Earth to participate in the formation of such boundary structures. To this end, we have investigated primitive organic mixtures present in carbonaceous meteorites such as the Murchison meteorite, which contains 1-2 percent of its mass in the form of organic carbon compounds. It is likely that such compounds contributed to the inventory of organic carbon on the prebiotic earth, and were available to participate in chemical evolution leading to the emergence of the first cellular life forms. We found that Murchison components extracted into non-polar solvent systems are surface active, a clear indication of amphiphilic character. One acidic fraction self-assembles into vesicular membranes that provide permeability barriers to polar solutes. Other evidence indicates that the membranes are bimolecular layers similar to those formed by contemporary membrane lipids. We conclude that bilayer membrane formation by primitive amphiphiles on the early Earth is feasible. However, only a minor fraction of acidic amphiphiles assembles into bilayers, and the resulting membranes require narrowly defined conditions of pH and ionic composition to be stable. It seems unlikely, therefore, that meteoritic infall was a direct source of membrane amphiphiles. Instead, the hydrocarbon components and their derivatives more probably would provide an organic stock available for chemical evolution. Our current research is directed at possible reactions which would generate substantial quantities of membranogenic amphiphiles. One possibility is photochemical oxidation of hydrocarbons. Author

**N92-13615\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**STRUCTURE AND FUNCTIONS OF WATER-MEMBRANE INTERFACES AND THEIR ROLE IN PROTO-BIOLOGICAL EVOLUTION Abstract Only**

A. POHORILLE, M. WILSON, and R. D. MACELROY *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 48 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Among the most important developments in proto-biological evolution was the emergence of membrane-like structures. These

are formed by spontaneous association of relatively simple amphiphilic molecules that would have been readily available in the primordial environment. The resulting interfacial regions between water and nonpolar interior of the membrane have several properties which made them uniquely suitable for promoting subsequent evolution. They can (1) selectively attract organic material and mediate its transport, (2) serve as simple catalysts for chemical reactions, and (3) promote the formation of trans-membrane electrical and chemical gradients which could provide energy sources for proto-cells. Understanding the structure of interfaces, their interactions with organic molecules and molecular mechanisms of their functions is an essential step to understanding proto-biological evolution. In our computer simulation studies, we showed that the structure of water at interfaces with nonpolar media is significantly different from that in the bulk. In particular, the average surface dipole density points from the vapor to the liquid. As a result, negative ions can approach the interface more easily than positive ions. Amphiphilic molecules composed of hydrocarbon conjugated rings and polar substituents (e.g., phenol) assume at the interface rigid orientations in which polar groups are buried in water while hydrocarbon parts are located in the nonpolar environment. These orientational differences are of special interest in connection with the ability of some of these molecules to efficiently absorb photons. Flexible molecules with polar substituents often adopt at interfaces conformations different from those in the bulk aqueous solution and in the gas phase. As a result, in many instances both specificity and kinetics of chemical reactions in which these molecules can participate is modified by the presence of surfaces. Of special interest is the mechanism by which polar molecules are transferred across interface between water and a nonpolar medium. Our recent study showed that simple ionophores bind ions by the same mechanisms as ion channels and carriers from modern cells. Author

**N92-13616\*#** Roswell Park Memorial Inst., Buffalo, NY. Dept. of Biophysics.

**MACROMOLECULAR RECOGNITION: STRUCTURAL ASPECTS OF THE ORIGIN OF THE GENETIC SYSTEM Abstract Only**

ROBERT REIN, DOV BARAK, NING LUO, THERESA JULIA ZIELINSKI, and MASAYUKI SHIBATA *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 49 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Theoretical simulation of prebiotic chemical processes is an invaluable tool for probing the phenomenon of evolution of life. Using computational and modeling techniques and guided by analogies from present day systems we, seek to understand the emergence of genetic apparatus, enzymatic catalysis and protein synthesis under prebiotic conditions. In one possible scenario, the RNA enzymatic reaction plays a key role in the emergence of the self-replicating and offers a clue to the onset of enzymatic catalysis prior to the existence of the protein biosynthetic machinery. Our ultimate goal is to propose a simple RNA segment which contains the specificity and catalytic activity of the contemporary RNA enzyme and which could emerge in a primordial chemical environment. To understand the mechanism of ribozyme catalyzed reactions, ab initio and semi-empirical (ZINDO) programs were used to investigate the reaction path of transphosphorylation. A special emphasis was placed on the possible catalytic and structural roles played by the coordinated magnesium cation. Both the inline and adjacent mechanisms of transphosphorylation have been studied. Another important aspect of this reaction is the identity of the functional groups which are essential for the acid base catalysis. The structural characteristics of the target helices, particularly a possible role of G center dot T pair, is under examination by molecular dynamics (MD) simulation technique. Modeling of the ancestral aminoacyl-tRNA synthetases (aRS) may provide important clues to the emergence of the genetic code and the protein synthetic machinery. Assuming that the catalytic function evolved before the elements of specific recognition of a particular amino acid, we are exploring the minimal structural requirements for the catalysis of tRNA aminoacylation. The molecular modeling system SYBYL was used for this study based

on the high resolution crystallographic structures of the present day tyrosyl-adenylate:tyrRS and tRNA(Gln): ATP:glnRS complexes. The trinucleotide CCA of the 3'-end tRNA is placed into the active site pocket of tyrRS, based on the scheme of interaction between tRNA(Gln) and glnRS, and upon the stereochemistry of the tyrRS:tRNA:Tyr-AMP transition state. This provides a model of the non-specific recognition of a tRNA's 3'-end by an aRS, which might be similar to that of the ancestral aRS's. In the next step, modeling of the rest of the acceptor stem of tRNA (Tyr) with tyrRS is carried out. Author

**N92-13617\*#** Salk Inst. for Biological Studies, San Diego, CA.  
**TEMPLATE POLYMERIZATION OF NUCLEOTIDE ANALOGUES**  
**Abstract Only**

L. E. ORGEL *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 50 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Recent work on the template-directed reactions of the natural D-nucleotides has made it clear that L-nucleotides and nucleotide-like derivatives of other sugars would strongly inhibit the formation of long oligonucleotides. Consequently, attention is focusing on molecules simpler than nucleotides that might have acted as monomers of an information transfer system. We have begun a general exploration of the template directed reactions of diverse peptide analogues. I will present work by Dr. Taifeng Wu on oxidative oligomerization of phosphorothioates and of Dr. Mary Tohidi on the cyclic polymerization of nucleoside and related cyclic pyrophosphates. Author

**N92-13618\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**PRODUCT AND RATE DETERMINATIONS WITH CHEMICALLY ACTIVATED NUCLEOTIDES IN THE PRESENCE OF VARIOUS PREBIOTIC MATERIALS, INCLUDING OTHER MONO- AND POLYNUCLEOTIDES Abstract Only**

A. KANAVARIOTI, D. J. ALBERAS, M. T. ROSENBAACH, C. F. BERNASCONI (California Univ., Santa Cruz.), and S. CHANG *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 51 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

We are investigating the reactions of ImpN's in the presence of a number of prebiotically plausible materials, such as metal ions, phosphate, amines and other nucleotides and hope to learn more about the stability/reactivity of ImpN's in a prebiotic aqueous environment. We find that, in the presence of phosphate, ImpN's form substantial amounts of diphosphate nucleotides. These diphosphate nucleotides are not very good substrates for template directed reactions, but are chemically activated and are known to revert to the phosphoimidazolides in the presence of imidazole under solid state conditions. With respect to our studies of the oligomerization reaction, the determination of the dimerization rate constant of a specific ImpN (guanosine 5'-phospho 2 methylimidazolide) both in the absence and the presence of the template leads to the conclusion that at 37 C the dimerization is not template directed, although the subsequent polymerization steps are. In other words, this specific polynucleotide synthesizing system favors the elongation of oligonucleotides as compared with the formation of dimers and trimers. This favoring of the synthesis of long as opposed to short oligonucleotides may be regarded as a rudimentary example of natural selection at the molecular level. Author

**N92-13619\*#** Salk Inst. for Biological Studies, San Diego, CA.  
**CARBOHYDRATES AS A SOURCE OF ENERGY AND MATTER FOR THE ORIGIN OF LIFE Abstract Only**

A. L. WEBER *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 52 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Recently, we proposed a new model of early glycolysis in which the oxidation of glyceraldehyde self-hemiacetals yielded energy rich polyglyceric acid instead of energy rich thioesters. In

this model, polyglyceric acid not only acts as an energy source for phosphoanhydride synthesis, but also as an autocatalyst that can replicate the sequence of D and L residues in its structure. We began our investigation of this new hypothesis - the triose model - by developing a thermal method for the racemization-free synthesis of polyglyceric acid. The hydrolytic stability and the role of chirality in interactions of polyglyceric acid were studied using this thermal polymer. Next, we established that the 2- and 3-glycerol esters of polyglyceric acid are energy rich by measuring the Gibbs free energy change of hydrolysis of the 2- and 3-glycerol esters of 2 and 3-O-L glyceroyl-glyceric acid methyl ester - a model of polyglyceric acid. Recently, we discovered that glyceraldehyde is bound and oxidized to glyceric acid on the surface of ferric hydroxide and that soluble ferric ion catalyzes the rearrangement of glyceraldehyde to lactic acid. We are exploring the possibility that these reactions could yield polyglyceric acid and polylactic acid under plausible prebiotic conditions. Author

**N92-13620\*#** Houston Univ., TX. Dept. of Biochemical and Biophysical Sciences.

**ON THE ORIGIN AND EARLY EVOLUTION OF BIOLOGICAL CATALYSIS AND OTHER STUDIES ON CHEMICAL EVOLUTION Abstract Only**

J. ORO and A. LAZCANO (Universidad Nacional Autonoma de Mexico, Mexico City.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 53 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

One of the lines of research in molecular evolution which we have developed for the past three years is related to the experimental and theoretical study of the origin and early evolution of biological catalysis. In an attempt to understand the nature of the first peptidic catalysts and coenzymes, we have achieved the non-enzymatic synthesis of the coenzymes ADPG, GDPG, and CDP-ethanolamine, under conditions considered to have been prevalent on the primitive Earth. We have also accomplished the prebiotic synthesis of histidine, as well as histidyl-histidine, and we have measured the enhancing effects of this catalytic dipeptide on the dephosphorylation of deoxyribonucleotide monophosphates, the hydrolysis of oligo A, and the oligomerization 2', 3' cAMP. We reviewed and further developed the hypothesis that RNA preceded double stranded DNA molecules as a reservoir of cellular genetic information. This led us to undertake the study of extant RNA polymerases in an attempt to discover vestigial sequences preserved from early Archean times. In addition, we continued our studies of on the chemical evolution of organic compounds in the solar system and beyond. Author

**N92-13621\*#** Alabama Univ., Birmingham. Dept. of Biochemistry.

**CHEMISTRY OF AMINOACYLATION OF 5'-AMO AND THE ORIGIN OF PROTEIN SYNTHESIS Abstract Only**

J. C. LACEY, JR. *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 54 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Much of our recent work has been a study of aminoacyl AMP derivatives. Elucidation of the character of aminoacyl AMP derivatives has made it obvious that AMP has characteristics which should allow it to preferentially catalyze the synthesis of L-amino acid peptides. The essential features which lead to this conclusion are that all L-amino acids (but not all D amino acids) when esterified to 5'-AMP preferentially (65 percent) distribute to the 3' position of the 5'-AMP; that esterification is predominantly at the 2' position; that 2', 3' diaminoacyl esters are readily formed; and that a peptide bond can be formed between adjacent 2',3' aminoacyl esters. Author

**N92-13622\*#** Cornell Univ., Ithaca, NY. Dept. of Chemistry.  
**CATALYTIC RNA AND SYNTHESIS OF THE PEPTIDE BOND**  
**Abstract Only**

D. A. USHER, M. KOZLOWSKI, and X. ZOU *In* NASA, Washington,

Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 55 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

We are studying whether the L-19 IVS ribozyme from *Tetrahymena thermophila* can catalyze the formation of the peptide bond when it is supplied with synthetic aminoacyl oligonucleotides. If this reaction works, it could give us some insight into the mechanism of peptide bond formation and the origin of coded protein synthesis. Two short oligoribonucleotides, CCCCC and a protected form of CCCCC were prepared; the former was made by the controlled hydrolysis of Poly(C), and the later by multistep chemical synthesis from the protected monomers. The homopentamer was then aminocylated using C-14 labelled Boc-protected glycine imidazolide. This aminoacylated oligonucleotide has now been shown to enter the active site of the L-19 IVS, and aminoacyl transfer, and peptide bond formation reactions are being sought. Our synthesis of CCCCC made us aware of the inadequacy of many of the 2'-hydroxyl protecting groups that are in use today and we therefore designed a new 2'-protecting group that is presently being tested. Author

**N92-13625\*#** George Mason Univ., Fairfax, VA.  
**A WINDOW IN TIME FOR THE FIRST EVOLUTIONARY RADIATION Abstract Only**

H. J. MOROWITZ *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 58 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The window in time between the last globally sterilizing event and the evidence for a complex prokaryotic ecosystem is quite narrow, perhaps as small as 200 million years. We will present a heuristic model outlining the first evolutionary radiation that could have led from primordial vesicles to the universal ancestor. The concept of the universal ancestor will be developed in terms of contemporary molecular biology. Author

**N92-13626\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.  
**THE EFFECTS OF OXYGEN ON THE EVOLUTION OF MICROBIAL MEMBRANES Abstract Only**

L. L. JAHNKE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 62 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

One prokaryote, *Methylococcus capsulatus*, synthesizes both hopanoids and sterols and, thus, provides a unique opportunity to study the evolution of membrane function. When *M. capsulatus* was grown at different temperatures, lipid analysis of the whole cells showed that both sterol and unsaturated fatty acid levels decreased at higher growth temperatures; sterol concentrations were 0.116 micro mole/micro mole phospholipid at 30 C and 0.025 micro mole/micro mole phospholipid at 45 C, while the saturated to unsaturated fatty acid ratio increased from 0.397 to 1.475. Hopane polyol levels were constant over this range; however, methylation of the A-ring decreased markedly in cells grown at 30 C. These results imply that sterol and hopane molecules are required for enhancement of some specific membrane function, potentially by modulating membrane fluidity. Author

**N92-13627\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ON THE CHIMERIC NATURE OF THE MEMBRANE-BOUND ATPASE FROM HALOBACTERIUM SACCHAROVORUM Abstract Only**

L. I. HOCHSTEIN *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 63 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

A series of experiments are described that were carried out with the goal of determining how the membrane-bound ATPase from *H. saccharovorum* is related to V- and F-type ATPases. They reflect three approaches: the use of inhibitors; structural studies; and immunological relatedness. Author

**N92-13628\*#** California Univ., Irvine.

**ARCHAEBACTERIAL RHODOPSIN SEQUENCES: IMPLICATIONS FOR EVOLUTION**

J. K. LANYI *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 64 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

It was proposed over 10 years ago that the archaebacteria represent a separate kingdom which diverged very early from the eubacteria and eukaryotes. It follows that investigations of archaebacterial characteristics might reveal features of early evolution. So far, two genes, one for bacteriorhodopsin and another for halorhodopsin, both from *Halobacterium halobium*, have been sequenced. We cloned and sequenced the gene coding for the polypeptide of another one of these rhodopsins, a halorhodopsin in *Natronobacterium pharaonis*. Peptide sequencing of cyanogen bromide fragments, and immuno-reactions of the protein and synthetic peptides derived from the C-terminal gene sequence, confirmed that the open reading frame was the structural gene for the pharaonis halorhodopsin polypeptide. The flanking DNA sequences of this gene, as well as those of other bacterial rhodopsins, were compared to previously proposed archaebacterial consensus sequences. In pairwise comparisons of the open reading frame with DNA sequences for bacterio-opsin and halo-opsin from *Halobacterium halobium*, silent divergences were calculated. These indicate very considerable evolutionary distance between each pair of genes, even in the same organism. In spite of this, three protein sequences show extensive similarities, indicating strong selective pressures. Author

**N92-13629\*#** California Univ., Berkeley.

**THIOREDOXIN AND EVOLUTION**

B. B. BUCHANAN *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 65 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Comparisons of primary structure have revealed significant homology between the m type thioredoxins of chloroplasts and the thioredoxins from a variety of bacteria. Chloroplast thioredoxin f, by comparison, remains an enigma: certain residues are invariant with those of the other thioredoxins, but a phylogenetic relationship to bacterial or m thioredoxins seems distant. Knowledge of the evolutionary history of thioredoxin f is, nevertheless, of interest because of its role in photosynthesis. Therefore, we have attempted to gain information on the evolutionary history of chloroplast thioredoxin f, as well as m. Our goal was first to establish the utility of thioredoxin as a phylogenetic marker, and, if found suitable, to deduce the evolutionary histories of the chloroplast thioredoxins. To this end, we have constructed phylogenetic (minimal replacement) trees using computer analysis. The results show that the thioredoxins of bacteria and animals fall into distinct phylogenetic groups - the bacterial group resembling that derived from earlier 16s RNA analysis and the animal group showing a cluster consistent with known relationships. The chloroplast thioredoxins show a novel type of phylogenetic arrangement: one m type aligns with its counterpart of eukaryotic algae, cyanobacteria and other bacteria, whereas the second type (f type) tracks with animal thioredoxin. The results give new insight into the evolution of photosynthesis. Author

**N92-13630\*#** Houston Univ., TX.

**EXPLORATION OF RNA STRUCTURE SPACES Abstract Only**

G. E. FOX *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 66 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

In order to understand the structure of real structure spaces, we are studying the 5S rRNA structure space experimentally. A plasmid containing a synthetic 5S rRNA gene, two rRNA promoters, and transcription terminators has been assembled. Assays are conducted to determine if the foreign 5S rRNA is expressed, and to see whether or not it is incorporated into ribosomes. Evolutionary competition is used to determine the relative fitness of strains containing the foreign 5S rRNA and a control 5S rRNA. By using site directed mutagenesis, a number of mutants can be made in

order to study the boundaries of the structure space and how sharply defined they are. By making similar studies in the vicinity of structure space, it will be possible to determine how homogeneous the 5S rRNA structure space is. Useable experimental protocols have been developed, and a number of mutants have already been studied. Initial results suggest an explanation of why single stranded regions of the RNA are less subject to mutation than double stranded regions. Author

**N92-13631\*#** Virginia Univ., Charlottesville. Dept. of Biology.  
**FUNCTIONAL CHARACTERISTICS OF THE CALCIUM MODULATED PROTEINS SEEN FROM AN EVOLUTIONARY PERSPECTIVE**

R. H. KRETSINGER, S. NAKAYAMA, and N. D. MONCRIEF *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 67 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

We have constructed dendrograms relating 173 EF-hand proteins of known amino acid sequence. We aligned all of these proteins by their EF-hand domains, omitting interdomain regions. Initial dendrograms were computed by minimum mutation distance methods. Using these as starting points, we determined the best dendrogram by the method of maximum parsimony, scored by minimum mutation distance. We identified 14 distinct subfamilies as well as 6 unique proteins that are perhaps the sole representatives of other subfamilies. This information is given in tabular form. Within subfamilies one can easily align interdomain regions. The resulting dendrograms are very similar to those computed using domains only. Dendrograms constructed using pairs of domains show general congruence. However, there are enough exceptions to caution against an overly simple scheme in which one pair of gene duplications leads from one domain precursor to a four domain prototype from which all other forms evolved. The ability to bind calcium was lost and acquired several times during evolution. The distribution of introns does not conform to the dendrogram based on amino acid sequences. The rates of evolution appear to be much slower within subfamilies, especially within calmodulin, than those prior to the definition of subfamily. Author

**N92-13632\*#** Arizona State Univ., Tempe. Center for the Study of Early Events in Photosynthesis.

**PHOTOSYNTHETIC REACTION CENTER COMPLEXES FROM HELIOBACTERIA Abstract Only**

J. T. TROST, W. F. J. VERMAAS, and R. E. BLANKENSHIP *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 68 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

The goal of this project is to understand the early evolutionary development of photosynthesis by examining the properties of reaction centers isolated from certain contemporary organisms that appear to contain the simplest photosynthetic reaction centers. The major focus of this project is the family of newly discovered strictly anaerobic photosynthetic organisms known as Heliobacteria. These organisms are the only known photosynthetic organisms that are grouped with the gram-positive phylum of bacteria. The properties of these reaction centers suggest that they might be the descendants of an ancestor that also gave rise to Photosystem 1 found in oxygen-evolving photosynthetic organisms. Photoactive reaction center-core antenna complexes have been isolated from the photosynthetic bacteria *Heliobacillus mobilis* and *Heliobacterium gestii*. The absorption and fluorescence properties of membranes and reaction centers are almost identical, suggesting that a single pigment-protein complex serves as both antenna and reaction center. Experiments in progress include sequence determination of the 48,000 Mr reaction center protein, and evolutionary comparisons with other reaction center proteins. Author

**N92-13633\*#** University of Southern Illinois, Carbondale. Dept. of Engineering.

**MOLECULAR BASES FOR UNITY AND DIVERSITY IN ORGANIC EVOLUTION Abstract Only**

S. W. FOX, P. RUECKNAGEL, and G. BRAUNITZER *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 69 Oct. 1991 Prepared in cooperation with Max-Planck-Inst. fuer Biochemie, Martinsried bei Muenchen (Fed. Republic of Germany)  
 Avail: NTIS HC/MF A07 CSCL 06/3

The origin of biological information has been ascribed at various times to DNA, RNA, or protein. The origin of nucleic acids without the action of prior informed protein has not been supported by plausible experiments, although such possibilities have been examined. The behavior of thermal proteins and of the microspheres selfassembled therefrom explain the origin of the first cells, the first membrane, the first reproduction cycle, ancient metabolism including ATP-aided synthesis of peptides and polynucleotides, growth, bioelectricity, and polybiofunctionality in general. Author

**N92-13634\*#** Indiana Univ., Bloomington. Biogeochemical Lab.  
**SEDIMENTARY ORGANIC MOLECULES: ORIGINS AND INFORMATION CONTENT Abstract Only**

J. M. HAYES and K. H. FREEMAN *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 70 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

To progress in the study of organic geochemistry, we must dissect the processes controlling the composition of sedimentary organic matter. Structurally, this has proven difficult. Individual biomarkers can often be recognized, but their contribution to total organic materials is small, and their presence does not imply that their biochemical cell mates have survived. We are finding, however, that a combination of structural and isotopic lines of evidence provides new information. A starting point is provided by the isotopic compositions of primary products (degradation products of chlorophylls, alkenones derived from coccoliths). We find strong evidence that the isotopic difference between primary carbonate and algal organic material can be interpreted in terms of the concentration of dissolved CO<sub>2</sub>. Moreover, the isotopic difference between primary and total organic carbon can be interpreted in terms of characteristic isotopic shifts imposed by secondary processes (responsive, for example, to O<sub>2</sub> levels in the depositional environment. In favorable cases, isotopic compositions of a variety of secondary products can be interpreted in terms of flows of carbon, and, therefore, in terms of specific processes and environmental conditions within the depositional environment. Author

**N92-13635\*#** Stanford Univ., CA. Dept. of Geology.

**EARLY ARCHEAN STROMATOLITES: PALEOENVIRONMENTAL SETTING AND CONTROLS ON FORMATION Abstract Only**

D. R. LOWE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 71 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The earliest record of terrestrial life is contained in thin, silicified sedimentary layers within enormously thick, predominantly volcanic sequences in South Africa and Western Australia. This record includes bacteria-like microfossils, laminated carbonaceous structures resembling flat bacterial mats and stromatolites, and a morphologically diverse assemblage of carbonaceous particles. These structures and particles and their host sediments provide the only direct source of information on the morphology, paleoecology, and biogeochemistry of early life; the nature of interactions between organisms and surface systems on the early earth; and possible settings within which life might have evolved. The three known occurrences of 3.5 to 3.2 billion-year-old stromatolites were evaluated in terms of depositional setting and biogenicity. Author

**N92-13636\*#** California Univ., Los Angeles. Dept. of Earth and Space Sciences.

**EARLY ARCHEAN (APPROXIMATELY 3.4 GA) PROKARYOTIC FILAMENTS FROM CHERTS OF THE APEX BASALT, WESTERN AUSTRALIA: THE OLDEST CELLULARLY PRESERVED MICROFOSSILS NOW KNOWN** Abstract Only

J. W. SCHOPF *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 72 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

In comparison with that known from later geologic time, the Archean fossil record is miniscule: although literally hundreds of Proterozoic formations, containing more than 2800 occurrences of bona fide microfossils are now known, fewer than 30 units containing some 43 categories of putative microfossils (the vast majority of which are of questionable authenticity) have been reported from the Archean. Among the oldest known fossils are Early Archean filaments reported from cherts of the Towers Formation and the Apex Basalt of the 3.3-3.6 Ga-old Warrawoona Group of Western Australia. The paleobiologic significance of the Towers Formation microstructures is open to question: thin aggregated filaments are properly regarded as dubiomicrofossils (perhaps biogenic, but perhaps not); therefore, they cannot be regarded as firm evidence of Archean life. Although authentic, filamentous microfossils were reported from a second Towers Formation locality, because the precise layer containing the fossiliferous cherts was not relocated, this discovery can neither be reconfirmed by the original collector nor confirmed independently by other investigators. Discovery of microfossils in bedded cherts of the Apex Basalt, the stratigraphic unit immediately overlying the Towers Formation, obviates the difficulties stored above. The cellularly preserved filaments of the Apex Basalt meet all of the criteria required of a bona fide Archean microfossils. Recent studies indicate that the Apex assemblage includes at least six morphotypes of uniseriate filaments, composed of barrel-shaped, discoidal, or quadrate cells and exhibiting rounded or conical terminal cells and medial bifurcated and paired half-cells that reflect the occurrence of prokaryotic binary cell division. Interestingly, the majority of these morphotypes are morphologically more similar to extant cyanobacteria than to modern filamentous bacteria. Prokaryotes seem clearly to have been hypobrydetic, and the evidence suggests (but does not prove) that physiologically advanced oxygen-producing photosynthesizers may have been represented in the Early Archean biota. Author

**N92-13637\*#** Harvard Univ., Cambridge, MA.

**THE ENVIRONMENTAL DISTRIBUTION OF LATE PROTEROZOIC ORGANISMS** Abstract Only

A. H. KNOLL *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 73 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Along present day coast lines, the environmental distributions of prokaryotic and protistan populations are often sharply delimited. Realized habitat ranges are generally narrower than those circumscribed by physiological tolerances, suggesting the importance of organism-organism interactions in the determination of population distributions. Microfossil populations preserved in silicified carbonates, dolomites, and shales of the 700-800 Ma old Akademikerbreen Group, Svalbard, and elsewhere indicate that the environmental distributions were defined equally clearly during the Proterozoic Eon. The Draken Conglomerate Formation is a tidal flat/lagoonal complex in which we have distinguished five principle biofacies containing a total of 42 taxa. Supratidal to subtidal gradients include the increasing abundance and diversity of both mat dweller microbenthos and allochthonous (principally planktonic) organisms, as well as a taphonomically important pattern of decreasing sheath thickness among mat builder microorganisms. The seaward barriers of Akademikerbreen lagoons were oolitic shoals, and these contain about a dozen endolithic and epilithic species not observed elsewhere in the group. Subtidal environments below fair weather wave base are represented by mudstones of the Svanbergfjellet Formation. These contain

abundant and diverse cyanobacteria-like fossils generally similar to but specifically different from those found in tidal flat sediments, as well as diverse unicellular protists (some of impressive morphological complexity) and at least half a dozen cellularly preserved metaphyte populations. In all, more than 80 species are distributed among Akademikerbreen lithologies. Fossil assemblages from Svalbard and elsewhere illustrate the potential for a much finer paleoecological, biostratigraphic, and, hence, evolutionary resolution of the early fossil record. Author

**N92-13638\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**THE BIOGEOCHEMISTRY OF MICROBIAL MATS, STROMATOLITES AND THE ANCIENT BIOSPHERE**

D. J. DESMARAIS and D. E. CANFIELD *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 74 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Stromatolites offer an unparalleled geologic record of early life, because they constitute the oldest and most abundant recognizable remains of microbial ecosystems. Microbial mats are living homologs of stromatolites; thus, the physiology of the microbiota as well as the processes which create those features of mats (e.g., biomarker organic compounds, elemental and stable isotopic compositions) which are preserved in the ancient record. Observations of the carbon isotopic composition ( $\delta C-13$ ) of stromatolites and microbial mats were made and are consistent with the hypothesis that atmospheric  $CO_2$  concentrations have declined by at least one to two orders of magnitude during the past 2.5 Ga. Whereas  $\delta C-13$  values of carbonate carbon average about 0 permil during both the early and mid-Proterozoic, the  $\delta C-13$  values of stromatolitic organic matter increase from an average of -35 between 2.0 and 2.6 Ga ago to an average of about -28 about 1.0 Ga ago. Modern microbial mats in hypersaline environments have  $\delta C-13$  values typically in the range of -5 to -9, relative to an inorganic bicarbonate source at 0 permil. Both microbial mats and pure cultures of cyanobacteria grown in waters in near equilibrium with current atmospheric  $CO_2$  levels exhibit minimal discrimination against C-13. In contrast, hot spring cyanobacterial mats or cyanobacterial cultures grown under higher  $CO_2$  levels exhibit substantially greater discrimination. If care is taken to compare modern mats with stromatolites from comparable environments, it might be possible to estimate ancient levels of atmospheric  $CO_2$ . In modern microbial mats, a tight coupling exists between photosynthetic organic carbon production and subsequent carbon oxidation, mostly by sulfate reduction. The rate of one process fuels a high rate of the other, with much of the sulfate reduction occurring within the same depth interval as oxygenic photosynthesis. Other aspects of this study are presented. Author

**N92-13639\*#** Massachusetts Univ., Amherst. Dept. of Botany. **SYMBIOSIS AND THE ORIGIN OF EUKARYOTIC MOTILITY** Abstract Only

L. MARGULIS and G. HINKLE *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 75 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Ongoing work to test the hypothesis of the origin of eukaryotic cell organelles by microbial symbioses is discussed. Because of the widespread acceptance of the serial endosymbiotic theory (SET) of the origin of plastids and mitochondria, the idea of the symbiotic origin of the centrioles and axonemes for spirochete bacteria motility symbiosis was tested. Intracellular microtubular systems are purported to derive from symbiotic associations between ancestral eukaryotic cells and motile bacteria. Four lines of approach to this problem are being pursued: (1) cloning the gene of a tubulin-like protein discovered in Spirocheata bajacaliforniensis; (2) seeking axoneme proteins in spirochetes by antibody cross-reaction; (3) attempting to cultivate larger, free-living spirochetes; and (4) studying in detail spirochetes (e.g., *Cristispira*) symbiotic with marine animals. Other aspects of the investigation are presented. Author

## 55 SPACE BIOLOGY

**N92-13640\*#** Pennsylvania State Univ., University Park. Dept. of Geosciences.

### **IS CO<sub>2</sub> CAPABLE TO KEEPING EARLY MARS WARM?**

#### **Abstract Only**

J. F. KASTING *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 76 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

One of the goals of NASA's Exobiology Research Program is to determine whether life exists today on Mars (unlikely) or whether it might have existed there at some time in the past (more likely). Speculation about extinct life is driven by the observation of channels on the Martian surface, thought to indicate the past presence of liquid water and, hence, the existence of a warmer climate. Current thinking suggests that such a climate could have been maintained if early Mars had a dense CO<sub>2</sub> atmosphere with a surface pressure of 1 to 5 bars. One of the phenomena that Martian climate modelers have not looked at very carefully is the process of CO<sub>2</sub> condensation. Reexamination of some of my own calculations indicates that condensation should occur at high altitudes in some high-CO<sub>2</sub> Martian atmospheres, particularly those in which the solar constant is set to its initial main sequence value (about 70 percent of present). CO<sub>2</sub> condensation should affect the surface temperature in two ways: (1) if it occurs in the convective lower atmosphere, condensation will reduce the magnitude of the greenhouse effect by decreasing the lapse rate; and (2) condensation at any altitude will produce clouds, which can either warm or cool the climate depending on their altitude and optical depth. Preliminary calculations with a 1-D, radiative-convective climate model indicate that the lapse rate change is substantial for low solar luminosity models. Other aspects of this study are discussed. Author

**N92-13641\*#** California Univ., Santa Barbara. Dept. of Geological Sciences.

### **NONMARINE STROMATOLITES AND THE SEARCH FOR EARLY LIFE ON MARS Abstract Only**

S. M. AWRAMIK *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 77 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The available evidence permits one to conclude that streams flowed and lakes developed on Mars sometime in the remote past. The lessons learned from the Earth's earliest fossil record suggest that stromatolites might have formed on Mars, speculating that: (1) biopoiesis occurred on Mars during its earliest history; (2) life evolved and diversified; (3) life inhabited aqueous environments; and (4) sunlight was an important environmental resource. The most likely place to find stromatolites and possibly microbial fossils on Mars would be in ancient lake and stream deposits. If thermal spring deposits can be identified, then they too are sites for biogeological investigations. Other aspects of this study are presented. Author

**N92-13642\*#** Florida Agricultural and Mechanical Univ., Tallahassee.

### **ENDOLITHIC MICROBIAL MODEL FOR MARTIAN EXOBIOLGY: THE ROAD TO EXTINCTION Abstract Only**

R. OSCAMPO-FRIEDMANN and E. I. FRIEDMANN (Florida State Univ., Tallahassee.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 78 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Martian exobiology is based on the assumption that on early Mars, liquid water was present and that conditions were suitable for the evolution of life. The cause for life to disappear from the surface and the recognizable fingerprints of past microbial activity preserved on Mars are addressed. The Antarctic cryptoendolithic microbial ecosystem as a model for extinction in the deteriorating Martian environment is discussed. Author

**N92-13643\*#** Massachusetts Univ., Amherst. Dept. of Botany. **THE NASA PLANETARY BIOLOGY INTERNSHIP EXPERIENCE Abstract Only**

G. HINKLE and L. MARGULIS *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 79 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

By providing students from around the world with the opportunity to work with established scientists in the fields of biogeochemistry, remote sensing, and origins of life, among others, the NASA Planetary Biology Internship (PBI) Program has successfully launched many scientific careers. Each year approximately ten interns participate in research related to planetary biology at NASA Centers, NASA-sponsored research in university laboratories, and private institutions. The PBI program also sponsors three students every year in both the Microbiology and Marine Ecology summer courses at the Marine Biological Laboratory. Other information about the PBI Program is presented including application procedure. Author

**N92-13644\*#** California Univ., Berkeley. Lawrence Berkeley Lab.

### **FINE STRUCTURE OF THE LATE EOCENE IR ANOMALY IN MARINE SEDIMENTS Abstract Only**

F. ASARO *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 84 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The Late Eocene Ir abundance profile in deep sea cores from Ocean Drilling Program Leg 113 Hole 689B on the Maude Rise off of Antarctica was studied with 410 samples continuously in 10 cm increments and measured with the Iridium Coincidence (ICS). The ICS was subsequently modified to measure 13 other elements simultaneously with the Ir. The abundance profiles of these elements were then determined in the Late Eocene Massignano section in central Italy with 250 samples (encompassing roughly 2 million years of accumulation) which were collected about every 5 cm in about 2 cm increments. These studies augmented a previous one (which included many elements) of deep sea cores from Deep Sea Drilling Project Site 592 on the Lord Howe Rise in the Tasman Sea between Australia and New Zealand. In the latter study, 50 samples (encompassing roughly 0.7 million years of accumulation) were collected continuously in 10 cm increments. The results from these studies are discussed. Author

**N92-13645\*#** Chicago Univ., IL.

### **CUMULATIVE FREQUENCY DISTRIBUTION OF PAST SPECIES EXTINCTIONS Abstract Only**

D. M. RAUP *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 85 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Analysis of Sepkoski's compendium of the time ranges of 30,000+ taxa yields a mean duration of 28.4 ma for genera of fossil invertebrates. This converts to an average extinction rate of 3.5 percent per million years or about one percent every 286,000 years. Using survivorship techniques, these estimates can be converted to the species level, yielding a Phanerozoic average of one percent species extinction every 40,000 years. Variation in extinction rates through time is far greater than the null expectation of a homogeneous birth-death model and this reflects the well-known episodicity of extinction ranging from a few large mass extinctions to so-called background extinction. The observed variation in rates can be used to construct a cumulative frequency distribution of extinction intensity, and this distribution, in the form of a kill curve for species, shows the expected waiting times between extinction events of a given intensity. The kill curve is an average description of the extinction events of a given intensity. The kill curve is an average description of the extinction record and does not imply any cause or causes of extinction. The kill curve shows, among other things, that only about five percent of total species extinctions in the Phanerozoic were involved in the five largest mass extinctions. The other 95 percent were distributed among large and small events not normally called mass extinctions.

As an exploration of the possibly absurd proposition that most past extinctions were produced by the effects of large-body impact, the kill curve for species was mapped on the comparable distribution for comet and asteroid impacts. The result is a curve predicting the species kill for a given size of impacting object (expressed as crater size). The results are reasonable in that impacts producing craters less than 30 km (diameter) cause negligible extinction but those producing craters 100-150 km (diameter) cause extinction of species in the range of 45-60 percent. Author

**N92-13646\*#** Chicago Univ., IL.

**GEOGRAPHY OF CRETACEOUS EXTINCTIONS: DATA BASE DEVELOPMENT Abstract Only**

D. M. RAUP *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 86 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Data bases built from the source literature are plagued by problems of data quality. Unless the data acquisition is done by experts, working slowly, the data base may contain so much garbage that true signals and patterns cannot be detected. On the other hand, high quality data bases develop so slowly that satisfactory statistical analysis may never be possible due to the small sample sizes. Results of a test are presented of the opposite strategy: rapid data acquisition by non-experts with minimal control on data quality. A published list of 186 species and genera of fossil invertebrates of the latest Cretaceous Age (Maestrichtian) were located through a random search of the paleobiological and geological literature. The geographic location for each faunal list was then transformed electronically to Maestrichtian latitude and longitude and the lists were further digested to identify the genera occurring in each ten-degree, latitude-longitude block. The geographical lists were clustered using the Otsuka similarity coefficient and a standard unweight-pair-group method. The resulting clusters are remarkably consistent geographically, indicating that a strong biogeographic signal is visible despite low-quality data. A further test evaluated the geographic pattern of end-Cretaceous extinctions. All genera in the data base were compared with Sepkoski's compendium of time ranges of genera to determine which of the reported genera survived the Cretaceous mass extinction. In turn, extinction rates for the ten-degree, latitude-longitude blocks were mapped. The resulting distribution is readily interpretable as a robust pattern of the geography of the mass extinction. The study demonstrates that a low-quality data base, built rapidly, can provide a basis for meaningful analysis of past biotic events. Author

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**THE FOSSIL RECORD OF EVOLUTION: DATA ON DIVERSIFICATION AND EXTINCTION Abstract Only**

J. J. SEPKOSKI, JR. *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 87 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Understanding of the evolution of complex life, and of the roles that changing terrestrial and extraterrestrial environments played in life's history, is dependent upon synthetic knowledge of the fossil record. Paleontologists have been describing fossils for more than two centuries. However, much of this information is dispersed in monographs and journal articles published throughout the world. Over the past several years, this literature was surveyed, and a data base on times of origination and extinction of fossil genera was compiled. The data base, which now holds approximately 32,000 genera, covers all taxonomic groups of marine animals, incorporates the most recent taxonomic assignments, and uses a detailed global time framework that can resolve originations and extinctions to intervals averaging three million years in duration. These data can be used to compile patterns of global biodiversity, measure rates of taxic evolution, and test hypotheses concerning adaptive radiations, mass extinctions, etc. Thus far, considerable effort was devoted to using the data to test the hypothesis of periodicity of mass extinction.

Rates of extinction measured from the data base have also been used to calibrate models of evolutionary radiations in marine environments. It was observed that new groups, or clades of animals (i.e., orders and classes) tend to reach appreciable diversity first in nearshore environments and then to radiate in more offshore environments; during decline, these clades may disappear from the nearshore while persisting in offshore, deep water habitats. These observations have led to suggestions that there is something special about stressful or perturbed environments that promotes the evolution of novel kinds of animals that can rapidly replace their predecessors. The numerical model that is being investigated to study this phenomenon treats environments along onshore-offshore gradients as if they were discrete habitats. Other aspects of this investigation are presented. Author

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**BIOGEOCHEMICAL MODELING AT MASS EXTINCTION BOUNDARIES Abstract Only**

M. R. RAMPINO and K. G. CALDEIRA *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 88 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The causes of major mass extinctions is a subject of considerable interest to those concerned with the history and evolution of life on earth. The primary objectives of the proposed plan of research are: (1) to develop quantitative time-dependent biogeochemical cycle models, coupled with an ocean atmosphere in order to improve the understanding of global scale physical, chemical, and biological processes that control the distribution of elements important for life at times of mass extinctions; and (2) to develop a comprehensive data base of the best available geochemical, isotopic, and other relevant geologic data from sections across mass extinction boundaries. These data will be used to constrain and test the biogeochemical model. These modeling experiments should prove useful in: (1) determining the possible cause(s) of the environmental changes seen at bio-event boundaries; (2) identifying and quantifying little-known feedbacks among the oceans, atmosphere, and biosphere; and (3) providing additional insights into the possible responses of the earth system to perturbations of various timescales. One of the best known mass extinction events marks the Cretaceous/Tertiary (K/T) boundary (66 Myr ago). Data from the K/T boundary are used here to constrain a newly developed time-dependent biogeochemical cycle model that is designed to study transient behavior of the earth system. Model results predict significant fluctuations in ocean alkalinity, atmospheric CO<sub>2</sub>, and global temperatures caused by extinction of calcareous plankton and reduction in the sedimentation rates of pelagic carbonates and organic carbon. Oxygen-isotope and other paleoclimatic data from K/T time provide some evidence that such climatic fluctuations may have occurred, but stabilizing feedbacks may have acted to reduce the ocean alkalinity and carbon dioxide fluctuations. Author

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**THE NASA SETI PROGRAM**

J. BILLINGHAM and D. H. BROCKER *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 91 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

In 1959, it was proposed that a sensible way to conduct interstellar communication would be to use radio at or near the frequency of hydrogen. In 1960, the first Search for Extraterrestrial Intelligence (SETI) was conducted using a radiotelescope at Green Bank in West Virginia. Since 1970, NASA has systematically developed a definitive program to conduct a sophisticated search for evidence of extraterrestrial intelligent life. The basic hypothesis is that life may be widespread in the universes, and that in many instances extraterrestrial life may have evolved into technological civilizations. The underlying scientific arguments are based on the continuously improving knowledge of astronomy and astrophysics,

especially star system formation, and of planetary science, chemical evolution, and biological evolution. If only one in a million sun-like stars in our galaxy harbors species with cognitive intelligence, then there are 100,000 civilizations in the Milky Way alone. The fields of radioastronomy digital electronic engineering, spectrum analysis, and signal detection have advanced rapidly in the last twenty years and now allow for sophisticated systems to be built in order to attempt the detection of extraterrestrial intelligence signals. In concert with the scientific and engineering communities, NASA has developed, over the last several years, a Microwave Observing Project whose goal is to design, build, and operate SETI systems during the decade of the nineties in pursuit of the goal signal detection. The Microwave Observing Project is now approved and underway. There are two major components in the project: the Target Search Element and the Sky Survey Element.

Author

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**NASA-SETI MICROWAVE OBSERVING PROJECT: TARGETED SEARCH ELEMENT (TSE) Abstract Only**

L. D. WEBSTER /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 92 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The Targeted Search Element (TSE) performs one of two complimentary search strategies of the NASA-SETI Microwave Observing Project (MOP): the targeted search. The principle objective of the targeted search strategy is to scan the microwave window between the frequencies of one and three gigahertz for narrowband microwave emissions emanating from the direction of 773 specifically targeted stars. The scanning process is accomplished at a minimum resolution of one or two Hertz at very high sensitivity. Detectable signals will be of a continuous wave or pulsed form and may also drift in frequency. The TSE will possess extensive radio frequency interference (RFI) mitigation and verification capability as the majority of signals detected by the TSE will be of local origin. Any signal passing through RFI classification and classifiable as an extraterrestrial intelligence (ETI) candidate will be further validated at non-MOP observatories using established protocol. The targeted search will be conducted using the capability provided by the TSE. The TSE provides six Targeted Search Systems (TSS) which independently or cooperatively perform automated collection, analysis, storage, and archive of signal data. Data is collected in 10 megahertz chunks and signal processing is performed at a rate of 160 megabits per second. Signal data is obtained utilizing the largest radio telescopes available for the Targeted Search such as those at Arecibo and Nancay or at the dedicated NASA-SETI facility. This latter facility will allow continuous collection of data. The TSE also provides for TSS utilization planning, logistics, remote operation, and for off-line data analysis and permanent archive of both the Targeted Search and Sky Survey data.

Author

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**NASA SETI MICROWAVE OBSERVING PROJECT: SKY SURVEY ELEMENT Abstract Only**

M. J. KLEIN /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 93 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The SETI Sky Survey Observing Program is one of two complimentary strategies that NASA plans to use in its microwave Search for Extraterrestrial Intelligence (SETI). The primary objective of the sky survey is to search the entire sky over the frequency range of 1.0 to 10.0 GHz for evidence of narrow band signals of extraterrestrial intelligent origin. Frequency resolutions of 30 Hz or narrower will be used across the entire band. Spectrum analyzers with upwards of ten million channels are required to keep the survey time approximately 6 years. Data rates in excess of 10 megabits per second will be generated in the data taking process. Sophisticated data processing techniques will be required to

determine the ever changing receiver baselines, and to detect and archive potential SETI signals. Existing radio telescopes, including several of NASA's Deep Space Network (DSN) 34 meter antennas located at Goldstone, CA and Tidbinbilla, Australia will be used for the observations. The JPL has the primary responsibility to develop and carry out the sky survey. In order to lay the foundation for the full scale SETI Sky Survey, a prototype system is being developed at the JPL. The system will be installed at the new 34-m high efficiency antenna at the Deep Space Station (DSS) 13 research and development station, Goldstone, CA, where it will be used to initiate the observational phase of the NASA SETI Sky Survey. It is anticipated that the early observations will be useful to test signal detection algorithms, scan strategies, and radio frequency interference rejection schemes. The SETI specific elements of the prototype system are: (1) the Wide Band Spectrum Analyzer (WBSA); a 2-million channel fast Fourier transformation (FFT) spectrum analyzer which covers an instantaneous bandpass of 40 MHz; (2) the signal detection processor; and (3) the SETI Sky Survey Manager, a network-based C-language environment that provides observatory control, performs data acquisition and analysis algorithms. A high level description of the prototype hardware and software systems will be given and the current status of the system development will be reported.

Author

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**THE SERENDIP 2 SETI PROJECT: CURRENT STATUS Abstract Only**

C. S. BOWYER, D. WERTHIMER, C. DONNELLY, W. HERRICK, and M. LAMPTON /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 94 Oct. 1991

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Over the past 30 years, interest in extraterrestrial intelligence has progressed from philosophical discussion to rigorous scientific endeavors attempting to make contact. Since it is impossible to assess the probability of success and the amount of telescope time needed for detection, Search for Extraterrestrial Intelligence (SETI) Projects are plagued with the problem of attaining the large amounts of time needed on the world's precious few large radio telescopes. To circumvent this problem, the Search for Extraterrestrial Radio Emissions from Nearby Developed Intelligent Populations (SERENDIP) instrument operates autonomously in a piggyback mode utilizing whatever observing plan is chosen by the primary observer. In this way, large quantities of high-quality data can be collected in a cost-effective and unobtrusive manner. During normal operations, SERENDIP logs statistically significant events for further offline analysis. Due to the large number of terrestrial and near-space transmitters on earth, a major element of the SERENDIP project involves identifying and rejecting spurious signals from these sources. Another major element of the SERENDIP Project (as well as most other SETI efforts) is detecting extraterrestrial intelligence (ETI) signals. Events selected as candidate ETI signals are studied further in a targeted search program which utilizes between 24 to 48 hours of dedicated telescope time each year.

Author

**N92-13653\*#** Ohio State Univ., Columbus. Radio Observatory. **REOPTIMIZATION OF THE OHIO STATE UNIVERSITY RADIO TELESCOPE FOR THE NASA SETI PROGRAM**

R. S. DIXON /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 95 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The Ohio State University radiotelescope is the second largest radio telescope in the United States, equivalent in collecting area (2200 sq m) to a 175-foot diameter dish. For the past 17 years it has been dedicated fulltime to SETI, and it is now being considered by NASA for selection as the NASA dedicated SETI observatory. The telescope was originally designed, optimized, and used as an all-sky survey instrument to create detailed maps and catalogs of the radio astronomical sky. For the SETI Program, some re-optimizations are required. Right ascension tracking for one to two hours (depending on the declination) was achieved by exploiting

the exceptionally large  $f/d$  ratio of the telescope. The feed horns were mounted on a large moveable, rubber-tired cart which is capable of a total motion of 100 feet. The cart can carry many horns, making possible simultaneous observations at many sky directions and frequency ranges. Rapid declination movement and its automation will be accomplished through simplification of the existing braking system, and replacement of older mechanical sensors by modern electronic inclinometers and proximity detectors. Circular polarization capability will be achieved through an increase in the number of horizontal wires in the reflector mesh, or addition of a finer mesh on top of the existing one. The telescope has great inherent resistance to radio frequency interference, due to its ground-mounted feed horns and shielding by the large reflectors of half the horizon. The resistance was recently increased further by installation of rolled-edges and diffraction-trapping gratings on the feed horns. If further shielding should be required, inexpensive side shields could be added to the telescope, making it a totally closed structure on all four sides. Author

**N92-13654\*#** California Univ., Berkeley. Space Sciences Lab.  
**A DIRECTED SEARCH FOR EXTRATERRESTRIAL LASER SIGNALS Abstract Only**

A. BETZ /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 96 Oct. 1991  
 Avail: NTIS HC/MF A07 CSCL 06/3

The focus of NASA's Search for Extraterrestrial Intelligence (SETI) Program is on microwave frequencies, where receivers have the best sensitivities for the detection of narrowband signals. Such receivers, when coupled to existing radio telescopes, form an optimal system for broad area searches over the sky. For a directed search, however, such as toward specific stars, calculations show that infrared wavelengths can be equally as effective as radio wavelengths for establishing an interstellar communication link. This is true because infrared telescopes have higher directivities (gains) that effectively compensate for the lower sensitivities of infrared receivers. The result is that, for a given level of transmitted power, the signal to noise ratio for communications is equally as good at infrared and radio wavelengths. It should also be noted that the overall sensitivities of both receiver systems are quite close to their respective fundamental limits: background thermal noise for the radio frequency system and quantum noise for the infrared receiver. Consequently, the choice of an optimum communication frequency may well be determined more by the achievable power levels of transmitters rather than the ultimate sensitivities of receivers at any specific frequency. In the infrared, CO<sub>2</sub> laser transmitters with power levels greater than 1 MW can already be built on Earth. For a slightly more advanced civilization, a similar but enormously more powerful laser may be possible using a planetary atmosphere rich in CO<sub>2</sub>. Because of these possibilities and our own ignorance of what is really the optimum search frequency, a search for narrowband signals at infrared frequencies should be a part of a balanced SETI Program. Detection of narrowband infrared signals is best done with a heterodyne receiver functionally identical to a microwave spectral line receiver. We have built such a receiver for the detection of CO<sub>2</sub> laser radiation at wavelengths near 10 microns. The spectrometer uses a high-speed HgCdTe diode as the photomixer and a small CO<sub>2</sub> laser as the local oscillator. Output signals in the intermediate frequency range 0.1-2.6 GHz are processed by a 1000-channel acousto-optic signal processor. The receiver is being used on a 1.5-m telescope on Mt. Wilson to survey a selected sample of 150 nearby stars. The current status of the work is discussed along with future project plans. Author

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**LIFE ON ICE, ANTARCTICA AND MARS Abstract Only**  
 D. T. ANDERSON, C. P. MCKAY, ROBERT A. WHARTON, JR., C. SAGAN, S. W. SQUYRES, and G. M. SIMMONS (Virginia Polytechnic Inst. and State Univ., Blacksburg.) /in NASA, Washington, Fourth Symposium on Chemical Evolution and the

Origin and Evolution of Life p 108 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

The study of the origin of life and the prospects for human exploration of Mars are two themes developed in a new 57-minute film, *Life on Ice, Antarctica, and Mars*, produced by the InnerSpace Foundation and WHRO Television for broadcast by the Public Broadcasting System (PBS). A brief explanation of the film and how it relates to the future human exploration of space is presented. Author

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**IDENTIFICATION AND CHARACTERIZATION OF EXTRATERRESTRIAL NON-CHONDRITIC INTERPLANETARY DUST Abstract Only**

D. F. BLAKE and R. H. FLEMING (Evans, Charles and Associates, Redwood City, CA) /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 109 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Interplanetary dust particles (IDPs) are among the most pristine and primitive extraterrestrial materials available for direct study. Most of the stratospheric particles selected for study from the JSC Curatorial Collection were chondritic in composition (major element abundances within a factor of two of chondritic meteorites) because this composition virtually ensures that the particle is from an extraterrestrial source. It is likely that some of the most interesting classes of IDP's have not been recognized simply because they are not chondritic or do not fit established criteria for extraterrestrial origin. Indeed, mass spectroscopy data from the Giotto Flyby of comet Halley indicate that a substantial fraction of the dust is in the submicron size range and that a majority of these particles contain C, H, O, and/or N as major elements. The preponderance of CHON particles in the coma of Halley implies that similar particles may exist in the JSC stratospheric dust collection. However, the JSC collection also contains a variety of stratospheric contaminants from terrestrial sources which have these same characteristics. Because established criteria for extraterrestrial origin may not apply to such particles in individual cases, and integrated approach is required in which a variety of analysis techniques are applied to the same particle. Non-chondritic IDP's, like their chondritic counterparts, can be used to elucidate pre- and early solar system processes and conditions. The study of non-chondritic IDP's may additionally yield unique information which bears on the nature of cometary bodies and the processing of carbonaceous and other low atomic number materials. A suite of complementary techniques, including Low Voltage Scanning Electron Microscopy (LVSEM), Energy-Dispersive X-ray Microanalysis (EDX), Secondary Ion Mass Spectrometry (SIMS) isotope-ratio imaging and Analytical Electron Microscopy (AEM), were utilized to accomplish the following two objectives: (1) to develop criteria for the unequivocal identification of extraterrestrial non-chondritic IDP's; and (2) to infer IDP parent body, solar nebula, and pre-solar conditions through the study of phases, textures, and components contained within non-chondritic IDP's. The general approach taken is designed to maximize the total information obtained from each particle. Techniques will be applied in order from least destructive to most destructive. Author

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**LDEF POST-RETRIEVAL EVALUATION OF EXOBIOLOGY INTERESTS Abstract Only**

T. E. BUNCH, F. RADICATLDIBROZOLO, and RAY FITZGERALD (Diafin, La Jolla, CA.) /in NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 110 Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Cursory examination of the Long Duration Exposure Facility (LDEF) shows the existence of thousands of impact craters of which less than 1/3 exceed 0.3 mm in diameter; the largest crater is 5.5 mm. Few craters show oblique impact morphology and, surprisingly, only a low number of craters have recognizable impact

debris. Study of this debris could be of interest to exobiology in terms of C content and carbonaceous materials. All craters greater than 0.3 mm have been imaged and recorded into a data base by the preliminary examination team. Various portions of the LDEF surfaces are contaminated by outgassed materials from experimenters trays, in addition to the LDEF autocontamination and impact with orbital debris not of extraterrestrial origin. Because interplanetary dust particles (IDP's) nominally impacted the LDEF at velocities greater than 3 km/s, the potential for intact survival of carbonaceous compounds is mostly unknown for hypervelocity impacts. Calculations show that for solid phthalic acid (a test impactor), molecular dissociation would not necessarily occur below 3 km/s, if all of the impact energy was directed at breaking molecular bonds, which is not the case. Hypervelocity impact experiments (LDEF analogs) were performed using the Ames Vertical Gun Facility. Grains of phthalic acid and the Murchison meteorite (grain diameter = 0.2 for both) were fired into an Al plate at 2.1 and 4.1 km/s respectively. The results of the study are presented, and it is concluded that meaningful biogenic elemental and compound information can be obtained from IDP impacts on the LDEF. Author

**N92-13665\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**RECENT SPECTROSCOPIC FINDINGS CONCERNING CLAY/WATER INTERACTIONS AT LOW HUMIDITY: POSSIBLE APPLICATIONS TO MODELS OF MARTIAN SURFACE REACTIVITY Abstract Only**

L. COYNE, J. BISHOP, L. HOWARD, and T. W. SCATTERGOOD (State Univ. of New York, Stony Brook.) *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 111 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

A feasibility study assessing the utility of the adaptation of near infrared correlation spectroscopy to quantifying iron and adsorbed water in some clay-based Mars soil analog materials (MarSAM's). The work was intended to constitute Phase 1 of an approach to identifying optical analytical wavelength regions, not only for important mineral classes, but for chemically active centers within them. Many of these centers are common to unrelated mineral classes and of disproportionate influence relative to the mineral structure as a whole in determining the surface reactivity of mineral surfaces. We previously reported linearity between reflectance and total iron and total moisture over a large range of both key variables. We also discovered interesting relationships between the intensity of iron bands and the relative humidity of the systems. These relationships were confirmed. We also show that, in the low humidity range, reflectance is linearly dependent on a different kind of water from that best representing the full humidity range (the kind of water associated, in clays, with surface acidity). These relationships and the sensitivity and capability of quantitation of near infrared data indicate high promise with the production of reactive surface intermediates of products of surface reactions. Author

**N92-13666\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**CRYSTAL-FIELD-DRIVEN REDOX REACTIONS: HOW COMMON MINERALS SPLIT H<sub>2</sub>O AND CO<sub>2</sub> INTO REDUCED H<sub>2</sub> AND C PLUS OXYGEN Abstract Only**

F. FREUND, F. BATLLO, R. C. LEROY, S. LERSKY, M. M. MASUDA (San Jose State Univ., CA.), and S. CHANG *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 112 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

It is difficult to prove the presence of molecular H<sub>2</sub> and reduced C in minerals containing dissolved H<sub>2</sub> and CO<sub>2</sub>. A technique was developed which unambiguously shows that minerals grown in viciously reducing environments contain peroxy in their crystal structures. The peroxy represent interstitial oxygen atoms left behind when the solute H<sub>2</sub>O and/or CO<sub>2</sub> split off H<sub>2</sub> and C as a result of internal redox reactions, driven by the crystal field. The

observation of peroxy affirms the presence of H<sub>2</sub> and reduced C. It shows that the solid state is indeed an unusual reaction medium. Author

**N92-13667\*#** California Univ., Santa Cruz. Dept. of Chemistry. **KINETICS OF THE TEMPLATE-DIRECTED OLIGOMERIZATION OF GUANOSINE 5'-PHOSPHATE-2-METHYLIMIDAZOLID: EFFECT OF TEMPERATURE ON INDIVIDUAL STEPS OF REACTIONION Abstract Only**

A. KANAVARIOTI, C. F. BERNASCONI, and D. J. ALBERAS *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 113 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Non-enzymatic, template-directed reactions have been proposed as models for prebiological polynucleotide synthesis. Chemically activated mononucleotides react in the presence of a polynucleotide, acting as the template in a Watson-Crick base-pairing fashion, and form the complementary daughter polynucleotide. Phosphoimidazole-activated nucleotides have been used successfully as substrates in these reactions. The kinetics of the guanosine 5'-monophosphate-2-methylimidazole (2-MelpmG) reaction in aqueous pH 8.0 solutions in the presence and in the absence of polycytidylate (poly(C)) were studied, acting as the template at 6, 23, and 37 C. In the absence of the template, the major reaction pathway of 2-MelpmG is hydrolysis of the P-N bond to form the unreactive guanosine 5'-monophosphate (5'-GMP) and 2-methylimidazole. Concentrated solution of 2-MelpmG (greater than 0.02 M) in the absence of the template form only a small amount dinucleotide, (pG)<sub>2</sub>, but in the presence of poly(C), oligoguanylates, (pG)<sub>n</sub> with 2 less than or = n less than or = 40, can be detected. We were able to determine the rate constants for individual steps of this reaction. A summary of the conclusions is presented. Author

**N92-13668\*#** Roswell Park Memorial Inst., Buffalo, NY. Dept. of Biophysics.

**MACROMOLECULAR RECOGNITION: STRUCTURAL ASPECTS OF THE ORIGIN OF THE GENETIC SYSTEM**

ROBERT REIN, W. ANDRZEJ SOKALSKI, DOV BARAK, NING LUO, THERESA JULIA ZIELINSKI, and MASAYUKI SHIBATA *In* NASA, Washington, Fourth Symposium on Chemical Evolution and the Origin and Evolution of Life p 114 Oct. 1991  
Avail: NTIS HC/MF A07 CSCL 06/3

Theoretical simulation of prebiotic chemical processes is an invaluable tool for probing the phenomenon of the evolution of life. Using computational and modeling techniques and guided by analogies from present day systems, we seek to understand the emergence of the genetic apparatus, enzymatic catalysis and protein synthesis under prebiotic conditions. Modeling of the ancestral aminoacyl-tRNA-synthetases (aRS) may provide important clues to the emergence of the genetic code and the protein synthetic machinery. The minimal structural requirements for the catalysis of tRNA aminoacylation are being explored. A formation of an aminoacyl adenylate was studied in the framework of ab initio molecular orbital theory. The role of individual residues in the vicinity of the TyrRS active site was examined, and the effect of all possible amino acids substitutions near the active site was examined. A formation of aminoacyl tRNA was studied by the molecular modeling system SYBYL with the high resolution crystallographic structures of the present day tRNA, aRS's complexes. The ultimate goal is to propose a simple RNA segment that is small enough to be build in the primordial chemical environment but maintains the specificity and catalytic activity of the contemporary RNA enzyme. To understand the mechanism of ribozyme catalyzed reactions, ab initio and semi-empirical (ZINDO) programs were used to investigate the reaction path of transphosphorylation. A special emphasis was placed on the possible catalytic and structural roles played by the coordinated magnesium cation. Both the inline and adjacent mechanisms of transphosphorylation were studied. The structural characteristics of the target helices, particularly a possible role for the G-T pair, is also studied by a molecular dynamics (MD) simulation technique. Author

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**BIOLOGICALLY CONTROLLED MINERALS AS POTENTIAL  
INDICATORS OF LIFE Abstract Only**

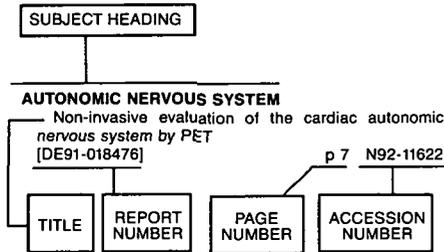
D. E. SCHWARTZ, R. L. MANCINELLI, and E. KANESHIRO  
(Cincinnati Univ., OH.) *In* NASA, Washington, Fourth Symposium  
on Chemical Evolution and the Origin and Evolution of Life p 117  
Oct. 1991

Avail: NTIS HC/MF A07 CSCL 06/3

Minerals can be produced and deposited either by abiotic or biologic means. Regardless of their origin, mineral crystals reflect the environment conditions (e.g., temperature, pressure, chemical composition, and redox potential) present during crystal formation. Biologically-produced mineral crystals are grown or reworked under the control of their host organism and reflect an environment different from the abiotic environment. In addition, minerals of either biologic or abiotic origin have great longevities. For these reasons, biologically produced minerals have been proposed as biomarkers. Biomarkers are key morphological, chemical, and isotopic signatures of living systems that can be used to determine if life processes have occurred. Studies of biologically controlled minerals produced by the protist, *Paramecium tetraurelia*, were initiated since techniques have already been developed to culture them and isolate their crystalline material, and methods are already in place to analyze this material. Two direct crystalline phases were identified. One phase, whose chemical composition is high in Mg, was identified as struvite. The second phase, whose chemical composition is high in Ca, has not been previously found occurring naturally and may be considered a newly discovered material. Analyses are underway to determine the characteristics of these minerals in order to compare them with characteristics of these minerals in order to compare them with characteristics of minerals formed abiotically, but with the same chemical composition.

Author

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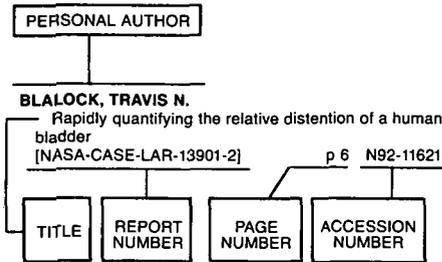
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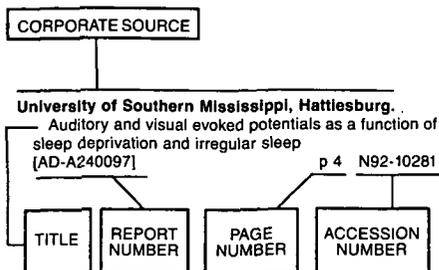
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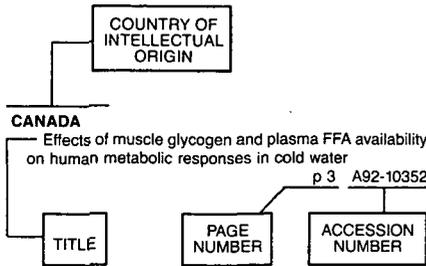
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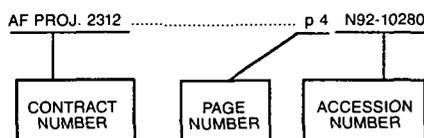
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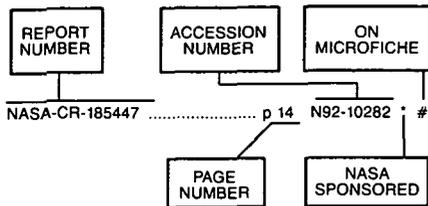


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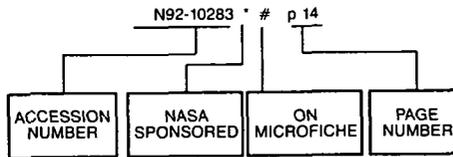


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