NASA SP-7011 (401)
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P-66

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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May 1995

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

National Aeronautics and Space Administration
Scientific and Technical Information Office
Washington, DC 1995

This publication was prepared by the NASA Center for AeroSpace Information,
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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 140 reports, articles, and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)	N95-19506 — N95-19882
Open Literature (A-60000 Series)	A95-65816 — A95-69893

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

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

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

A cumulative index for 1995 will be published in early 1996.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

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

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

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

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

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

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

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

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

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

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

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

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

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 401)

May 1995

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LIFE SCIENCES (GENERAL)

A95-66753
LABORATORY ASTROPHYSICS AND MOLECULAR ASTRONOMY OF PURE CARBON MOLECULES
P. F. BERNATH Univ. of Waterloo, Waterloo, Ontario, Canada Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 15-23
Copyright

The pure carbon molecules C(n) are currently of great experimental and theoretical interest. Our work in this area begins with detection of the SiC molecule, which is isovalent with C2. New infrared electronic transitions of C2 and C3 were discovered by emission spectroscopy of hydrocarbon dicharges. The C3 and C5 molecules were found by infrared vibration-rotation spectroscopy of the prototypical obscured carbon star, IRC+10216. C7 and C9 were searched for in the same source, but not found. The laboratory infrared emission spectrum of C60 was recorded to aid in a search for C60 in extraterrestrial sources. Author (Herner)

A95-66754* National Aeronautics and Space Administration, Washington, DC.
TOWARD THE DETECTION OF PURE CARBON CLUSTERS IN THE INTERSTELLAR MEDIUM (ISM)
J. R. HEATH T. J. Watson Research Center, Yorktown Heights, NY, US, A. VAN ORDEN Univ. of California, Berkeley, CA, US, H. J. HWANG Univ. of California, Berkeley, CA, US, E. W. KUO Univ. of California, Berkeley, CA, US, K. TANAKA Kyushu Univ., Higashiku, Fukuoka, Japan, and R. J. SAYKALLY Univ. of California, Berkeley, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 25-33 Research sponsored by the NSF (Contract(s)/Grant(s): NAGW-2991; NAGW-2763)
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Determination of the form and distribution of carbon in the universe is critical to understanding the origin of life on Earth and elsewhere. Two potentially large reservoirs of carbon in the interstellar medium (ISM) remain unexplored. These are polycyclic aromatic hydrocarbons (PAH) and pure carbon clusters. Little information exists on the structures, properties, and transition frequencies of pure carbon clusters. The work described is designed to provide a specific inventory of laboratory frequencies and physical properties of this carbon clusters so that efforts can be made to detect them in cold interstellar sources by far-infrared astronomy. Data is given from infrared laser spectroscopy determination of the structure of C3, C4, C5, C6, C7, and C9. Herner

A95-66755* National Aeronautics and Space Administration, Washington, DC.
ORGANIC MOLECULES IN THE GAS PHASE OF DENSE INTERSTELLAR CLOUDS
W. M. IRVINE Univ. of Massachusetts, Amherst, MA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 35-43
(Contract(s)/Grant(s): NAGW-436; NSF AST-91-15721)
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Since a previous Committee on Space Research (COSPAR) review on this subject, the number of molecular species identified by astronomers in dense interstellar clouds or in the envelopes expelled by evolved stars has grown from about eighty to approximately one hundred. Recent detections in stellar envelopes include the radical CP, the second phosphorus-containing astronomical molecule; SiN, the first astronomical molecule with a Si-N bond; and the HCCN radical. In the dense interstellar clouds recent detections or verifications of previous possible identifications include the H3O(+) ion, which is a critical intermediary in the production of H2O and O2; the CCO radical, which is isoelectronic with HCCN; the SO(+) ion, which appears to be diagnostic of shock chemistry; two new isomers of cyanoacetylene, HCCNC and CCCNH; and the two cumulenes H2C3 and H2C4. Some recent work is also described on the mapping of interstellar clouds in multiple molecular transitions in order to separate variations in chemical abundance from gradients in physical parameters. Author (Herner)

A95-66757
COMETARY ORIGIN OF THE BIOSPHERE: A PROGRESS REPORT
A. H. DELSEMME Univ. of Toledo, Toledo, OH, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 49-57
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Empirical evidence of the accretion temperature for undifferentiated meteorites coming from the asteroid belt, combined with any reasonable temperature gradient extending from the asteroid belt to the Earth's zone, suggests that the Earth accreted from very hot dust grains that were degassed from all volatile elements and depleted in labile compounds. Isotopic evidence from the atmospheric noble gases also shows that no primary atmosphere has survived on the Earth. The only possible source for the atmosphere and the oceans is therefore the cometary bombardment that is predicted as the inescapable consequence of the formation of the giant planets. This implies that comets are the only source of organic carbon, nitrogen and water, hence of the total biosphere of the Earth.
Author (Herner)

A95-66758
MASS-SPECTROMETRIC IN SITU STUDIES OF COMETARY ORGANICS FOR P/HALLEY AND OPTIONS FOR THE FUTURE
J. KISSEL Max Planck Institut fuer Kernphysik, Heidelberg, Germany and F. R. KRUEGER Ing.-Bureau Krueger, Darmstadt, Germany Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 59-63

When the VEGA and GIOTTO spacecrafts flew by comet p/Halley in 1986 the mass-spectrometers Puma and Particulate Impact Analyzer (PIA) measured the composition of cometary dust particles impacting at speeds of well above 65 km/s. Ion formation upon impact lead to mostly atomic ions. However, a small fractions of the ions measured could be related to molecules. A sophisticated analysis allowed for the first time to point to the chemical nature of cometary organics based on actual mass spectra. With the instrument Cometary Matter Analyzer (CoMA) for the NASA-BMFT mission Comet Rendezvous Asteroid Flyby (CRAF) much higher mass-resolution and molecule masses become accessible for in situ measurement, and will yield complementary information to the gas chromatograph CIDEX also onboard CRAF. Author (Herner)

A95-66759
POSSIBLE EVIDENCE OF HYDROCARBONS RELEASED BY THE NUCLEUS OF HALLEY'S COMET
G. MOREELS Observatoire de Besancon, Besancon, France, J. CLAIREMIDI Observatoire de Besancon, Besancon, France, and P. ROUSSELOT Observatoire de Besancon, Besancon, France Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 65-70

After subtracting the intense dust-scattered continuum from the original spectra transmitted by the Vega 2 three-channel spectrometer, a broad-band emission emerges in the 342-375 nm spectral range when the cometocentric projected distance p is smaller than 5000 km. This newly detected emission varies as p(exp -1), which implies that the involved molecule(s) has a parent-type behavior. The emission band presents four peaks at 347, 356, 364, and 373 nm. It is tentatively identified as being due to phenanthrene, a three-cycle aromatic condensed hydrocarbon. A determination of the gQ product, where g is the fluorescence quantum efficiency and Q the production rate gives gQ = 1.2 x 10(exp 25). If g = 0.012, it comes Q = 1 x 10(exp 27)/s. The detection of phenanthrene in Halley's inner coma is an important argument in favor of a similarity of composition between cometary material and interstellar matter. It supports the hypothesis that comets have kept trace of the interstellar composition through the solar system formation epoch. Author (Herner)

A95-66760
ORGANIC ANALYSIS OF HYDROGEN CYANIDE POLYMERS: PREBIOTIC AND EXTRATERRESTRIAL CHEMISTRY
S. A. LIEBMAN CCS Instrument Systems, Inc., Avondale, PA, US, R. A. PESCE-RODRIGUEZ U.S. Army Research Lab., Aberdeen, MD, US, and C. N. MATTHEWS Univ. of Illinois at Chicago, Chicago, IL, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 71-80

Hydrogen cyanide polymerizes readily to a black solid from which a yellow-brown powder can be extracted by water and further hydrolyzed to alpha-amino acids. These macromolecules could be major components of the dark matter observed on many bodies in the outer solar system, including comets and asteroids. Primitive Earth might therefore have been covered with HCN polymers through bolide bombardment or by terrestrial synthesis. Several instrumental methods were used for the separation and identification of these intriguing polymetic materials, including photoacoustic Fourier transform infrared spectroscopy, supercritical fluid extraction chromatography and pyrolysis mass spectrometry. Our integrated analytical approach revealed fragmentation patterns and chemical functionalities consistent with the presence of polymeric peptide precursors both in HCN polymers and in the Murchison meteorite. Author (Herner)

A95-66761*
COMETS AND LIFE IN THE UNIVERSE
J. ORO Univ. of Houston, Houston, TX, US, T. MILLS Univ. of Houston, Houston, TX, US, and A. LAZCANO Facultad de Ciencias-UNAM, Mexico, Mexico Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 81-90 Research sponsored by NASA

The notion that comets supplied the primitive Earth with the requisite chemical species for the process of chemical evolution, which is widely held to have led to the origin of life on Earth, has now gained considerable intellectual momentum since its first formulation in 1961. The role of comets in the Earth's biogenesis has been thoroughly addressed in the literature. At this time, in light of a few recent findings, we present here a concise review of this topic together with a brief discussion of the possible role of cometary material in the origin of life elsewhere in the Universe. Author (Herner)

A95-66762* National Aeronautics and Space Administration, Washington, DC.
CHARACTERISTICS AND FORMATION OF AMINO ACIDS AND HYDROXY ACIDS OF THE MURCHISON METEORITE
J. R. CRONIN Arizona State Univ., Tempe, AZ, US, G. W. COOPER Arizona State Univ., Tempe, AZ, US, and S. PIZZARELLO Arizona State Univ., Tempe, AZ, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 91-97
(Contract(s)/Grant(s): NAGW-1899; NGT-70100)

Eight characteristics of the unique suite of amino acids and hydroxy acids found in the Murchison meteorite can be recognized on the basis of detailed molecular and isotopic analyses. The marked structural correspondence between the alpha-amino acids and alpha-hydroxy acids and the high deuterium/hydrogen ratio argue persuasively for their formation by aqueous phase Strecker reactions in the meteorite parent body from presolar, i.e., interstellar, aldehydes, ketones, ammonia, and hydrogen cyanide. The characteristics of the meteoritic suite of amino acids and hydroxy acids are briefly enumerated and discussed with regard to their consonance with this interstellar-parent body formation hypothesis. The hypothesis has interesting implications for the organic composition of both the primitive parent body and the presolar nebula. Author (Herner)

A95-66763* National Aeronautics and Space Administration, Washington, DC.
STABLE ISOTOPE ANALYSIS AT THE MOLECULAR LEVEL: A NEW APPROACH FOR DETERMINING THE ORIGINS OF AMINO ACIDS IN THE MURCHISON METEORITE
M. H. ENGEL Univ. of Oklahoma, Norman, OK, US, S. A. MACKO Univ. of Virginia, Charlottesville, VA, US, Y. QIAN Univ. of

Oklahoma, Norman, OK, US, and J. A. SILFER Univ. of Oklahoma, Norman, OK, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 99-106
(Contract(s)/Grant(s): NAGW-2765)

A combined gas chromatography/isotope ratio mass spectrometry (GC/IRMS) method has been developed that permits the direct stable carbon isotope analysis of N(O)-trifluoroacetyl-isopropyl esters of individual amino acids and their respective enantiomers at nanomole abundances. Calculation of the original delta C-13 values of the amino acids is accomplished via a correction for the carbon introduced during the derivatization process. Previous GC/IRMS analyses of individual amino acids in the non-hydrolyzed water extract of an interior sample of a Murchison meteorite stone revealed an enrichment in C-13 relative to terrestrial organic matter, in agreement with previous findings for bulk extracts. The range of amino acid delta C-13 values (+5 to +30 per mill, PDB) suggests possible kinetic effects during synthesis. In this study, an apparent kinetic isotope effect was also observed for the amino acid products of a spark discharge experiment. These preliminary resutls are supportive of a similar mechanism for the abiotic synthesis of amino acids in the Murchison meteorite. Author (Herner)

A95-66765
WERE MICROMETEORITES A SOURCE OF PREBIOTIC MOLECULES ON THE EARLY EARTH?

M. MAURETTE Centre de Spectrometrie Nucleaire, Orsay-Campus, France, A. BRACK Centre de Biphysique Moleculaire du CNRS, Orleans, France, G. KURAT Naturhistorisches Museum, Wien, Austria, M. PERREAU ONERA, Chatillon, France, and C. ENGRAND Centre de Spectrometrie Nucleaire, Orsay-Campus, France Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 113-126 Research sponsored by the Austrian FWF
(Contract(s)/Grant(s): EEC-SC1-CT-91-0618)

Interplanetary Dust Particles (IDPs) with sizes approximately 10 micrometer collected in the stratosphere (IDPs), as well as much larger 'giant' micrometeorites retrieved from Antarctic ice melt water (AMMs), are mostly composed of unequilibrated assemblages of minerals, thus being related to primitive unequilibrated meteorites. Two independent evaluations of the mass flux of micrometeorites measuring approximately 50 micrometer to approximately 200 micrometer, recovered from either the Greenland or the Antarctic ice sheets have been reported (approximately 20,000 tons/a). A comparison with recent evaluation of the flux of meteorites reaching the Earth'surface (up to masses of 10,000 tons), indicates that micrometeorites represent about 99.5% of the extraterrestrial material falling on the Earth'surface each year. As they show carbon concentrations exceeding that of the most C-rich meteorite (Orgueil), they are the major contributors of extraterrestrial C-rich matter accreting to the Earth today. Moreover they are complex microstructured aggregates of grains. They contain not only a variety of C-rich matter, such as a new 'dirty' magnetite phase enriched in P, S, and minor elements, but also a diversity of potential catalysts (hydrous silicates, oxides, sulfides and metal grains of Fe/Ni composition, etc.). They could have individually functioned on the early Earth, as 'micro-chondritic-reactors' for the processing of prebiotic organic molecules in liquid water. Future progress requires the challenging development of meaningful laboratory simulation experiments, and a better understanding of the partial reprocessing of micrometeorites in the atmosphere. Author (Herner)

A95-66767
RADIATION AND THERMAL STABILITIES OF ADENINE NUCLEOTIDES

V. V. DEMIDOV Russian Academy of Sciences, Kurchatov Square, Moscow, Russia, V. N. POTAMAN Russian Academy of Sciences, Kurchatov Square, Moscow, Russia, I. P. SOLYANINA Scientific Industrial Association Biotechnology, Moscow, Russia, and V. I. TROFIMOV Scientific Industrial Association Biotechnology, Moscow, Russia Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 131-134

We have investigated in detail radiation and thermal stabilities and transformations of adenosine mono- and trophosphates in liquid and frozen solid aqueous solutions within a wide range of absorbed radiation dose (up to 75 kGy) and temperature (up to 160 C). Dephosphorylation is the main pathway of high temperature hydrolysis of adenine nucleotides. Basic thermodynamic and kinetic parameters of this process have been determined. Radiolysis of investigated compounds at room temperature results in scission of N-glycosidic bond with a radiation yield about of 1 mol/100 eV. Solution freezing significantly enhances radiation stability of nucleotides as well as other biomolecules. This circumstance is essential in the discussion of panspermia concepts. Author (Herner)

A95-66769
EXTINCTION OF DINOSAURS: A POSSIBLE NOVEL CAUSE

S. RAMADURAI Tata Inst. of Fundamental Research, Bombay, India, DAVID LLOYD Univ. of Wales, Cardiff, UK, MAX WALLIS Univ. of Wales, Cardiff, UK, and N. C. WICKRAMASINGHE Univ. of Wales, Cardiff, UK Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 139-146 Research sponsored by INDO-US, the Univ. of Wales, and Queen Mary and Westfield College, London, UK

A novel cause of mass extinction of fauna close to the Cretaceous/Tertiary (K/T) Boundary is suggested. A large amount of non-protein amino acids alpha-amino isobutyric acid (AIB) and isovuline (ISOVAL) has been observed close to this event. It is speculated that these amino acids may be toxic and are responsible for the extinction. The toxicity level is estimated for this suggestion to be true and experimentalists are encouraged to test this level of toxicity for the amino acids. Author (Herner)

A95-66777* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A PRELIMINARY COMPARISON OF TWO PERENNIALLY ICE-COVERED LAKES IN ANTARCTICA: ANALOGS OF PAST MARTIAN LACUSTRINE ENVIRONMENTS

D. T. ANDERSEN SETI Inst., Mt. View, CA, US, P. DORAN Desert Research Inst., Reno, NV, US, D. BOLSHIYANOV Inst. of Arctic and Antarctic Research, St. Petersburg, Russia, J. RICE Arizona State Univ., Tempe, AZ, US, V. GALCHENKO Russian Academy of Sciences, Moscow, Russia, N. CHERYCH Russian Academy of Sciences, Moscow, Russia, R. A. WHARTON Desert Research Inst., Reno, NV, US, C. P. MCKAY NASA. Ames Research Center, Moffett Field, CA, US, M. MEYER Lockheed Engineering and Sciences Co., Washington, DC, US, and V. GARSHNEK Lockheed Engineering and Sciences Co., Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 199-202

Perennially ice-covered lakes in the Antarctic have been suggested as analogs to lakes which may have existed on the surface of Mars 3.5 billion years ago. During the 1991-1992 austral summer, a joint Russian/American research effort was directed at studies of ice-covered lakes in the Bunger Hills Oasis, Antarctica (66 deg S, 100 deg E). The primary objective of the expedition was to investigate this ice-free area for features analogous to ancient martian environments that may have been capable of supporting life and to compare the ice-covered lakes of the Bunger Hills with those in the McMurdo Dry Valleys of southern Victoria Land (77 deg S, 166 deg E) as part of the continuing studies of Antarctic-Mars analogs. Author (Herner)

A95-66778
BIOCHEMICAL CONSTRAINTS FOR SURVIVAL UNDER MARTIAN CONDITIONS

K. DOSE J. Gutenberg-Universitaet, Mainz, Germany, C. STRIDDE J. Gutenberg-Universitaet, Mainz, Germany, R. DILLMANN J. Gutenberg-Universitaet, Mainz, Germany, S. RISI J. Gutenberg-Universitaet, Mainz, Germany, and A. BIEGER-DOSE J. Gutenberg-Universitaet, Mainz, Germany Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 203-210

A wide variety of terrestrial organisms, the so-called 'anhydrobiotes,' have learned to survive in a state of extreme dehydration in dry environments. Strategies for survival include the accumulation of certain polyols and nonreducing saccharides, which help to prevent damage to membranes and proteins, but at low water partial pressure DNA is also progressively damaged by various lesions, including strand breaks and cross-linking to proteins. These lesions, if they are not too numerous, can be repaired before the first replication step after rehydration, but long-term exposure to dry conditions finally diminishes the chances of survival as these lesions accumulate. If an organism has no chance to repair the accumulated DNA damage during intermittent periods of active life, survival will not exceed a few decades. The restriction of survival by dryness-induced DNA lesions is corroborated by new data on conidia of Aspergillus and the free plasmid pBR 322. Our results will be discussed with respect to the chance of finding dormant life or biochemical fossils on the surface of Mars. Author (Herner)

A95-66779
STUDIES IN THE SEARCH FOR LIFE ON MARS

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The ability of living organisms to survive extraterrestrial conditions has implications for the origins of life in the solar system. We have therefore studied the survival of viruses, bacteria, yeast, and fungi under simulated Martian conditions. The environment on Mars was simulated by low temperature, proton irradiation, ultraviolet irradiation, and simulated Martian atmosphere (CO2 95.46%, N2 2.7%, water vapor 0.03%) in a special cryostat. After exposure to these conditions, tobacco mosaic virus and spores of Bacillus, Aspergillus, Clostridium, and some species of coccus showed significant survival. Author (Herner)

A95-66780
BIOGEOCHEMICAL EVIDENCE OF MICROBIAL ACTIVITY ON MARS

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We suggest a new interpretation of the data on and chassignites (SNC meteorites) and delta C-13 values of the calcium carbonate minerals and organic matter discovered in them. The delta C-13 value of calcite (up to 15 ppt) is accounted for by the microbial reaction CO2 + H2 yields CH4 + H2O. Methane-forming bacteria also synthesize organic carbon (in the form of biomass) from CO2, and this process is accompanied by C-12 fractionation. Therefore, the organic carbon of SNC meteorites is enriched with C-12 (delta C-13 as low as -35 ppt). The environmental conditions under which the calcite of SNC meteorites was formed were favorable for the activity of methanogens. Author (Herner)

A95-66781* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A 'CRYTIC' MICROBIAL MAT: A NEW MODEL ECOSYSTEM FOR EXTANT LIFE ON MARS

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If life were present on Mars today, it would face potentially lethal environmental conditions such as a lack of water, frigid temperatures, ultraviolet radiation, and soil oxidants. In addition, the Viking missions did not detect near-surface organic carbon available for assimilation. Autotrophic organisms that lived under a protective layer of sand or gravel would be able to circumvent the ultraviolet radiation and lack of fixed carbon. Two terrestrial photosynthetic near-surface microbial communities have been identified, one in the inter- and supertidal of Laguna Ojo de Liebere (Baja California Sur, Mexico) and one in the acidic gravel near several small geysers in Yellowstone National Park (Wyoming, U.S.A.). Both communities have been studied with respect to their ability to fix carbon under different conditions, including elevated levels of inorganic carbon. Although these sand communities have not been exposed to the entire suite of Martian environmental conditions simultaneously, such communities can provide a useful model ecosystem for a potential extant Martian biota. Author (Herner)

A95-66783
PRESERVATION OF CELL STRUCTURES IN PERMAFROST: A MODEL FOR EXOBIOLOGY

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The present report is the first contribution toward a comprehensive fine-structural study of microbial cells from permafrost. Prokaryotes with a variety of cell wall types demonstrate high stability of cell structure after long-term cryopreservation in frozen soils and sediments of the Arctic. The surface capsular layers that were a salient

feature of the cells both in situ and on nutrient media may be an adaptation to low temperature. To the extent that permafrost regions on Earth approximate Martian conditions, preservation of cell structure there can serve as the basis for predictions about preservation in Martian permaforst sediments. Author (Herner)

A95-66784
A PRIMITIVE CYANOBACTERIUM AS PIONEER MICROORGANISM FOR TERRAFORMING MARS
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The primitive characteristics of the cyanobacterium Chroococcidiopsis suggest that it represents a very ancient type of this group. Its morphology is simple but shows a wide range of variability, and it resembles certain Proterozoic microfossils. Chroococcidiopsis is probably the most desiccation-resistant cyanobacterium, the sole photosynthetic organism in extreme arid habitats. It is also present in a wide range of other extreme environments, from Antarctic rocks to thermal springs and hypersaline habitats, but it is unable to compete with more specialized organisms. Genetic evidence suggests that all forms belong to a single species. Its remarkable tolerance of environmental extremes makes Chroococcidiopsis a prime candidate for use as a pioneer photosynthetic microorganism for terraforming of Mars. The hypolithic microbial growth form (which lives under stones of a desert pavement) could be used as a model for development of technologies for large-scale Martian farming. Author (Herner)

A95-66793* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SURFACE-ATMOSPHERE INTERACTIONS ON TITAN COMPARED WITH THOSE ON THE PRE-BIOTIC EARTH
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The surface and atmosphere of Titan constitute a system which is potentially as complex as that of the Earth, with the possibility of precipitation, surface erosion due to liquids, chemistry in large surface or subsurface hydrocarbon resevoirs, surface expressions of internal activity, and occasional major impacts leading to crustal melting. While none of the above have been observed as yet, the composition, density and thermal properties of Titan's atmosphere make it uniquely suited in the outer solar system as a place where such processes may occur. The one attribute of the Earth not expected on Titan is biological activity, which has had a profound effect on the evolution of the Earth's surface-atmosphere system. The earliest environment of Titan could have been warm enough for liquid ammonia-water solutions to exist on or near surface; pre-biotic organic processes may have taken place in such an environment. After a few hundred million years surface ammonia-water would have disappeard. Therefore, study of Titan through Cassini/Huygens mission, planned for launch in 1997, primarily affords the opportunity to understand planet-side surface-atmophsre interactions in the presence of fluids but in the absence of life. More speculative is the possibility that endogenic and exogenic heating continue to provide short-lived environments on Titan wherein pre-biotic organic processes in the presence of water happen.
Author (Herner)

A95-66794* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE PHYSICAL NATURE OF TITAN'S AEROSOLS: LABORATORY SIMULATIONS
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The atmosphere of Titan is known to contain aerosols, as evidenced by the Voyager observations of at least three haze layers. Such aerosols can have significant effects on the reflection spectrum of Titan and on the chemistry and thermal structure of its atmosphere. To investigate some of these effects laboratory simulations of the chemistry of Titan's atmosphere have been done. The results of these studies show that photolysis of acetylene, ethylene, and hydrogen cyanide, known constituents of Titan's atmosphere, yields sub-micron sized spheres, with mean diameters ranging from 0.4 to 0.8 micron, depending on the pressures of the reactant gases. Most of the spheres are contained in near-linear aggregates. The formation of the aggregates is consistent with models of Titan's reflection spectrum and polarization, which are best fit with non-spherical particles. At room temperature, the particles are very sticky, but their properties at low temperatures on Titan are presently not known. Author (Herner)

A95-66797* National Aeronautics and Space Administration, Washington, DC.
ANALYTICAL PYROLYSIS EXPERIMENTS OF TITAN AEROSOL ANALOGUES IN PREPARATION FOR THE CASSINI HUYGENS MISSION
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(Contract(s)/Grant(s): NAGW-1896)
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Comparative pyrolysis mass spectrometric data of Titan aerosol analogs, called 'tholins', are presented. The Titan tholins were produced in the laboratory at Cornell by irradiation of simulated Titan atmospheres with high energy electrons in plasma discharge. Mass-spectrometry measurements were performed at FOM of the solid phase of various tholins by Curie-point pyrolysis Gas-Chromatography/Mass-Spectrometry (GCMS) and by temperature resolved in-source Pyrolysis Mass-Spectrometry to reveal the composition and evolution temperature of the dissociation products. The results presented here are used to further define the ACP (Aerosol Collector Pyrolyser)-GCMS experiment and provide a basis for modelling of aerosol composition on Titan and for the iterpretation of Titan atmosphere data from the Huygens probe in the future.
Author (Herner)

A95-66798* National Aeronautics and Space Administration, Washington, DC.
ON THE LEVELS OF ENZYMATIC SUBSTRATE SPECIFICITY: IMPLICATIONS FOR THE EARLY EVOLUTION OF METABOLIC PATHWAYS
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Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 345-356
Research sponsored by UNAM
(Contract(s)/Grant(s): NAGW-2788)

The most frequently invoked explanation for the origin of metabolic pathways is the retrograde evolution hypothesis. In contrast, according to the so-called 'patchwork' theory, metabolism evolved by the recruitment of relatively inefficient small enzymes of broad specificity that could react with a wide range of chemically related substrates. In this paper it is argued that both sequence comparisons and experimental results on enzyme substrate specificity support the patchwork assembly theory. The available evidence supports previous suggestions that gene duplication events followed by a gradual neoDarwinian accumulation of mutations and other minute genetic changes lead to the narrowing and modification of enzyme function in at least some primordial metabolic pathways.
Author (Herner)

A95-66799
ROLE OF TRACE METAL IONS IN CHEMICAL EVOLUTION. THE CASE OF FREE-RADICAL REACTIONS
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We have studied the effect of iron in the free-radical oligomerization of hydrogen cyanide and acetic acid, and found that iron(II) and iron(III) readily reduces or oxidizes free radicals, respectively. The transient species produce by these reactions do not induce a chain ologomerization process and, therefore, they protect the solute molecules from degradation. Analysis of the available kinetic data for the reactions of a variety of transition metal ions with free radicals indicate that transition metal ions behave similarly to iron. Since Fe, Zn and Mo are essential to all living organisms, and there seems to be no apparent difference in chemical reactivity among transition metal ions towards free radicals, we suggest that these metal ions probably protected the biomolecules from degradation induced by free-radical reactions in the later stages of chemical evolution.
Author (Herner)

A95-66800
DIRECT INTERACTION BETWEEN AMINO ACIDS AND NUCLEOTIDES AS A POSSIBLE PHYSICOCHEMICAL BASIS FOR THE ORIGIN OF THE GENETIC CODE
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A study of the association of homocodonic amino acids and selected heterocodonic amino acids with selected nucleotides in aqueous solution was undertaken to examine a possible physical basis for the origin of codon assignments. These interactions were studied using 1H nuclear magnetic resonance spectroscopy (NMR). Association constants for the various interactions were determined by fitting the changes in the chemical shifts of the anomeric and ring protons of the nucleoside moieties as a function of amino acid concentration to an isotherm which described the binding interaction. The strongest association of all homocodonic amino acids were with their respective anticodonic nucleotide sequences. The strength of association was seen to increase with increase in the chain length of the anticodonic nucleotide. The association of these amino acids with different phosphate esters of nucleotides suggests that a definite isomeric structure is required for association with a specified amino acid; the 5'-mononucleotides and (3'-5') - linked dinucleotides are the favored geometries for strong associations. Use of heterocodonic amino acids and nonprotein amino acids supports these findings. We conclude that there is at least a physicochemical, anticodonic contribution to the origin of the genetic code.
Author (Herner)

A95-66802* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VERY LOW TEMPERATURE FORMALDEHYDE REACTIONS AND THE BUILD-UP OF ORGANIC MOLECULES IN COMETS AND INTERSTELLAR ICES
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We have investigated thermally promoted reactions of formaldehyde (H2CO) in very low temperature ices. No such reactions occurred in ices of pure formaldehyde. However, addition of trace amounts of ammonia (NH3) were sufficient to catalyze reactions at temperatures as low as 40 K. Similar reactions could take place in interstellar ices and in Comets and produce considerable amounts of organic molecules.
Author (Herner)

A95-66804* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
POLYCYCLIC AROMATIC HYDROCARBON IONS AND THE DIFFUSE INTERSTELLAR BANDS
F. SALAMA NASA. Ames Research Center, Moffett Field, CA, US and L. J. ALLAMANDOLA NASA. Ames Research Center, Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 413-422

Neutral naphthalene (C10H8), phenanthrene (C14H10), and pyrene (C16H10) absorb strongly in the ultraviolet and may contribute to the extinction curve. High abundances are required to produce detectable structures. The cations of these Polycyclic Aromatic Hydrocarbons (PAHs) absorb in the visible. C10H8(+) has 12 discrete absorption bands which fall between 6800 and 5000 A. The strongest band at 6741 A falls close to the weak 6742 A diffuse interstellar band (DIB). Five other weaker bands also match DIBs. The possibility that C10H8(+) is responsible for some of the DIBs can be tested by searching for new DIBS at 6520, 6151, and 5965 A, other moderately strong naphthalene cation band positions. If C10H8(+) is indeed responsible for the 6742 A feature, it accounts for 0.3% of the cosmic carbon. The spectrum of C16H10(+) is dominated by a strong band at 4435 A in an Ar matrix and 4395 A in a Ne matrix, a position which falls very close to the strongest DIB, that at 4430 A. If C16H10(+), or a closely related pyrene-like ion is indeed responsible for the 4430 A feature, it accounts for 0.2% of the cosmic carbon. We also report an intense, very broad UV-to-visible continuum which is associated with both ions and could explain how PAHs convert interstellar UV and visible radiation into IR.
Author (Herner)

A95-66805* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COSMIC DUST ANALOG SIMULATION IN A MICROGRAVITY ENVIRONMENT: THE STARDUST PROGRAM
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We have undertaken a project called STARDUST which is a collaboration with Italian and American investigators. The goals of this program are to study the condensation and coagulation of refractory materials from the vapor and to study the properties of the resulting grains as analogs to cosmic dust particles. To reduce thermal convective currents and to develop valuable experience in designing an experiment for the Gas-Grain Simulation Facility aboard Space Station, Freedom we have built and flown a new chamber to study these processes under periods of microgravity available on NASA's KC-135 Research Aircraft. Preliminary results from flights with magnesium and zinc are discussed.
Author (Herner)

A95-66807
ISOTOPE FRACTIONATIONS IN THE TERRESTRIAL CARBON CYCLE: A BRIEF OVERVIEW
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The bias in favor of isotopically light carbon inherent in biological carbon fixation has brought about an isotopic disproportionation of primordial (mantle-derived) carbon on a global scale, causing an enrichment of C-12 in reduced (biogenic) carbon and a concomitant accumulation of the heavy complement (C-13) in the residual oxidized (inorganic) carbon pool. As a result, the terrestrial carbon cycle has gone bipartite, comprising an organic branch of isotopically light carbon, and an inorganic branch made up of C-13-enriched carbon (mostly in the form of carbonate). The isotopic disparity between the two principal terrestrial carbon species can be traced back over 3.8 Gyr of Earth history, attesting to a biological modulation of the carbon cycle since the time of formation of the oldest sediments. Author (Herner)

A95-67426
INTELLIGENT MATERIALS PROPERTIES OF DNA AND STRATEGIES FOR ITS INCORPORATION INTO ELECTROACTIVE POLYMERIC THIN FILM SYSTEMS
KENNETH A. MARX Univ. of Massachusetts Lowell, Lowell, MA, JEONG OK LIM, DANIEL MINEHAN, RAJIV PANDE, MANJUNATH KAMATH, and SUKANT K. TRIPATHY Journal of Intelligent Material Systems and Structures (ISSN 1045-389X) vol. 5, no. 4 July 1994 p. 447-454 refs
(BTN-94-EIX94501433007) Copyright

We propose to create a novel class of intelligent materials by integrating two separate classes of intelligent materials - one biological and the other a thin film conducting polymer. The first class, DNA possesses superior intelligent material properties designed over evolutionary time to function specifically and efficiently in integrated macromolecular arrays in cells called chromosomes. The second material is the polymeric thin film or two-dimensional Langmuir Blodgett (LB) monolayer film. In our approach, films will be comprised of electroactive alkylated conducting polymeric materials, such as polyalkylpyrrole and polyalkylthiophene, that are derivatized with biotin. Steptavidin conjugated DNA will be attached directly or biotinylated DNA will be stably attached to this film via a bridging streptavidin protein. To date, the bulk of our work has centered on characterizing the DNA binding to thick films of conducting polymers. A near term aim is to incorporate this signal transduction system into fiber optic biosensors for specifically detecting nucleic acid analyte. Our ultimate aim is to create novel ordered structures possessing unique integrated intelligent functions which respond to their environment and provide signal transduction approaches via their electronic and optical functions. Author (EI)

A95-68775
THE USE OF COSMIC RAYS FOR CONTINUOUS MONITORING AND PREDICTION OF SOME DANGEROUS PHENOMENA FOR THE EARTH'S CIVILIZATION
L. I. DORMAN Inst. of Terrestrial Magnetism, Troitsk, Moscow, Russia, N. IUCCI Univ. 'La Sapienza', Rome, Itlay, and G. VILLORESI Univ. 'La Sapienza', Rome, Italy Astrophysics and Space Science (ISSN 0004-640X) vol. 208, no. 1 October 1993 p. 55-68
(HTN-95-60524) Copyright

The main idea of the International Cosmic Ray Service (ICRS) is to combine satellite and spaceprobe cosmic rays, magnetic and plasma data with groudbased cosmic ray data (exchanged in real time) for obtaining continuous information on the electromagnetic and radiation situation in the interplanetary space and Earth's magnetosphere: prediction of great geomagnetic storms, big increases of radiation hazards and other dangerous phenomena in space and on the Earth for people and technology. ICRS can predict not only geomagnetic storms and unfavorable days in the environment (especially important for old people and people with some disease), but, in combination with astrophysical methods, can predict big increases of radiation hazards very dangerous for the Earth's civilization and big changes in the environment due to extremely powerful solar flares and local supernova explosions. We hope that, after some additional investigation of high energy cosmic-ray distribution function outside the heliosphere, it could be possible to solve by ICRS more complicated problems: to determine in combination with astrophysical methods the location and velocity of nearest dust-molecular galactic clouds with frozen-in magnetic fields and predict the expected time of the Sun capturing by some clouds with possible changes of Earth's global climate. The foundation of ICRS could bring a new possibility of development to the cosmic ray observatories, release scientists from a lot of routine work and increase the fundamental and applied research efficiency.
Author (Herner)

A95-68885
MYOSIN ISOFORMS IN MAMMALIAN SKELETAL MUSCLE
STEFANO SCHIAFFINO Padova Univ., Padua, Italy and CARLO REGGIANI Pavia Univ., Pavia, Italy Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 493-501 Research sponsored by Ministero dell'Universita e delle Ricerca Scientifica e Tecnologica of Italy, Agenzia Spaziale Italiana, and Telethon-Italia
(HTN-95-A0102) Copyright

Skeletal muscles of different mammalian species contain four major myosin heavy-chain (MHC) isoforms: the ?slow' or beta-MHC and the three ?fast' IIa-, IIx-, and IIb-MHCs; and three major myosin light-chain (MLC) isoforms, the ?slow' MLC1s and the two ?fast' MLC1f and MLC3f. The differential distribution of the MHCs defines four major fiber types containing a single MHC isoform and a number of intermediate hybrid fiber populations containing both beta slow- and IIa-MHC, IIa- and IIx-MHC, or IIx- and IIb-MHC. The IIa-, IIx-,

and IIb-MHCs were first detected in neonatal muscles, and their expression in developing and adult muscle is regulated by neural, hormonal, and mechanical factors. The transcriptional mechanisms responsible for the fiber type-specific regulation of MHC and MLC gene expression are not known and are presently being explored by in vivo transfection experiments. The functional role of MHC isoforms has been in part clarified by correlated biochemical-physiological studies on single skinned fibers: these studies, in agreement with results from in vitro motility assays, indicate that both MHC and MLC isoforms determine the maximum velocity of shortening of skeletal muscle fibers.
Author (Herner)

A95-68886
CAROTOID BAROREFLEX CONTROL OF BLOOD PRESSURE AND HEART RATE IN MEN DURING DYNAMIC EXERCISE
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Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 502-506 Research sponsored by Inst. de Recherches Internationales Servier
(Contract(s)/Grant(s): NIH-HL-16910)
(HTN-95-A0103)

The degree of control of blood pressure (BP) and heart rate (HR) by arterial baroreflex during exercise is still controversial. We studied baroreflex control of BP and HR in seven normal young men by a noninvasive procedure employing a neck suction chamber that delivers pulsatile positive and negative pressures to the carotid sinus (CS). Pressures applied to the CS ranged from -80 to +60 Torr in steps of 20 Torr. Pressure stimuli were triggered by electrocardiogram R wave, and each pressure step was maintained for 20 s in a continuous sequence. One baroreflex-response curve was obtained during the last 3 min of each 6-min period of exercise. The four levels of upright (cycle) exercise were 60, 120, 180, and 240 W, the highest requiring approximately 75% of maximal O2 uptake. The sensitivity of the HR baroreflex response assessed by linear regression of HR vs. CS pressure (CSP) did not significantly decrease from rest (-0.09 +/- 0.053 beat/Torr) to 240 W (-0.06 +/- 0.025 beat/Torr). The BP above or below which CSP was increased or decreased by neck collar pressure was significantly increased from rest (76 +/- 6.5 Torr) to 240 W (111.2 +/- 4.0 Torr). The sensitivity of baroreflex response was assessed by linear regression of BP vs. CSP and was not significantly different from rest (-0.29 +/- 0.054 Torr/Torr) up to exercise at 240 W (-0.29 +/- 0.048 Torr/Torr). We conclude that mild to severe exercise does not reduce the gain of the CS reflex below resting values. CS function is changed by exercise so that at any CSP, systemic BP is higher and the upward shift in the CS stimulus-response curve is increased as work rate increases.
Author (Herner)

A95-68887
DEVELOPMENTAL DIFFERENCES IN VASCULAR RESPONSES TO HYPOXIA IN LUNGS OF RABBITS
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Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 507-516
(Contract(s)/Grant(s): NIH-R-29-HL-42883)
(HTN-95-A0104)

Our purpose was to determine whether postnatal age and prostaglandins influence the sites of hypoxic vasoconstriction in lungs of rabbits. To do this, we used the micropuncture technique to measure pressures in 20- to 80-micrometer-diam subpleural arterioles and venules during sequential inflation of lungs of newborn and adult rabbits with normoxic (21% O2-7 - 10% CO2-69 - 72% N2) and hypoxic (90 - 93 % N2-7 - 10% CO2) gas mixtures. Indomethacin (40 microgram/ml) was added to the perfusate of some lungs of each age group. During hypoxia in untreated lungs of newborn rabbits, both pulmonary arterial and 20- to 80-micrometer-diam arteriolar pressure increased by 5% whereas 20- to 80-micrometer-diam venular pressure remained the same. In contrast, during hypoxia in untreated lungs of adult rabbits, pulmonary arterial pressure increased by 48%, whereas 20- to 80-micrometer-diam arteriolar pressure decreased slightly and 20- to 80-micrometer-diam venular pressure did not change. Regardless of the presence of indomethacin, location of vessels used for micropuncture, or level of left atrial pressure, pulmonary arterial pressure was the only measured vascular pressure that increased with hypoxia in adult lungs. Thus, in adult lungs, the site of hypoxia-induced vasoconstriction was limited to arteries greater than 80 micrometer diam, whereas in newborn lungs the site of hypoxia-induced vasoconstriction included vessels both larger and smaller than 20- to 80-micrometer-diam arteries. This age-related difference in the sites of hypoxia-induced vasoconstriction was not found in indomethacin-treated lungs.
Author (Herner)

A95-68888
IMPAIRED PLASMA FFA OXIDATION IMPOSED BY EXTREME CHO DEFICIENCY IN CONTRACTING RAT SKELETAL MUSCLE
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Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 517-525 Research sponsored by Danish Medical Research Council, Fonds de la Recherche en Santa du Quebec, Belgian National Fonds voor Wetenschappelijk Onderzoek, and Natural Sciences and Engineering Research Council of Canada
(HTN-95-A0105)

The extent to which carbohydrate (CHO) availability affects free fatty acid (FFA) metabolism in contracting skeletal muscle is not well characterized. To study this question, rats were depleted of glycogen by swimming exercise and lard feeding 24 h before perfusion of their isolated hindquarters. After 20 min of preperfusion with a medium containing no glucose, palmite (600 or 2,000 micro M), and (1 - C-14) palmitate, flow was restricted to one hindlimb, which was electrically stimulated for 2 min to further deplete muscles of glycogen. After 2 min of recovery, glucose was added to the perfusate at final concentrations of 0, 6, or 20 mM, and after another 3 min muscles were stimulated for 30 min. At 6 and 2,000 micro M palmitate, glucose uptake after 30 min of stimulation averaged 23.5 +/- 9.3 and 45.9 =/- 10.6 micromol/g/h with 6 and 20 mM glucose, respectively. At 6 and 2,000 micro M palmitate, palmitate uptake was lower (30 - 37%, P less than 0.05) with 0 than with 6 or 20 mM glucose. At 600 micro M palmitate, percent palmitate oxidation was higher (27%, P less than 0.05) with 0 than with 6 or 20 mM glucose, resulting in similar total palmitate oxidation with the three glucose concentrations. At 2,000 micro M palmitate, percent palmitate oxidation was not significantly different among glucose concentrations, resulting in a significantly lower rate of palmitate oxidation with 0 than with 6 or 20 mM glucose. Muscle levels of malate and citrate and ammonia release from contracting muscle were not significantly different among glucose concentrations. It is concluded that, at a constant FFA concentration, contracting skeletal muscle does compensate for low CHO availability by increasing uptake and oxidation of FFA. At high FFA concentration, low CHO avilability is accompanied by a decrease in FFA oxidation that is not associated with a decrease in the level of tricarboxylic acid cycle intermediates. Author (Herner)

A95-68889
NITRIC OXIDE-INDEPENDENT RESPONSE TO ACETYLCHOLINE BY TERMINAL ARTERIOLES IN RAT CREMASTER MUSCLE
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Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 526-533 Research sponsored by Paris VII Univ. and ASRM
(HTN-95-A0106)

The aim of the present study was to establish whether, in terminal arterioles from the rat cremaster, acetylcholine (ACh) elicits nitric oxide (NO)-independent dilation corresponding to the transient

ACh-induced endothelium-dependent hyperpolarization described in arteries. For this purpose, The responses of terminal arterioles (mean diam 15.0 +/- 0.4 (SE) micrometers) were studied by intravital microscopy in rat cremaster muscle. During 15 min of superfusion by 10(exp -5) M ACh, the response was characterized by an initial maximal dilation (peak time less than 3 min) followed by a more sustained dilation that slightly decreased with time. Inhibition of NO synthesis by 2 x 10(exp -4) M N(sup omega)-nitro-L-arginine (L-NNA) significantly reduced, but did not eliminate, both the peak and sustained responses. Simultaneous administration of 2 x 10(exp -4) M L-NNA and 2 x 10(exp -5) M mefenamic acid, an inhibitor of prostagandin synthesis, did not induce a significantly different response from that observed with L-NNA alone. Procaine (10 (exp -3) M), which is known to inhibit completely ACh-induced hyperpolarization in carotid artery, drastically reduced the initial part of the ACh-induced dilation but not the sustained response. Simultaneous administration of procaine and L-NNA almost completely inhibited the peak response to ACh. Similar results were obtained when L-NNA was combined with a superfusion bath containing 20 mM KCl, a concentration known to reduce hyperpolarization in arteries. Simultaneous administration of L-NNA and 10(exp -5) M ouabain, which inhibits Na(+)-K(+); 3 x 10(exp -6) M glibenclamide, which inhibits ATP sensitive K(+) channels; or 10(exp -8) M iberiotoxin, which inhibits Ca(2+)-dependent K(+) channels, did not cause any additional inhibition to that resulting from L-NNA alone. We conclude that the ACh-induced dilation in terminal arterioles simultaneously involves NO- dependent and -independent mechanisms. The latter displayed characteristics very similar to those demonstrated for ACh-induced hyperpolarization in arteries. They were transient, chiefly occurred during the initial part of the response, and were abolished by procaine. In terminal arterioles, these NO-independent mechanisms were not mediated by either activation of the Na(+)-K(+) adenosinetriphosphatase or ATP-sensitive or Ca(2+)-dependent K(+) channels. +) Author (Herner)

A95-68890

EFFECTS OF ACUTE RUNNING EXERCISE ON WHOLE BODY INSULIN ACTION IN OBESE MALE SHHF/MCC-FA(CP) RATS

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(HTN-95-A0107) Copyright

This study utilized the obese male spontaneously hypersensitive heart failure rat (SHHF/Mcc-fa(cp), which has metabolic features very similar to human non-insulin-dependent diabetes mellitus. The purpose of this study was to assess the insulin sensitivity and responsiveness of whole body glucose disposal and insulin suppressability of hepatic glucose production with use of the euglycemic-hyperinsulinemic clamp procedure in 12- to 15-wk-old SHHF/Mcc-fa(cp) rats at rest (OS) and 2.5 h after a single session of acute exercise (OE). Lean male SHHF/Mcc-fa(cp) rats were sedentary (LS) control animals. At least three clamps producing different insulin-simulated responses were performed on each animal in a randomized order. At this age the obese animals are normotensive and have not developed congestive heart failure. Compared with LS, OS were significantly hyperglycemic and hyperinsulinemic and insulin sensitivity and responsiveness of whole body glucose uptake and insulin supressability of hepatic glucose production were significantly decreased. Compared with LS and OS, acute exercise significantly decreased resting plasma glucose but did not alter plasma insulin. Compared with OS, acute exercise significantly increased the insulin responsiveness of whole body glucose disposal but did not affect the sensitivity of whole body glucose or insulin suppressability of hepatic glucose production. Compared with LS, however, acute exercise did not ?normalize' the insulin responsiveness of whole body glucose disposal. Thus a single acute exercise session improves but does not normalize whole body insulin resistance in the SHHF/MCC-fa(cp) rat.
Author (Herner)

A95-68891

TISSUE OXYGEN AND CARBON DIOXIDE STORES AND BREATH-HOLD DIVING IN HUMANS

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(HTN-95-A0108) Copyright

Alveolar gas exchange was studied in 11 submerged subjects during and after 75-s breath holds with or without a transient increase of ambient pressure to 3 ATA (20 msw). During surface breath holds (SBH) cardiac index fell to 73% of eupneic control but was partially restored at depth to 88% of control during breath-hold dives (BHD). O2 uptake fell to 84% of control during SBH and was restored to control level during BHD. The turnover of O2 stores was much slower during SBH than during the ensuing recovery. Carbon dioxide store dynamics were markedly slowed after BHD. We conclude that SBH and BHD are associated with large shifts in tissue O2 and CO2 stores and that much of these shifts in turnover rate for tissue O2 and CO2 stores could not be explained by the cardiac index changes alone but were compatible with peripheralization of venous blood volume and preferential peripheral vasoconstriction induced by apnea with elevated intrathoracic pressure during SBH. The transient compression during BHD reversed these central and peripheral circulatory changes by counteracting the increase in intrathoracic pressure. Author (Herner)

A95-68892

HYPERTHERMIA STIMULATES NITRIC OXIDE FORMATION: ELECTRON PARAMAGNETIC RESONANCE DETECTION OF (DOT)NO-HEME IN BLOOD

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(HTN-95-A0109) Copyright

Previous experiments from our laboratory have demonstrated that severe hyperthermia results in a selective loss of splanchnic vasoconstriction. Using electron paramagnetic resonance spectroscopy to scan whole blood samples collected in vivo from the portal vein and femoral artery of conscious unrestrained rats, we observed an increase in the concentration of spectroscopy-detectable species in portal venous blood of all heat-stressed animals. These spectra consisted of at least three distinct species: one with a broad feature having an effective g factor for the unpaired electron (g) of 2.06 assigned to the copper-binding acute phase protein ceruloplasmin, and two with narrower features that evolved at core temperature greater than 39 C representing a semiquinone radical and (dot)NO-heme. This heat-induced signal displays the classic nitrogen triplet hyperfine structure (nitrogen hyperfine splitting constant = 17.5 gauss, centered at g = 2.012) that is consistent with a five-coordinate heme complex and is characteristic of an unimpaired electron coupled to nitrogen in the ferrous (dot)NO-heme adduct ((alpha(2+)NO)beta(3+))(sub 2). The intensity of this signal increased approximately twofold as core temperature rose to greater than 39 C, peaking 1 h post-heat exposure at greater than threefold basal concentration. This species was not seen in corresponding arterial blood samples. This is the first demonstration that whole body hyperthermia produces increased concentrations of radicals and metal binding proteins in the venous blood of the rat and suggests that severe hyperthermia stimulates an enhanced local release of (dot)NO within the splanchnic circulation.
Author (Herner)

A95-68893

SERIAL DISTRIBUTION OF AIRWAY MECHANICAL PROPERTIES IN DOGS: EFFECTS OF HISTAMINE

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7587) vol. 77, no. 2 August 1994 p. 554-566 Research sponsored by Whitaker Foundation, Medical Research Council of Canada, J. T. Costello Memorial Research Fund, and Respiratory Health Network of Centres of Excellence
(Contract(s)/Grant(s): NIH-HL-31248)
(HTN-95-A0110) Copyright

We measured respiratory input impedance (Zin; 8 - 2,048 Hz) in five dogs (anesthetized, tracheostomized, vagotomized, and mechanically ventilated) during 80 s of apnea after a bolus intravenous injection of saline or histamine (5.0 mg). In the control case, three antiresonances in Zin were found in four of the dogs, whereas in the remaining dog only two were found. The magnitude and frequency of these antiresonances were significantly altered after bronchoconstriction. To interpret Zin, a model incorporating detailed airway geometry, asymmetrical branching, and nonrigid airway walls was developed. The model fit both the saline and histamine Zin data well and predicted a serial distribution of bronchoconstriction consistent with known effects of histamine; i.e., the diameters of the most peripheral airways were reduced (26% of their control values), whereas tracheal diameters were not significantly affected. The model provided estimates of tracheal diameters that were well correlated ($r = 0.92$) with direct measurements. Control estimates of soft tissue viscosity and Young's modulus compared closely with values in the literature. These results indicate that bronchoconstriction induced by histamine results in significant changes in Zin over this frequency range and that by using this data analysis approach definitive physiological parameters relative to airway geometry and wall mechanical properties can be obtained from measurements made at the airway opening. Author (Herner)

A95-68894
REGIONAL LUNG HEMATOCRIT VARIATION AND ASSESSMENT OF ACUTE LUNG INJURY

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(HTN-95-A0111) Copyright

Estimating blood content in the lung remains a key step in calculating lung water volume and microvascular permeability. We studied the effect of regional lung hematocrit (Hct) variation on assessment of acute lung injury. Escherichia coli endotoxin was administered in guinea pigs intravenously. Lung injury was evaluated by measuring the wet-to-dry weight ratio (W/D) and transvascular I-125-labeled albumin leakage for 3 h (tissue-to-plasma I-125-albumin ratio (T/P)) in five tissue samples from each animal. Residual blood content was corrected using either Cr-51-red blood cells as a blood cell marker, (99m)Tc-albumin as a plasma marker, or both, injected 10 min before the guinea pigs were killed. Lung Hct, estimated from the marker counts of lung and peripheral blood samples, was lower than peripheral blood Hct; intraindividual variation, represented by the standard deviation in each subject, was 0.024 +/- 0.015 for the control group (coefficient of variation 8.0 +/- 5.1%) and 0.026 +/- 0.013 for the endotoxin group (coefficient of variation 8.5 +/- 4.1%). Uncorrected W/D for residual blood content was greater than the corrected W/D. (99m)Tc-albumin correction gave values closer to the W/D corrected by both markers. T/P corrected by (99m)Tc-albumin showed smaller data variations than the values obtained with Cr-51-red blood cell correction, which was affected by variations in lung Hct. We recommend using a plasma marker to correct for blood content in assessing acute lung injury by W/D and T/P. Author (Herner)

A95-68895
LONGITUDINAL DISTRIBUTION OF OZONE ABSORPTION IN THE LUNG: EFFECTS OF RESPIRATORY FLOW

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(Contract(s)/Grant(s): EPA-X-812059; NIH-ES-06075)
(HTN-95-A0112) Copyright

In our previous work, we developed a bolus inhalation apparatus and measured the longitudinal distribution of ozone (O3) uptake in intact human lungs at a quiet respiratory flow of 250 ml/min. The objective of the present study was to determine the effect of alternative respiratory flows between 150 and 1,000 ml/s. Uptake was expressed as the O3 absorbed during a single breath relative to the amount of O3 in the inhaled bolus Lambda. Measurements of Lambda were correlated with the penetration volume of the bolus into the respiratory tract (Vp). Vp in the range of 20 - 70 ml was considered to indicate upper airways (UA), the Vp interval of 70 - 180 ml was identified as lower conducting airways (CA), and Vp greater than 180 ml was associated with the respiratory air spaces (RA). During quiet oral breathing at 250 ml/s, Lambda increased smoothly as Vp increased, with 50% of the inhaled O3 absorbed in the UAs and the remainder absorbed within the CAs such that no O3 reached the RAs. The effect of increasing the respiratory flow was to shift the Lambda - Vp distribution distally such that significantly less O3 was absorbed in the UAs and CAs and some O3 reached the RAs. For example, at 1,000 ml/s, only 10% of the inhaled O3 was absorbed in UAs and 65% was absorbed in the CAs such that 25% reached the RAs. Further analysis of these data with a mathematical diffusion model suggested that the reaction between O3 and biochemical substrates is so fast (i.e., estimated 1st-order rate constant was on the order of 10(exp 6)/s) that O3 is decomposed close to the gas-mucus interface in the CAs. Author (Herner)

A95-68896* National Aeronautics and Space Administration, Washington, DC.
INTERLEUKIN-2 THERAPY REVERSES SOME IMMUNOSUPPRESSIVE EFFECTS OF SKELETAL UNLOADING

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(Contract(s)/Grant(s): NAGW-1197; NAGW-2328; DAMD17-89-Z-9039)
(HTN-95-A0113) Copyright

Using antiorthostatic suspension, we characterized hematopoietic changes that may be responsible for the detrimental effect of skeletal unloading on macrophage development. Skeletally unloaded mice had suppressed macrophage development in unloaded and loaded bones, which indicated a systemic effect. Bone marrow cells from unloaded mice secreted less macrophage colony-stimulating factor and interleukin-6 than control mice. Additionally, T-lymphocyte proliferation was reduced after skeletal unloading. We show that polyethylene glycol-interleukin-2 therapy reversed the effects of skeletal unloading on macrophage development and cell proliferation. Author (Herner)

A95-68897
SURFACE ACTIVITY OF RABBIT PULMONARY SURFACTANT SUBFRACTIONS AT DIFFERENT CONCENTRATIONS IN A CAPTIVE BUBBLE

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(Contract(s)/Grant(s): NIH-HL-24075; NIH-HL-40666)
(HTN-95-A0114) Copyright

This study investigates the surface activity of rabbit pulmonary surfactant subfractions at different concentrations in a new pressure-driven captive bubble surfactometer, which provides more

rigorous testing conditions than heretofore applied to this material. Subfractions were separated by centrifugation of lavage return into a third (P3; 1,000 x average g, 20min), a fourth (P4; 60,000 x average g, 60 min), and a fifth (P5; 100,000 x average g, 16 h) pellet. At 2.0 mg phospholipid/ml, P3 and P4 demonstrated more rapid adsorption, lower minimum surface tensions on first and subsequent compressions, and lower monolayer compressibilities than did P5. This surface activity of P3 and P4 increased with concentration between 0.1 and 2.0 mg phospholipid/ml. Adsorption rate constants were approximately 10,000 times faster than desorption constants. We conclude that, in a normal lung, components of P3 and P4 determine alveolar surface tension. We speculate that under special circumstances even less surface active P5 could have an important influence at the air-water interface. Author (Herner)

A95-68898

GENDER-RELATED DIFFERENCES IN THE BARORECEPTOR REFLEX CONTROL OF HEART RATE IN NORMOTENSIVE HUMANS

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(HTN-95-A0115)

The present study investigates the baroreceptor reflex control of heart rate (HR) of normotensive male and female human volunteers under two conditions: bolus- and infusion-evoked elevations of blood pressure by intravenous administration of phenylephrine. Average age and blood pressure were similar in both sexes, but females had a significantly lower heart period (HP; higher HR). A major difference existed between the two sexes when the blood pressure was elevated by the bolus method. Females had a significantly (50%) smaller baroreflex sensitivity (regression coefficient), which inferred a gender-related difference in baroreceptor reflex control of HR. However, because a positive correlation existed between basal HP and baroreflex sensitivity, it was important to investigate whether this difference was related to the significantly lower basal HP in females. This possibility was ruled out because a similar difference still existed when the data were collected from another group of females who had basal HP values similar to those of males. This gender-related difference in baroreceptor reflex control of HR seems to depend on the pattern by which the pressor stimulus is evoked. The baroreceptor HP response to a slowly developing pressor response that was maintained at a steady-state level was very similar in both sexes. Because the HP response to abrupt (bolus-evoked) pressor stimuli mainly reflects the activity of the vagal component, our findings suggest that the cardiac vagal component seems to play a substantially smaller role in the baroreflex-medicated bradycardia in females. Author (Herner)

A95-68899

EFFECTS OF STRENGTH TRAINING ON TOTAL AND REGIONAL BODY COMPOSITION IN OLDER MEN

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(Contract(s)/Grant(s): NIH-PO1-AG-04402; NIH-RO1-AG-07660; NIH-KO8-AG-00494; NIH-MO1-RR-02719; NIH-IT32-AG-00219)
(HTN-95-A0116)

The effects of a 16-wk strength-training program on total and regional body composition were assessed by dual-energy X-ray absorptiometry (DEXA), magnetic resonance imaging (MRI), and hydrodensitometry in 13 untrained healthy men. Nine additional men served as inactive control. The strength-training program resulted in substantial increases in both upper and lower body strength. Total fat-free mass (FFM) increased by 2 kg, and total fat mass decreased by the same amount when measured by DEXA. When measured by hydrodensitometry, similar increases in FFM and decreases in fat mass were observed. When measured by DEXA, FFM was increased in the arms, legs, and trunk, whereas fat mass was reduced in the arms, legs, and trunk as a result of training. MRI analysis revealed significant increases in midthigh muscle cross-sectional area and significant reductions in midthigh subcutaneous fat. These changes in body composition were not associated with changes in serum concentration of growth hormone, insulin-like growth factor I, or testoserone. None of the measured variables changed significantly in the control subjects. Thus, strength training increases regional and total lean mass and decreases regional and total fat mass in middle-aged and older men. Author (revised by Herner)

A95-68900

INTERACTION OF THYROID HORMONE AND FUNCTIONAL OVERLOAD ON SKELETAL MUSCLE ISOMYOSIN EXPRESSION

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(Contract(s)/Grant(s): NIH-AR-30346)
(HTN-95-A0117)

This study examined the interaction of exogenous thyroid hormone 3,5,3'-triiodothyronine (T sub 3) and functional overload on skeletal muscle myosin heavy chain (MHC) expression, studied at both the protein and mRNA level of analysis. Animals were allocated to the following groups: (1) normal control, (2) overload control, (3) hyperthyroid control, and (4) hyperthyroid + overload. Overload of the rat plantaris was accomplished by surgical removal of its synergists (soleus and gastronemius), and the animals were made hyperthyroid by injections of T(sub 3) (350 microgram/kg every other day). After overload of 8 wk, muscle enlargement occurred by 53% for both overload groups. This was accompanied by a 330 and 82% increase in the relative content of type I and IIa MHC, respectively, and a corresponding decrease by 16 and 44% in type IIx and IIb MHC, respectively, in the overload control group. Changes in the relative and absolute content of mRNA for these MHCs paralleled the protein response. Exogenous T(sub 3) completely reversed the upregulation of type I MHC and the downregulation of type IIx associated with overload at both the protein and mRNA. However, T(sub 3) was only partially effective in blunting the downregulation of IIb MHC and the upregulation of IIa MHC (protein and mRNA) accompanying the overload. These data suggest the following: (1) T(sub 3) can override the overload-induced signal in upregulating type I MHC expression in fast muscle, (2) the faster IIx and IIb MHC pools are differentially regulated by T(sub 3) and mechanical loading, and (3) both T(sub 3) and mechanical loading likely exert their impact on MHC expression at the pretranslational level of regulation. Author (Herner)

A95-68901

SIMULATION OF CARDIOVASCULAR RESPONSE TO LOWER BODY NEGATIVE PRESSURE FROM 0 TO -40 MMHG

FRANCOIS M. MELCHIOR, R. SRINI SRINIVASAN, PHILIPPE H. THULLIER, and JEAN-MICHEL CLERE Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 630-640
(Contract(s)/Grant(s): DRET-90-1053J)
(HTN-95-A0118)

This paper presents a mathematical model for simulation of the human cardiovascular response to lower body negative pressure (LBNP) up to -40 mmHg both under normal conditions and when arterial baroreflex sensitivity or leg blood capacity (LBC) is altered.

Development of the model assumes that the LBNP response could be explained solely on the basis of (1) blood volume redistribution, (2) left ventricular end-diastolic filling, (3) interaction between left ventricle and peripheral circulation, and (4) modulations of peripheral resistances and heart rate by arterial and cardiopulmonary baroreflexes. The model reproduced well experimental data obtained both under normal conditions and during complete autonomic blockade; thus it is validated for simulation of the cardiovascular response from 0 to -40 mmHg LBNP. We tested the ability of the model to simulate the changes in LBNP response due to a reduction in LBC. To assess these changes experimentally, six healthy men were subjected to LBNP of -15, -30, and -38 mmHg with and without wearing elastic compression stockings. Stockings significantly reduced LBC and attenuated the change in heart rate. The model accurately reproduced this result. The model is useful for assessing the influence of LBC or other parameters such as arterial baroreflex sensitivity in diminishing the orthstatic tolerance of humans after spaceflight, bed rest, or endurance training. Author (Herner)

A95-68902
EFFECT OF GLUCOSE INFUSION ON ENDURANCE PERFORMANCE AFTER BETA-ADRENOCEPTOR BLOCKER ADMINISTRATION
VAN BAAK, M. A. Limburg Univ., Maastricht, Netherlands and J. M. V. MOOIJ Limburg Univ., Maastricht, Netherlands Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 641-646
(HTN-95-A0119) Copyright

To investigate the effect of glucose (Glc) infusion on endurance performance after beta-adrenoceptor blockade, eight healthy male volenteers performed four endurance cycle ergometer tests at 67% of maximal work load after 80 mg of propranolol (Pr) of placedo (Pl) were administered orally in combination with a continuous infusion of Glc (0.5 g/min) or saline (Sal). The order of the tests was randomized. Endurance times were 53 +/- 6 (SE), 64 +/- 7, 26 +/- 5, and 31 +/- 6 min after Pl + Sal, Pl + Glc, Pr + Sal, and Pr + Glc, respectively (P less than 0.001). Glc infusion increased endurance after Pl (P less than 0.05) but not after Pr. Glc infusion resulted in significantly higher plasma Glc concentrations during exercise compared with Sal infusion (P less than 0.001). Glc infusion had no effect on cardiorespiratory or other metabolic variables. Plasma ammonia concentration was increased during the Pr tests (P less than 0.001) but reached similar values at exhaustion in all tests and was not affected by Glc infusion. The mainteneance of plasma Glc concentration during endurance exercise at or above preexercise levels did not improve the reduction of endurance performance after Pr, indicating that the availability of blood Glc is not a limiting factor in this process. Author (Herner)

A95-68903
CONTRIBUTION OF BODY COMPOSITION AND PHYSICAL ACTIVITY TO AGE-RELATED DECLINE IN PEAK DOT-VO2 IN MEN AND WOMEN
MICHAEL J. TOTH, ANDREW W. GARDNER, PHILIP A. ADES, and ERIC T. POEHLMAN Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 647-652
(Contract(s)/Grant(s): NIH-AG-00219; NIH-AG-07857; NIH-KO4-AG-00564; NIH-AG-0556; NIH-KO8-AG-00426)
(HTN-95-A0120) Copyright

We examined the contribution of variations in body composition and leisure time physical activity to the age-related decline in peak oxygen consumption (dot-VO2) in men and women. Healthy males 17 - 80 yr old (n = 378) and females 18 - 81 yr old (n = 224) were characterized for dot-VO2 from a treadmill test to exhaustion, fat-free mass and fat mass by underwater weighing, and leisure time physical activity. Peak dot-VO2 showed a greater absolute decline (P less than 0.05) with age in males (r = 0.70, slope = -0.034 l/min/yr; P less than 0.01) than in females (r = 0.78, slope = -0.028 l/min/yr; P less than 0.01). After statistically controlling for differences in fat-free mass and fat mass, the decline in peak dot-VO2 was diminished in both sexes, although a greater rate of decline persisted in males (r = -0.47, slope = -0.016 l/min/yr; P less than 0,01) than in females (r = -0.39, slope = -0.009 l/min/yr; P less than 0.01). We found that the addition of leisure time physical activity (independent of body composition) to the regression model further attenuated the rate of decline in males (r = 0.40, slope = -0.013 l/min/yr; P less than 0.01) but did not alter the age-related decline in peak dot-VO2 in females (r = -0.39, slope = -0.009 l/min/yr; P less than 0.01). We conclude that (1) the loss of fat-free mass and the increase in adiposity contribute to the decline in peak dot-VO2 with age in men and women and (2) the decline in leisure time physical activity, independent of differences in body composition is associated with the age-related decline in peak dot-VO2 in males but not in females. Author (Herner)

A95-68904
IMPACT OF PARALLEL HETEROGENEITY ON A CONTINUUM MODEL OF THE PULMONARY ARTERIAL TREE
GARY S. KRENZ, JIANMING LIN, CHRISTOPHER A. DAWSON, and JOHN H. LINEHAN Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 660-670 Research sponsored by Dept. of Veterans Affairs
(Contract(s)/Grant(s): NIH-HL-19298)
(HTN-95-A0121) Copyright

Model arterial trees were constructed following rules consistant with morphometric data. Simulated heterogeneous trees approximating these rules were constructed by assigning vessel diameters Hat-D(sub m) = D(sub a)(2/(m + 1))(exp 1/Beta(sub 1)), such that m - 1 vessels were larger than Hat-D(sub m) (vessel length proportional to diameter). Vessels were connected, forming random bifurcating trees. Longitudinal intravascular pressure (Q(sub cum)) with respect to cumulative vascular volume (Q(sub cum)) was computed for Poiseuille flow. Strahler-ordered tree morphometry yielded estimates of L(sub a), D(sub a), Beta(sub 1), Beta(sub 2), and mean number ratio(B); B is defined by N(sub K + 1) = B(sub K), where k is total number of Strahler orders minus Strahler order number. The resulting P(Q(sub cum)) relationship was compared with that of the simulated tree, where Pa is total arterial pressure drop, Q is flow rate, R(sub a) = (128/mu L(sub a))/(pi D(sub a exp 4)) (where mu is blood viscosity), and Q(sub a) (volume of inlet artery) = (1/4)D(sub a exp 2)/p;/L(sub a). Results indicate that the equation, originally developed for homogeneous trees(J. Appl. Physiol. 72: 2225-2237, 1992), provides a good approximation to the heterogeneous tree P(Q(sub cum)). Author (Herner)

A95-68905
EXERCISE O2 TRANSPORT MODEL ASSUMING ZERO CYTOCHROME PO2 AT DOT-VO2(SUB MAX)
JOHN W. SEVERINGHAUS California Univ., San Francisco, CA, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 671-678
(HTN-95-A0122) Copyright

An analogy is drawn between cytochrome aa(sub 3)function and a polarographic cathode at which the potential of -0.6 V captures all O2 diffusing to the surface, achieving maximal O2 consumption (dot-VO2(sub max) by eliminating O2 backpressure and outward diffusion from the surface, defined herein as zero surface PO2. The relationship of O2 consumption (as % dot-VO2(sub max) to muscle venous, myoglobin, and cytochrome PO2 is modeled assuming that cytochrome aa(sub 3) PO2 reaches zero at dot-VO2(sub max), incorporating published data on the profile of leg venous PO2, pH, and blood lactate vs. work. Equations describe hemoglobin and myoglobin O2 dissociation and the Bohr effect of acid on O2 unloading. The O2 gradient from capillary blood to cytochrome aa(sub 3) is assummed to be proportional to O2 consumption. The model suggests that (1) to extract 75% of the O2 from myoglobin at dot-VO2(sub max), myoglobin must lie 90% down the O2 gradient from capillary to cytochrome; (2) the Bohr effect adds 15 - 30% to dot-VO2(sub max) and keeps venous PO2 almost constant as work rises from 60 to 100% of dot-VO2(sub max); and (3) in steady heavy work, the rising arterial lactate may impede lactate excretion from

muscle, reduce anaerobic ATP generation, and shift the energy balance toward aerobic metabolism. The zero PO2 hypothesis facilitates modeling and may be the key to understanding the physiological limitation of work. Author (Herner)

A95-68906
HIGHER EXERCISE PERFORMANCE AND LOWER DOT-VO2(SUB MAX) IN TIBETAN THAN HAN RESIDENTS AT 4,700 M ALTITUDE
RI-LI GE, QIU-HONG CHEN, LI-HAU WANG, DING GEN, PING YANG, KEISHI KUBO, KEISAKU FUJIMOTO, YUKINORI MATSUZAWA, KAZUHIKO YOSHIMURA, MICHIKO TAKEOKA et al. Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 684-691
(HTN-95-A0123) Copyright

To examine the hypothesis that the pathway of adaptation to high altitude in natives differs considerably from that in newcomers, we measured maximal O2 uptake (dot-VO2(sub max)), minute ventilation, anaerobic threshold (AT), blood lactate, and blood gases during maximal exercise in 17 lifelong Tibetan residents and 14 acclimatized Han Chinese newcomers living at the high altitude of 4,700 m. The two groups were similar in age, height, and weight, and the subjects were nonatheletes. Although dot-VO2(sub max) was significantly lower in the Tibetans than in the Hans, at maximal exercise effort the exercise workload was greater. The mean AT values (in % dot-VO2(sub max)) in the Tibetan and Han subjects were 84.1 and 61.6%, respectively. Minute ventilation at maximal exercise was significantly lower in the Tibetans than in the Hans, whereas heart rate at maximal effort was equivalent in the two groups. The Tibetans showed lower blood lactate value than did the Hans both before and at the end of exercise. We conclude that the Tibetan natives have higher exercise performance and AT but lower dot-VO2(sub max) and blood lactate concentration than do acclimatized Han newcomers. These results may reflect the effects of genetic or peripheral adaptation factors in the Tibetan natives.
Author (revised by Herner)

A95-68907
ROLES OF INTRA- AND EXTRACELLULAR CARBONIC ANHYDRASE IN ALVEOLAR-CAPILLARY CO2 EQUILIBRATION
THOMAS A. HEMING, ERICH K. STABENAU, CARLOS G. VANOYE, HAMID MOGHADASI, and AKHIL BIDANI Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 697-705 Research sponsored by Moody Foundation
(HTN-95-A0124) Copyright

Alveolar-capillary CO2 equilibrium involves diffusive equilibration of CO2 across the blood-gas barrier and chemical equilibration of perfusate CO2-HCO3(-)-H(+) reactions. These processes are governed by different, but related, driving forces and conductances. The present study examined the importance of pulmonary carbonic anhydrase (CA) for diffusive and reactive CO2 equilibration in isolated rat lungs. Lungs were perfused with salines containing membrane-impermeant or -permeant inhibitors of CA. Measurements of CO2 excretion rate, equilibrated venous and arterial PCO2 and pH, and postcapillary pH and PCO2 disequilibria were used, together with our previous model of CO2-HCO3(-)-H(+) reactions and transport in saline-perfused capillaries, to compute the relevant driving forces and conductances. Reactive CO2 equilibration was markedly affected by extracellular (vascular) CA activity but not by the activity of intracellular (cytosolic) CA. The driving force for CO2 diffusion was strongly influenced by vascular CA activity. The conductance for CO2 diffusion was independent of CA activity. The minimum conductance for CO2 diffusion was estimated to be 700 - 800 ml/min/Torr. The results indicate that extracellular vascular CA activity influences both diffusive and reactive CO2 equilibration. However, cytosolic CA has no detectable role in alveolar-capillary CO2 equilibration. Author (Herner)

A95-68908
VASCULAR IMPEDANCE ANALYSIS IN DOG LUNG WITH DETAILED MORPHOMETRIC AND ELASTICITY DATA
R. Z. GAN Memphis State Univ., Memphis, TN, US and R. T. YEN Memphis State Univ., Memphis, TN, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 706-717
(HTN-95-A0125) Copyright

On the basis of experimentally measured morphometric and elasticity data and model-derived mean pressure-flow conditions, we attempt a theoretical modeling of pulsatile flow in the whole lung. In the model we use the ?elastic tube' for arteries and veins, and the vascular impedeance in arteries and veins follows Womersley's theory and electric analogue. We employ the ?sheet-flow' theory to describe the flow in the capillaries and to obtain the microvascular impedance matrix. The characteristic impedance of each order along the vascular tree, the input impedance at the capillary entrance and exit, and the pulmonary arterial input impedance at the main pulmonary artery are computed under certain physiological conditions. Using the pulsatile flow model, we investigate the effects of arterial vascular obstruction on pulmonary vascular impedance. The model-derived data are compared with the available experimental results in the literature. Author (Herner)

A95-68909
DIAMETERS OF JUXTACAPILLARY VENULES DETERMINED BY OIL-DROP METHOD IN RAT LUNG
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(Contract(s)/Grant(s): NIH-HL-36024)
(HTN-95-A0126) Copyright

We report a new method for precise quantification of lung microvascular diameter. Isolated blood-perfused rat lungs (500-g Sprague-Dawley rats) at constant inflation pressure (alveolar pressure (PA)) and stopped blood flow were viewed by microscopy and video. Subpleural venules of the second and third postcapillary generations were microinjected with oil colored with Sudan Black. Vascular pressure (Pvas) was varied in steps, and at each step the horizontal diameter (D(sub H)) and the length of the oil-filled segment were determined by microcaliper measurements of the replayed video image. At PA = 5 cmH2O, a decrease in Pvas from 25 to 0 cmH2O decreased D(sub H) in the second-generation venules from 55 +/- 2 (SE) to 41 +/- 1 micrometer (n = 13) and in the third-generation venules from 96 +/- 6 to 73 +/- 6 micrometer (n = 6). The constant-volume oil-filled segment conformed to the cylinder formula in that decreases in D(sub H) correlsted linearly with 1/square root of length, thereby indicating that all Pvas values venular geometry was constant and probably circular and probably circular in cross section. The decrease in Pvas to -5 cmH2O did not further decrease D(sub H). At Pvas = 10 - 25 cmH2O, an increase in PA to 15 cmH2O did not significantly increase D(sub H), although the increase in PA did diminish the slope (compliance) of the D(sub H)-Pvas relationship in second- but not third-generation venules. We conclude that (1) lung expansion decreases compliance of juxtacapillary venules, (2) venules retain circular cross sections at Pvas between -5 and 25 cmH2O, and (3) venules are patent at subzero Pvas. Author (Herner)

A95-68910
HYPOXIA SIMILARLY IMPAIRS METABOLIC RESPONSES TO CUTANEOUS AND CORE COLD STIMULI IN CONSCIOUS RATS
GORDON G. GIESBRECHT Calgary Univ., Calgary, Canada, JAMES E. FEWELL Calgary Univ., Calgary, Canada, DAVID MEGIRIAN Calgary Univ., Calgary, Canada, ROLLIN BRANT Calgary Univ., Calgary, Canada, and JOHN E. REMMERS Calgary Univ., Calgary, Canada Journal of Applied Physiology (ISSN 8750-

7587) vol. 77, no. 2 August 1994 p. 726-730 Research sponsored by Medical Research Council of Canada, Manitoba Health Research Council, and Canadian Lung Association
(Contract(s)/Grant(s): NIH-HL-42470)
(HTN-95-A0127) Copyright

Cold exposure elicits several thermoregulatory responses, including an increased metabolic heat production from shivering and nonshivering thermogenesis. The increased metabolism can be in response to body core and/or body cutaneous cooling. hypoxic hypoxia has been shown to attenuate the metabolic response to cutaneous cooling. We measured metabolic heat production in adult conscious rats during independent cutaneous and core cooling, during normoxia and hypoxia to (1) test the hypothesis that hypoxia suppresses the metabolic response to independent core cooling and (2) determine whether hypoxia acts preferentially on the response to cutaneous or core cooling. The animals were studied in a temperature-controlled metabolic chamber, and body core temperature was controlled by an abdominal heat exchange coil. Ambient temperature was varies (10, 19, and 28 C) while core temperature was clamped at 37 C or core temperature was varied (33, 35, and 37 C) at a stable ambient temperature of 28 C. Our data indicate that although the sensitivity of the metabolic response to core cooling is about five to six times that to cutaneous cooing, hypoxia similarly attenuates thermoregulatory responses to both stimuli.
Author (Herner)

A95-68911
INFLUENCE OF EXERCISE TRAINING ON MYOCARDIAL BETA-ADRENERGIC SIGNAL TRANSDUCTION: DIFFERENTIAL REGULATION WITH AGE

PHILIP J. SCARPACE, YE SHU, and NIHAL TUMER Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 737-741 Research sponsored by American Heart Association, Florida Affiliate and Dept. of Veterans Affairs
(HTN-95-A0128) Copyright

Exercise training is known to increase cardiovascular performance and decrease heart rate. Because activation of adenylyl cyclase is an important factor in beta-adrenergic signal transduction and in the decline in signal transduction with age, we hypothesized that some of the effects of exercise training may be mediated by changes in postreceptor activation of adenylyl cyclase. To this end, we assessed isoproterenol-, G protein-, and forskolin-medicated activation of adenylyl cyclase as well as G protein immunoreactivity in the myocardium from young and senescent F-344 rats with and without prior exercise training by treadmill running. Isoproterenol, beta-gamma-imidoguanosine 5'-triphosphate, and forskolin stimulation of adenylyl cyclase activity declined by approximately 50% with age. Training increased the stimulation in the senescent rats and decreased the stimulation in the young rats such that the age-related decline in signal transduction was no longer significant. G(sub s) alpha protein immunoreactivity was unchanged by age or training. These data suggest that in young rats exercise training decreases beta-adrenergic signal transduction, whereas in older rats training increases signal transduction, partially offsetting the decline in signal transduction with age. Author (Herner)

A95-68912
MAGNESIUM ATTENUATES PULMONARY HYPERTENSION DUE TO HYPOXIA AND GROUP B STREPTOCOCCI

MARK E. ANDERSON, TARA M. BURNETTE, DENNIS R. GEISER, and WARICHA JANJINDAMAI Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 751-756 Research sponsored by East Tennessee Foundation
(HTN-95-A0129) Copyright

We investigated whether hypermagnesemia alleviates hypoxic or group B streptococcal (GBS) pulmonary hypertension (PH). Hypoxic PH was induced and maintained in 14 lambs by continuous ventilation with 12% oxygen. GBS PH was induced and maintained in 16 lambs by the continuous infusion of 5 - 10 x 10(exp 8) colony-forming units /kg/h of GBS. After the onset of PH, lambs were randomized to recieve either magnesium sulfate (MgSO4, intermittent boluses of 0.38 mmol/kg, with a continuous infusion of 0.15 mmol/kg/h) or a similar volume of normal saline. Hypermagnesemia lowered pulmonary arterial pressure (PAP) and delayed the fall in systemic arterial pressure and stroke volume index seen in the control animals (each P less than 0.05). At a serum magnesium concentration (Mg) of 2.75 +/- 0.25 mmol/l, PAP was 27 +/- 3 compared with 40 +/- 4 Torr in the control animals (Mg = 0.87 +/- 0.06 mmol/l; P less than 0.05). In the GBS PH trial, hypermagnesemia prevented the continued increase in PAP seen in the control animals. At Mg = 2.15 +/- 0.07 mmol/l, PAP fell 2 +/- 1 Torr from prerandomization values, whereas it rose 4 +/- 2 Torr in the control animals (Mg = 0.59 +/- 0.07 mmol/l; P less than 0.05). However, during the same time the systemic arterial pressure fell further in the magnesium-treated animals (-19 +/- 1 vs. -2 +/- 5 Torr). MgSO4 attenuates PH in both models but may cause systemic hypotension in sepsis. Author (Herner)

A95-68913
EFFECT OF HYPEROXIA AT 1 AND 2 ATA ON HYPOXIA AND HYPERCAPNIA IN HUMAN SKIN DURING EXPERIMENTAL INFLAMMATION

NEIL C. ABBOT, J. SWANSON BECK, FIONA M. T. CARNOCHAN, JAMES H. GIBBS, DAVID K. HARRISON, PHILIP B. JAMES, and J. GRAHAM LOWE Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 767-773 Research sponsored by Scottish Home and Health Dept.
(HTN-95-A0130) Copyright

Transcutaneous PO2 and PCO2 measurements and estimates of skin respiration were monitored at different levels of inspired PO2 in 20 healthy adults during the first 4 days of the tuberculin reaction, a convenient model of acute inflammation. Hyperoxia at 1 and 2 ATA significantly increased transcutaneous PO2 levels in undisturbed and in inflamed skin but did not fully correct the relative hypoxia at the site of inflammation. Hypercapnia was reduced with O2 breathing at 2 ATA. The apparent rate of O2 consumption at the reaction site was raised during heperoxia, most prominently at 2 ATA. The most intense reactions showed a central relative slowing of laser-Doppler blood flow indicative of microcirculatory impairment. The extent of the relative hypoxia and hypercapnia was greatest in these strongest reactions. The density of lymphocytes and monocytes in biopsies of 48-h reactions was loosely related to the corresponding transcutaneous PO2 measurements. The present study provides evidence that diffusion barriers, in addition to increased local respiration, can contribute to the apparent hypoxia and hypercapnia of this inflammatory model.
Author (Herner)

A95-68914
LUNG VOLUME SPECIFICITY OF INSPIRATORY MUSCLE TRAINING

GEORGE E. TZELEPIS, DIEGO L. VEGA, MARK E. COHEN, and F. DENNIS MCCOOL Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 789-794 Research sponsored by Dept. of Veterans Affairs and Chicago Lung Association
(HTN-95-A0131) Copyright

We examined the extent to which training-related increases of inspiratory muscle (IM) strength are limited to the lung volume (VL) at which the training occurs. IM strength training consisted of performing repeated static maximum inspiratory maneuvers. Three groups of normal volunteers performed these maneuvers at one of three lung volumes: residual volume (RV), relaxation volume (Vrel), or Vrel plus one-half of inspiratory capacity (Vrel + 1/2IC). A control group did not train. We constructed maximal inspiratory pressure-VL curves before and after a 6-wk training period. For each group, we found that the greatest improvements in strength occurred at the volume at which the subjects trained and were significantly greater for those who trained at low (36% for RV and 26% for Vrel) than at high volumes (13% for Vrel + 1/2IC). Smaller increments in strength were noted at volumes adjacent to the training volume. The range of vital capacity (VC) over which strength was increased was greater for those who trained at low (70% of VC) than at high VL (20% of VC).

We conclude that the greatest improvements in IM strength are specific to the VL at which training occurs. However, the increase in strength, as well as the range of volume over which strength in increased, is greater for those who trained at the lower VL.
Author (Herner)

A95-68915
PRESSURE-FLOW SPECIFICITY OF INSPIRATORY MUSCLE TRAINING
GEORGE E. TZELEPIS, DIEGO L. VEGA, MARK E. COHEN, ASHOK M. FULAMBARKER, KISHOR K. PATEL, and F. DENNIS MCCOOL Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 795-801 Research sponsored by Dept. of Veterans Affairs and Chicago Lung Association
(HTN-95-A0132) Copyright

The inspiratory muscles (IM) can be trained by having a subject breathe through inspiratory resistive loads or by use of unloaded hyperpnea. These disparate training protocols are characterized by high inspiratory pressure or high inspiratory flow, respectively. We tested the hypothesis that the posttraining improvements in IM pressure or flow performance are specific to training protocols in a way that is similar to force-velocity specificity of skeletal muscle training. IM training was accomplished in 15 normal subjects by use of three protocols: high inspiratory pressure-no flow (group A, n = 5), low-inspiratory pressure-high flow (group B, n = 5), and intermediate inspiratory pressure and flow (group C, n = 5). A control group (n = 4) did no training. Before and after training, we measured esophageal pressure (Pes) and inspiratory flow (dot-VI) during single maximal inspiratory efforts against a range of external resistances including an occluded airway. Efforts originated below relaxation volume (Vrel), and peak Pes and dot-VI were measured at Vrel. Isovolume maximal Pes-dot-VI plots were constructed to assess maximal inspiratory pressure-flow performance. Group A (pressure training) performed 30 maximal static inspiratory maneuvers at Vrel daily, group B (flow training) performed 30 sets of three maximal inspiratory maneuvers with no added external resistance daily, and group C (intermediate training) performed 30 maximal inspiratory efforts on a midrange external resistance (7 mm ID) daily. Subjects trained 5 days/wk for 6 wk. Data analysis included comparison of posttraining Pes-dot-VI slopes among training groups. After training, group A increased maximal Pes (Pes(sub max); 37%) but not maximal dot-VI (dot-VI(sub max)) and group B increased dot-VI(sub max) (17%) but not Pes(sub max); group C increased Pes(sub max) (19%) and dot-VI(sub max) (14%), The posttraining slopes were dependent on the training protocol. We conclude that training protocols characterized by generating high inspiratory pressure or high inspiratory flow will specifically increase Pes(sub max) or dot-VI(sub max), respectively. In contrast, intermediate training protocols produce a more uniform increase in dot-VI(sub max) and flow.
Author (Herner)

A95-68916
SUPERNORMAL MUSCLE FIBER CONDUCTION VELOCITY DURING INTERMITTENT ISOMETRIC EXERCISE IN HUMAN MUSCLE
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(HTN-95-A0133) Copyright

Muscle fiber conduction velocity (MFCV) and surface electromyographic parameters were studied in the brachial biceps muscle of healthy males during voluntary intermittent isometric contractions at 50% of maximum force. Recovery in the following 15 min was then observed. The measurements were performed during duty cycles of 33, 25, and 10%. The main finding was a supernormal MFCV during the exercise phase when the duty cycle was 25 and 20%. The level continued to increase during the recovery phase. During the exercise phase when the duty cycle was 33%, the MFCV decreased slightly (suggesting that the local anaerobic threshold had been surpassed) but increased during recovery to supernormal values. The ratio of median frequency to MFCV was constant during all experiments, indicating that the changes in median frequency reflect those in MFCV. We suggest that the supernormal MFCV was due to a combination of altered membrane properties, muscle fiber swelling, and temperature increase and hypothesize that the changes of electrical properties formed part of an adaptive mechanism of the muscle fiber membrane during exercise. In that respect, the increase of the MFCV could be a component of the well-known warm-up effect.
Author (Herner)

A95-68917
MAXIMUM RATE OF FORCE DEVELOPMENT IS INCREASED BY ANTAGONIST CONDITIONING CONTRACTION
MARK D. GRABINER Cleveland Clinic Foundation, Cleveland, OH, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 807-811 Research sponsored by Chattecx Corp.
(HTN-95-A0134) Copyright

Nine subjects performed maximum contractions with the knee extensor muscles on an isokinetic device set at 4.36 rad/s. The knee extensions were preceded by isometric conditioning contractions of the antagonist knee flexor muscles. The conditioning contraction forces were 0, 25, 50, 75, and 100% of the maximum isometric force. The purpose of the study was to determine (1) the effects of graded conditioning contractions with the knee flexor muscles on the maximum performance of the quadriceps femoris and (2) whether the effects of the conditioning contractions are similarly distributed to components of the quadriceps femoris. The increased initial quadriceps femoris activation levels associated with the conditioning contractions were similarly distributed to quadriceps femoris components. In contrast with previously published research on exercise performed at substantially lower knee extension velocities, the maximum knee extension force and the work performed were not affected by the conditioning contractions. However, the maximum rate of force development increased significantly (P less than 0.05). The intensity of the knee flexor conditioning contractions likely influences agonist motor unit activation variables, but this influence may be related to the speed of the agonist contraction.
Author (Herner)

A95-68918
DETECTION OF FREE RADICALS BY ELECTRON SPIN RESONANCE IN RAT DIAPHRAGM AFTER RESISTIVE LOADING
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(Contract(s)/Grant(s): NIH-RR-03126)
(HTN-95-A0135) Copyright

Indirect evidence supports free radical production in the diaphragm under excessive mechanical loads in both in vitro and in situ preparations. We hypothesized that free radicals are produced in the diaphragm with loads in vivo at a sufficient concentration to be detected by electron spin resonance (ESR) spectroscopy. Anesthetized rats underwent severe inspiratory resistive loading for 2.5 - 3 h with maintenance of blood oxygenation and arterial blood pressure by breathing 70% oxygen. The ESR spectra of four samples (freeze-clamped at liquid nitrogen temperature) from each experimental animal were compared with the spectra from a control animal breathing air and a control animal breathing 70% oxygen. We observed (1) an approximately 30% increase in intensity of free radical signal in experimental animals (n = 10) compared with control animals breathing oxygen (n = 10; P less than 0.01) and control animals breathing air (n = 10; P less than 0.05), (2) that oxygen alone had no effect on the ESR spectrum, and (3) the intensity of the ESR signal decreased approximately 25% in the experimenatl group when samples were taken 10 min postmortem, whereas no differ-

ence in signal was observed for control animals. We conclude that the diaphragm shows an increased production of free radicals associated with respiratory failure induced by resistive breathing. Author (Herner)

A95-68919
EFFECTS OF HYPERINFLATION AND CPAP ON WORK OF BREATHING AND RESPIRATORY FAILURE IN DOGS
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(HTN-95-A0136)

Increased end-expiratory lung volume (EELV) and airway resistance are both characteristic features of obstructive lung disease. Increased EELV alone loads the respiratory muscles and may cause respiratory failure, changes that could be reversed by continuous positive airway pressure (CPAP). To study the effects of elevated EELV on respiration without increased airway resistance, we used a mechanical analogue of airway closure to increase EELV in six spontaneously breathing anesthetized dogs. Hyperinflation of 0.84 +/- 0.11 liter for 30 min decreased minute ventilation from 4.8 +/- 0.37 to 3.5 +/- 0.21 l/min and increased arterial PCO2 from 40.3 +/- 1.5 to 73.2 +/- 8.1 Torr (both P less than 0.01). Inspiratory work per breath increased 3-fold, work per liter increased 3.7-fold, and work per minute increased 2.8-fold (all P less than 0.01). CPAP at 15 cmH2O restored minute ventilation to 4.3 +/- 0.3 l/min and reduced arterial PCO2 to 54 +/- 6.6 Torr (NS vs. baseline). All measurements of inspiratory work were also restored to baseline, but cardiac output was reduced (baseline 3.09 +/- 0.36, hyperinflation 2.71 +/- 0.36, hyperinflation + CPAP 1.94 +/- 0.29 l/min; P less than 0.05, baseline vs. hyperinflation + CPAP). We conclude that increases in EELV mimic important features of airway obstruction, increase inspiratory work, and can cause respiratory failure independent of increased respiratory failure independent of increased airway resistance. This respiratory failure is reversed by CPAP at the potential expense of hemodynamic compromise. Author (Herner)

A95-68920
PERFORMANCE AND METABOLIC EFFECTS OF BENZODIAZEPINE DURING SUBMAXIMAL EXERCISE
K. COLLOMP, M. FORTIER, S. COOPER, A. LONG, S. AHMAIDI, C. PREFAUT, F. WRIGHT, M. PICOT, and M. G. COTE Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 828-833 Research sponsored by Canadian Center for Drug-free Sport
(HTN-95-A0137)

The present study examined whether benzodiazepine (BZ) intake alters performance and selected hormonal and metabolic variables during submaximal exercise. Seven triathletes completed two cycling trials at 85% maximum O2 uptake starting 3 h after an ingestion of either a placebo (PLA) of gelatin or BZ (1.5 mg lorazepam) and continuing until exhaustion, according to a double-blind randomized protocol. Blood samples were collected at rest; 5, 10, and 15 min; and exhaustion for dopamine (DA), norepinephrine (NE), epinephrine (Epi), adrenocorticotropic hormone (ACTH), cortisol (CORT), insulin (INS), free fatty acid, blood glucose, and lactate (La) determinations. Time of cycling was not significantly changed after BZ or PLA administration. A decrease in CORT and an increase in INS (P less than 0.05) were observed with BZ before cycling. In comparison with rest, exercise resulted in a decrease in INS and an increase in all the other variables investigated (P less than 0.001), but DA, NE, Epi, ACTH, CORT, La, and free fatty acid were significantly less elevated under BZ (P less than 0.05). No change was found in glucose and INS levels between the two treatments at the end of the test. There was a strong correlation under both PLA and BZ conditions between DA, NE, Epi, and ACTH and also between Epi and La levels. From these data, BZ intake did appear to alter metabolism but did not influence performance during intense submaximal exercise. Author (Herner)

A95-68921
INFLUENCE OF LUNG VOLUME DEPENDENCE OF UPPER AIRWAY RESISTANCE DURING CONTINUOUS NEGATIVE AIRWAY PRESSURE
F. SERIES Centre de Pneumologie de l'Hopital Laval, Univ. Laval, Sainte Foy, Canada and I. MARC Centre de Pneumologie de l'Hopital Laval, Univ. Laval, Sainte Foy, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 840-844 Research sponsored by Respiratory Health Network of Centres of Excellence of Canada
(HTN-95-A0138)

To quantify the contribution of lung volume dependence of upper airway (UA) on continuous negative airway pressure (CNAP)-induced increase in upper airway resistance, we compared the changes in supralaryngeal resistance during an isolated decrease in lung volume and during CNAP in eight normal awake subjects. Inspiratory supralaryngeal resistance was measured at isoflow during four trials, during two CNAP trials where the pressure in a nasal mask was progressively decreased in 3- to 5-cmH2O steps and during two continuous positive extrathoracic pressure (CPEP) trials where the pressure around the chest (in an iron lung) was increased in similar steps. The CNAP and CPEP trials were done in random order. During the CPEP trial, the neck was covered by a rigid collar to prevent compression by the cervical seal of the iron lung. In each subject, resistance progressively increased during the experiments. The increase was linearly correlated with the pressure increase in the iron lung and with the square of the mask pressure during CNAP. There was a highly significant correlation between the rate of rise in resistance between CNAP and CPEP: the steeper the increase in resistance with decreasing lung volume, the steeper the increase in resistance with decreasing airway pressure. Lung volume dependence in UA resistance can account for 61% of the CNAP-induced increase in resistance. We conclude that in normal awake subjects the changes in supralaryngeal resistance induced by CNAP can partly be explained by the lung volume dependence of this resistance. Author (Herner)

A95-68922
PULMONARY VASCULAR RESISTANCE DISTRIBUTION AND RECRUITMENT OF MICROVASCULAR SURFACE AREA
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(Contract(s)/Grant(s): NIH-HL-19153; NIH-HL-07411; NIH-RR-06558)
(HTN-95-A0139)

To test the hypothesis that the distribution of hemodynamic resistance is involved in the control of pulmonary capillary surface area, we measured permeability-surface area product (PS) and longitudinal resistance distribution (LRD) as functions of perfusion rate in isolated rabbit lungs under zone II conditions (n = 10) and through the zone II - III transition (n = 4). PS, considered to be indicative of functioning capillary surface area, was measured with the aid of the diffusion-limited tracer (C-14)propanediol, whereas LRD was determined using a viscous bolus technique, LRD was seen to change character with increasing flow and increasing PS/surface area, becoming bimodal with low central resistance as full capillary recruitment was approached in zone III. Effects of hypoxic ventillation were studied in zone II in five lungs; it was found that hypoxia altered the LRD and eradicated the normoxic dependence of PS/surface area on perfusion rate. It was concluded that LRD is involved in the determination of functioning capillary surface area. Author (Herner)

A95-68923
ENERGY BALANCE AT HIGH ALTITUDE OF 6,542 M
KLAAS R. WESTERTERP, BENGT KAYSER, LOEK WOUTERS, JEAN-LOUIS LE TRONG, and JEAN-PAUL RICHALET Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 862-866 Research sponsored by Sandoz Nutrition and Groupe de Reflexion sur le Probleme de l'Eau dans les Environnements d'Exception
(HTN-95-A0140) Copyright

Weight loss due to malnutrition and possibly intestinal malabsorption is a well-known phenomenon in high-altitude climbers. Up to approximately 5,000 m, energy balance may be attained and intestinal energy digestibility remains normal. To see whether (1) energy balance may also be attained at 6,542 m and, if not (2) whether decreased energy digestibility would play a significant role in the energy deficit, energy intake (EI), energy expenditure, body composition, and energy digestibility of 10 subjects (4 woman, 6 men; 27 - 44 yr) were assessed during a 21-day sojourn on the summit of Mt. Sajama, Bolivia (6,542 m). EI was measured during two 3-day intervals: EI1 (days 7 - 9) and EI2 (days 17 - 19). Total fecal energy loss during EI1 was calculated from fecal energy measured by bomb calorimetry. Average daily metabolic rate (ADMR) at altitude was measured in six subjects (2 women, 4 men) using doubly labeled water over a 10-day interval (days 9 - 19). Basal metabolic rate was measured before and after the expedition by respiratory gas analysis. Body composition was estimated from skinfolds and body mass before and during the altitude sojourn. Subjects were in negative energy balance throughout the observation period. The activity level, expressed as ADMR to basal metabolic rate, was 1.56 - 2.39. The loss of fat mass (3.7 +/- 1.5 kg) represented 74 +/- 15% of the loss of body mass. Energy content of the feces was 21 kJ/g dry wt, and gross energy digestibility amounted to 85%. The energy deficit increased to 3.5 MJ/day after correction for the decreased energy digestibility. In conclusion, energy balance was not attained at 6,542 m. The resulting energy deficit appeared to result mostly from malnutrition, and only a limited part could be attributed to malabsorption. Author (Herner)

A95-68924
RESPIRATORY RESPONSE TO INHALED CO2 DURING POSITIVE INSPIRATORY PRESSURE IN HUMANS
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(Contract(s)/Grant(s): DFG-II-B-7-SCHE-46/7-1)
(HTN-95-A0141) Copyright

To investigate ventilatory CO2 sensitivity during inspiratory pressure support (IPS), we administered inspiratory CO2 (fractional concn (FI(sub CO2) 0.01, 0.03, or 0.05) in eight normal subjects without (CTRL) or with (Pinsp) positive inspiratory airway pressure (5 or 10 cmH2O). At CTRL and low IPS, CO2 inhalation led to a significant increase in tidal volume (VT) with nearly identical slopes in the plot of VT vs. end-tidal PCO2. At the high IPS level, VT at FI(sub CO2) of 0 was significantly above the value at lower Pinsp and did not increase with CO2 unless FI(sub CO2) was elevated to greater than 0.03. There was very little effect of either Pinsp or FI(sub CO2) on respiratory frequency and respiratory timing. The data suggest that the CO2 sensitivity of ventilation is similar at low levels of IPS as during CTRL. However, at high levels of IPS, VT is determined largely by the passive inflation and, thus, independent of CO2. CO2 has to be elevated to increase the respiratory drive before VT becomes CO2 sensitive. Author (Herner)

A95-68925
CHEST WALL INTERRUPTER RESISTANCE IN ANESTHETIZED PARALYZED HUMANS
E. D'ANGELO, E. PRANDI, M. TAVOLA, E. CALDERINI, and J. MILIC-EMILI Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 883-887 Research sponsored by National Atlantic Treaty Organization-CNR Senior Guest Fellowship
(HTN-95-A0142) Copyright

Tracheal (Ptr) and esophageal (Pes) pressure and flow were measured in 12 supine anesthetized paralyzed normal subjects aged 16-22 yr. The subjects were ventilated with a fixed inflation volume (range 0.57 - 0.62 liter) and with different constant flows ranging between 0.24 and 1.12 l/s. A rapid airway shutter (closing time 10 - 15 ms) was used to briefly occlude (0.4 - 0.9 s) the airways at end inspiration for 33 - 44 consecutive breaths. At each flow level, Ptr and Pes records obtained during end-inspiratory occlusions were ensemble averaged to allow for the cardiac artifacts. The interrupter resistances of the chest wall and respiratory system were assessed as the rapid fall in Pes and Ptr with occlusion divided by the flow preceding the occlusion. Interrupter resistances of both the chest wall and lung were independent of flow and averaged 0.4 +/- 0.1 and 1.5 +/- 0.4 (SD) cmH2O/s/l, respectively. The contribution of the chest wall to the total interrupter resistance was approximately 27% at flows less than or equal to 1 l/s. Author (Herner)

A95-68926
HYPOXIA INCREASES GLUCOSE TRANSPORT AT BLOOD-BRAIN BARRIER IN RATS
SAMI I. HARIK, RAMIN A. BEHMAND, and JOSEPH C. LAMANNA Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 896-901 Research sponsored by Shriners-Burns and Fogarty International
(Contract(s)/Grant(s): NIH-HL-36829; NIH-HL-07354)
(HTN-95-A0143) Copyright

Prolonged hypoxia causes several adaptive changes in systemic physiology and tissue metabolism. We studied the effects of hypobaric hypoxia on glucose transport at the blood-brain barrier (BBB) in the rat. We found that hypoxia increased the density of brain microvessels seen on immunocytochemical stains using an antibody to the glucose transporting protein GLUT. In addition, we found that hypoxia increased the density of GLUT in isolated cerebral microvessels as determined by specific cytochalasin B binding. The higher GLUT density in isolated cerebral microvessels was evident after 1 wk of hypoxia and was associated with decreased activity of gamma-glutamyltranspeptidase. Consistent with these findings, we also demonstrated that 3 wk of hypobaric hypoxia caused increased unidirectional transport of glucose at the BBB in several brain regions in vivo, as determined by the doubly labeled single-pass indicator-fractionation atrial bolus injection method in anesthetized rats. We conclude that chronic hypobaric hypoxia is associated with increased glucose transport at the BBB. Author (Herner)

A95-68927
HYPERBARIC OXYGENATION INCREASES AROUSAL AND BREATHING MOVEMENTS IN FETAL LAMBS
M. H. TIKTINSKY-RUPP, S. U. HASAN, B. BISHOP, and F. C. MORIN, III Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 902-911 Research sponsored by Alberta Lung Association and Alberta Children's Hospital
(Contract(s)/Grant(s): NIH-RO1-HL-41387)
(HTN-95-A0144) Copyright

Oxygenation produced by distending the lungs with 100% O2 increases the occurrence of arousal and fetal breathing movements (FBM), particularly during non-rapid-eye-movement (NREM) sleep, in fetal sheep of equal to or greater than 35 days of gestation. We studied the breathing and behavioral responses in arterial PO2 (Pa(sub O2)) without lung distension in fetuses between 128 and 132 days gestation. Twelve fetuses were chronically instrumented to record FBM, behavioral state, blood pressure, arterial blood gas tensions, and pH. Fetal Pa(sub O2) was raised by having the ewe breathe 100% O2 at 3 atmosphere absolute pressure spontaneously (group 1) or with mechanical ventilation to control fetal arterial PCO2 (group 2). Hyperbaric oxygenation raised fetal Pa(sub O2) by 20 Torr in both groups. During hyperbaric oxygenation, the occurrence of arousal increased severalfold in both groups. The occurrence of FBM increased during arousal in both groups, during rapid-eye-

movement sleep in group 1, and during NREM sleep in group 2. The timing of diaphragmatic activity during arousal and the variability of diaphragmatic activity during NREM sleep were different than those in rapid-eye-movement sleep. We conclude that oxygenation without lung distension increases the occurrence of arousal and of FBM, principally during arousal and NREM sleep, in fetuses of less than or equal to 135 days of gestation. Author (Herner)

A95-68928
PULMONARY GAS EXCHANGE DURING EXERCISE IN ATHLETES. 1: VENTILATION-PERFUSION MISMATCH AND DIFFUSION LIMITATION
SUSAN R. HOPKINS, DONALD C. MCKENZIE, ROBERT B. SCHOENE, ROBB W. GLENNY, and H. THOMAS ROBERTSON Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 912-917 Research sponsored by Medical Research Council of Canada and British Columbia Lung Association
(HTN-95-A0145) Copyright

To investigate pulmonary gas exchange during exercise in athletes, 10 high aerobic capacity athletes (maximal aerobic capacity = 5.15 +/- 0.52 l/min) underwent testing on a cycle ergometer at rest, 150 W, 300 W, and maximal exercise (372 +/- 22 W) while trace amounts of six inert gases were infused intravenously. Arterial blood samples, mixed expired gas samples, and metabolic data were obtained. Indexes of ventilation-perfusion (dot-VA/dot-Q) mismatch were calculated by the multiple inert gas elimination technique. The alvelar-arterial difference for O2 (AaD(sub O2) was predicted from the inert gas model on the basis of the calculated dot-VA/dot-Q mismatch. dot-VA/dot-Q heterogeneity increased significantly with exercise and was predicted to increase the AaD(sub O2) by greater than 17 Torr during heavy and maximal exercise. The observed AaD(sub O2) increased significantly more than that predicted by the inert gas technique during maximal exercise (10 +/- 10 Torr). These data suggest that this population develops diffusion limitation during maximal exercise, but dot-VA/dot-Q mismatch is the most important contributor (greater than 60%) to the wide AaD(sub O2) observed.
Author (Herner)

A95-68929
LOWER LIMIT OF BODY FAT IN HEALTHY ACTIVE MEN
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(HTN-95-A0146) Copyright

We examined body composition changes in 55 normal young men during an 8-wk Army combat leadership training course involving strenuous exercise and low energy intake, with an estimated deficit of 5.0 +/- 2.0 MJ/day and a resultant 15.7 +/- 3.1% weight loss. Percent body fat (BF) measured by dual-energy X-ray absorptiometry (DEXA) averaged 14.3% (range 6 - 26%) and 5.8 +/- 1.8% (range 4 - 11%) at the beginning and end of the course, respectively. Men who achieved a minimum percent BF (4 - 6%) by 6 wk demonstrated only small additional total and subcutaneous fat losses in the final 2 wk and sacrificed increasingly larger proportions of fat-free mass. Percent BF estimated from skinfold thickness reflected changes in fat mass, although actual percent BF was overestimated. Instead of reaching a plateau after fat stores were substantially depleted, abdominal, hip, and thigh girths continued to decline with body weight loss. Final percent BF for the leanest men was similar to that observed after a 25% body weight reduction in the 1950 Minnesota study (5.2% by underwater weighing), and height-corrected final fat mass was the same, suggesting that these values represent a minimal body fat content in healthy men and that weight loss subsequent to achieving this level is contributed from the fat-free mass. Our results suggest that 4 - 6% BF approximately 2.5 kg fat represents the lower limit for healthy men, as assessed by DEXA or by underwater weighing. Author (Herner)

A95-68930
CATECHOLAMINE RESPONSES TO SHORT-TERM HIGH-INTENSITY RESISTANCE EXERCISE OVERTRAINING
A. C. FRY, W. J. KRAEMER, F. VAN BORSELEN, J. M. LYNCH, N. T. TRIPLETT, L. P. KOZIRIS, and S. J. FLECK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 941-946
(HTN-95-A0147) Copyright

Seventeen weight-trained males were divided into an overtraining group that weight trained their legs daily dor 2 wk with 100% 1 repetition maximum relative intensity on a squat machine and a control group that exercised 1 day/wk with low relative intensity (50% 1 repetition maximum). Test batteries including strength assessments and resting and exercise-induced concentrations of epinephrine and norepinephrine were conducted at the beginning, middle, and end (tests 1 - 3, respectively) of the study. Strength capabilities decreased by test 3 for the OT group. Resting catecholamine concentrations did not change either group during the study, whereas exercise-induced concentrations of both epinephrine and norepinephrine significantly increased by tests 2 and 3 for only the OT group. Correlation coefficients suggested decreased responsitivity of skeletal muscle to sympathetic nervous system activity. It appears that altered exercise-induced sympathetic nervous system accompanies high relative intensity resistance exercise overtraining and may be among the initial responses to the onset of the previously theoretical sympathetic overtraining syndrome.
Author (Herner)

A95-68931
INTERACTIVE EFFECTS OF EMPHYSEMA AND MALNUTRITION ON DIAPHRAGM STRUCTURE AND FUNCTION
MICHAEL I. LEWIS, STEPHEN A. MONN, WEN-ZHI ZHAN, and GARY C. SIECK Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 947-955 Research sponsored by American Lung Association of California
(Contract(s)/Grant(s): NIH-HL-01907; NIH-HL-34817; NIH-HL-37680; NIH-HL-01907)
(HTN-95-A0148) Copyright

Interactive effects of emphysema (EMP) and prolonged nutritional deprivation (ND) on contractile, morphometric, and metabolic properties of hamster diaphragm muscle (DIA) were examined. Six months after induction of EMP (intratracheal elastase), saline-treated controls (CTL) and EMP hamsters of similar body weights were subjected to ND over 6 wk. Isometric contractile and fatigue properties of costal DIA were determined in vitro. DIA fibers were histochemically classified as type I or II, and fiber succinate dehydrogenase activity and cross-sectional area were determined using quantitative microscopic procedures. From histochemical sections, the number of capillaries per fiber (C/F) and per fiber cross-sectional area (C/A) were determined. ND resulted in progressive loss of body weight. ND did not affect reduction in optimal length (L(sub O)) of DIA fibers in EMP compared with CTL and ND-CTL hamsters. Maximum specific force (i.e., force/unit area) was reduced by approximately 25% in EMP animals compared with CTL. Nd did not improve or exacerbate the reduction in specific force with EMP. ND attenuated improved fatigue resistance of DIA in EMP animals. No differences in fiber type proportions were noted among experimental groups. Significant atrophy of type I and II DIA fibers was noted after ND. Atrophy was proportionately greater in type II fibers of ND-EMP when referenced to EMP animals. Thus adaptive hypertrophy of type II DIA fibers in EMP animals was abolished. Fiber succinate dehydrogenase activity was significantly increased in type I and II fibers in EMP DIA. ND did not affect this metabolic adaptation of DIA fibers to persistent loads imposed by EMP. In EMP hamsters, C/F was increased for type I and II fibers, whereas C/A was unaffected. Significant increments in both indexes of capillary were evident in ND-EMP DIA. We conclude that interaction of ND with EMP has serious negative clinical implications, in that total force production, endurance, and functional force reserve of the DIA will be significantly curtailed. Author (Herner)

A95-68932
HIGH PHYSIOLOGICAL LEVELS OF EPINEPHRINE DO NOT ENHANCE MUSCLE GLYCOGENOLYSIS DURING TETANIC STIMULATION
ALAN CHESLEY Guelph Univ., Guelph, Canada, DAVID J. DYCK Guelph Univ., Guelph, Canada, and LAWRENCE L. SPRIET Guelph Univ., Guelph, Canada Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 956-962 Research sponsored by Natural Sciences and Engineering Research Council of Canada
(HTN-95-A0149) Copyright

This study examined whether high physiological concentrations of epinephrine (EPI) would enhance muscle glycogenolysis during intense muscular contractions. Muscles of the rat hindlimb were perfused for 12 min at rest and 45 s of tetanic stimulation (1.0-Hz train rate, 100-ms train duration at 80 Hz) without EPI (control) or with 15 or 35 nM EPI. In the EPI groups the muscles were perfused with EPI for the last 2 min of rest perfusion and throughout stimulation. Glycogenolysis in the white gastrocnemius, red gastrocnemius, plantaris, and soleus muscles during stimulation was unaffected by the presence of EPI in the perfusion medium. In addition, muscle lactate and hindlimb lactate efflux were similar in EPI and control groups. It is concluded that EPI is not important for enhancing glycogenolysis in rat muscles composed predominantly of fast-twitch fibers during intense short-term tetanic stimulation.
Author (Herner)

A95-68933
LUNG VOLUMES AND EXPIRATORY FLOW LIMITATION DURING EXERCISE IN INTERSTITIAL LUNG DISEASE
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(HTN-95-A0150) Copyright

Lung volumes were measured at rest and during exercise by an open-circuit N2-washout technique in patients with interstitial lung disease (ILD). Exercise tidal flow-volume (F-V) curves were also compared with maximal F-V curves to investigate whether these patients demonstrated flow limitation. Seven patients underwent 4 min of constant work rate bicycle ergometer exercise at 40, 70, and 90% of their previously determined maximal work rates. End-expiratory lung volume and total lung capacity were measured at rest and near the end of each period of exercise. There was no significant change in end-expiratory lung volume or total lung capacity when resting measurements were compared with measurements at 40, 70, and 90% work rates. During exercise, expiratory flow limitation was evident in four patients who reported stopping exercise because of dyspnea. In the remaining patients who discontinued exercise because of leg fatigue, no flow limitation was evident. In all patients, the mean ratio of maximal minute ventilation to maximal ventilatory capacity (calculated from maximal F-V curves) was 67%. We conclude that lung volumes during exercise do not significantly differ from those at rest in this population and that patients with ILD may demonstrate expiratory flow limitation during exercise. Furthermore, because most patients with ILD are not breathing near their maximal ventilatory capacity at the end of exercise, we suggest that respiratory mechanics are not the primary cause of their exercise limitation. Author (Herner)

A95-68934
SURFACE ACTIVITY OF LIPID EXTRACT SURFACTANT IN RELATION TO FILM AREA COMPRESSION AND COLLAPSE
SAMUEL SCHUERCH, DAVID SCHUERCH, TORE CURSTEDT, and BENGT ROBERTSON Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 974-986 Research sponsored by Medical Research Council of Canada, Alberta Heritage Foundation for Medical Research, Swedish Medical Research Council, and Oscar II:s Jubileumsfond
(HTN-95-A0151) Copyright

The physical properties of modified porcine surfactant (Curosurf), isolated from minced lungs by extraction with chloroform-methanol and further purified by liquid-gel chromatography, were investigated with the captive bubble technique. Bubble size, and thus the surface tension of an insoluble film at the bubble surface, is altered by changing the pressure within the closed bubble chamber. The film surface tension and area are determined from the shape (height and diameter) of the bubble. Adsorption of fresh Curosurf is characterized by stepwise decreases in surface tension, which can easily be observed by sudden quick movements of the bubble apex. The ?adsorption clicks' imply a cooperative movement of large collective units of molecules, approximately 10(exp 14) (corresponding to approximately 120 ng of phospholipid) or approximately 10(exp 18) molecules/sq m, into the interface during adsorption. Films formed in this manner are already highly enriched in dipalmitoyl phosphatidylcholine, as seen by the extremely low compressibility, close to that of dipalmitoyl phosphatidylcholine. Near-zero minimum tensions are obtained, even at phospholipid concentrations as low as 50 microgram/ml. During dynamic cycling (20 - 50 cycles/min), low minimum surface tensions, good film stability, low compressibility, and maximum surface tensions between 30 and 40 mN/m are possible only if the films are not overcompressed near zero surface tension; i.e., the overall film area compression should not substantially exceed 30%.
Author (Herner)

A95-68935
INDEX FINGER POSITION AND FORCE OF THE HUMAN FIRST DORSAL INTEROSSEUS AND ITS ULNAR NERVE ANTAGONIST
I. ZIJDEWIND Amsterdam Univ., Academisch Medisch Centrum, Amsterdam, Netherlands and D. KERNELL Groningen Univ., Groningen, Netherlands Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 987-997 Research sponsored by Nederlands Organization for Scientific Research
(HTN-95-A0152) Copyright

In normal subjects, maximum voluntary contraction (MVC) and electrical ulnar nerve stimulation (UNS; 30-Hz bursts of 0.33 s) were systematically compared with regard to the forces generated in different directions (abduction/adduction and flexion) and at different degrees of index finger abduction. With a ?resting' hand position in which there was no index finger abduction, UNS produced about one-half of the abduction force elicited by an MVC (mean ratio 51%). Qualitatively, such a discrepancy would be expected, because UNS activates two index finger muscles with opposing actions in the abduction/adduction plane of torques: the first dorsal interosseus (FDI) and the first palmar interosseus (FPI). The abduction forces produced by MVC and UNS were very sensitive to index finger abduction angle: at a maximum degree of abduction, the UNS-generated force even reversed its direction of action to adduction (with FPI dominating) and the abduction MVC declined to 37% of that in the resting hand position. Inasmuch as these declines in MVC and UNS-generated abduction force could not be explained by a change in moment arm, the main alternative seemed to be abduction-associated alterations in FDI fiber length (analysis by previously published biomechanical data). The FDI and FPI were further compared by application of a UNS-generated fatigue test (5-min burst stimulation), with the index finger kept at a ?neutral' angle, i.e., the abduction angle at which, in the unfatigued state, the forces of the FDI and FPI were in balance (zero net UNS-generated abduction/adduction force). There was no major difference in the fatigability of the two muscles, yet the fatigue reactions of the two muscles were not fully identical. Author (Herner)

A95-68936
CARDIOPULMONARY ADAPTATIONS TO PNEUMONECTOMY IN DOGS. 4: MEMBRANE DIFFUSING CAPACITY AND CAPILLARY BLOOD VOLUME
C. C. W. HSIA Texas Univ. Southwestern Medical Center, Dallas, TX, US, L. F. HERAZO Texas Univ. Southwestern Medical Center, Dallas, TX, US, M. RAMANATHAN Texas Univ. Southwestern Medical Center, Dallas, TX, US, and R. L. JOHNSON, JR. Texas Univ. Southwestern Medical Center, Dallas, TX, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 998-1005 Research sponsored by American Heart Association (Contract(s)/Grant(s): NIH-R01-HL-40070; NIH-TL-07362) (HTN-95-A0153)

Lung diffusing capacity for carbon monoxide (DL(sub CO)) and its components, membrane diffusing capacity (Dm(sub CO))) and capillary blood volume (Vc), as well as pulmonary blood flow (dot-QC), were measured at rest at several lung volumes and during treadmill exercise by a rebreathing technique in four adult dogs after right pneumonectomy (R-PNX) and in six matched control dogs (Sham) 6 - 12 mo after surgery. In both groups, lung inflation at rest was associated with a small increase in DL(sub CO) and Dm(sub CO) but not in Vc. After R-PNX, total DL(sub CO) was lower by 30% at peak exercise compared with control values. When compared with DL(sub CO) in a normal left lung, DL(sub CO) in the remaining lung continued to increase along the normal relationship with respect to dot-QC up to a cardiac output equivalent to 34 l/min through both lungs of the Sham dog. There was no evidence of an upper limit of DL(sub CO) being reached. The augmentation of DL(sub CO) from rest to exercise was associated with corresponding increases in Dm(sub CO) and Vc; after R-PNX, both Dm(sub CO) and Vc continued to increase with respect to dot-QC along similar relationships as in control dogs without reaching an upper limit, suggesting a much larger alveolar-capillary reserve for gas exchange by diffusion than previously recognized. At higher levels of blood flow through the remaining lung, DL(sub CO) was greater in adult dogs after R-PNX than after left pneumonectomy (Carlin et al., (1991)), suggesting that additional sources of compression, e.g., lung growth, exist after removal of greater than 50% of lung. Author (Herner)

A95-68937
(31)P-MRS AND SIMULTANEOUS QUANTIFICATION OF DYNAMIC HUMAN QUADRICEPS EXERCISE IN A WHOLE BODY MR SCANNER
J. B. RODENBURG, R. W. DE BOER, J. A. L. JENESON, C. J. A. VAN ECHTELD, and P. R. BAER Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 1021-1029 (HTN-95-A0154)

An ergometer for dynamic quadriceps exercise in a magnetic resonance (MR) scanner is physiologically validated, and its technical aspects are presented. The reproducibility of heart rate (HR), O2 consumption (dot-VO2), and power (P) during two graded exercise on the MR ergometer was good (n = 8). Graded exercises on the MR ergometer and on a cycle ergometer (n = 17) were similar with respect to the regression lines between (1) HR and dot-VO2 and (2) HR and P; also peak P did not differ significantly. Peak HR, peak dot-VO2, and the slope of the regression line between P and dot-VO2 were lower for MR exercise. During quadriceps exercise in an MR scanner (n = 12), peak P was 64 - 143 W for the right leg, with corresponding inorganic phosphate-to-phosphocreatine ratios of 0.85 - 7.2. It is concluded that continuous noninvasive assessment of energy metabolism with (31)P-MR spectroscopy and quantification of power output can be performed simultaneously during dynamic quadriceps exercise, without major reduction of the spectral resolution or the signal-to-noise ratio, and that exercise on this MR ergometer currently is the best possible approximation of cycling exercise for MR purposes. Author (Herner)

A95-68938
EVANS BLUE DYE IN THE ASSESSMENT OF PERMEABILITY-SURFACE AREA PRODUCT IN PERFUSED RAT LUNGS
MOHAMMED M. DALLAL Northwestern Univ. Medical School, Chicago, IL, US and SHIH-WEN CHANG Dept. of Veterans Affairs Lakeside Medical Center, Chicago, IL, US Journal of Applied Physiology (ISSN 8750-7587) vol. 77, no. 2 August 1994 p. 1030-1035 Research sponsored by Dept. of Veterans Affairs (HTN-95-A0155)

Evans blue dye (EBD) has been used extensively as a marker of extravascular protein leakage. We assessed the utility of EBD as an albumin marker in the measurement of permeability-surface area product (PS) in perfused rat lungs and compared the results with PS values obtained using I-125-labeled albumin. In isolated perfused rat lungs, PS was measured by exposure to a perfusate containing EBD (600 microgram/ml) and I-125-albumin (1 micro Ci) for exactly 3 min, followed by washout of the intravascular space with fresh perfusate for 6 min. In lungs from normal rats, we found that PS obtained by EBD (PS-EBD) was fivefold higher than PS obtained by I-125-albumin. Similarly, in rats pretreated with Salmonella enteritidis lipopolysaccharide (2 mg/kg iv), PS-EBD was much higher than PS-I-125. This discrepancy between PS-EBD and PS-I-125 was not explained by difference in the amount of free marker in perfusate, because the albumin-binding rate for both markers was very high. In addition, prolonged perfusion (40 min) with EBD did not significantly affect pulmonary vasoreactivity or water content in rat lungs. A detailed comparison of the kinetics of lung tissue uptake of the two markers showed an initial phase of rapid lung uptake of EBD, followed by parallel uptake of both markers up to 60 min of perfusion. We conclude that although EBD does not cause obvious lung injury, it is not a reliable marker for measurement of vascular permeability in perfused rat lungs. This is most likely due to rapid binding of EBD to lung tissue proteins. Author (revised by Herner)

N95-19536# Naval Research Lab., Washington, DC.
PROCEEDINGS OF NATURAL SCIENCES SYMPOSIUM
Jul. 1994 84 p Symposium held in Washington, DC, 14 Jun. 1993 (AD-A285452; NRL/PU/6000-94-252) Avail: CASI HC A05/MF A01

This symposium included seven Nobel Laureates' presentations: Prospects for the Physical Sciences; Creativity and Managed Research; Science — The Preeminent Random Process; Dealing with Genes; Understanding Life as Chemistry; The Impossible Takes a Little Longer; and Reflections of an Era. This last presentation is made by Dr. Jerome Karle, Nobel Laureate, Chemistry, 1985, for whom the conference marked a 75th birthday and 45th year in government service. The focus of these talks was an outlook on the 'Future Implications of Current Advances in the Natural Sciences'. CASI

N95-19613# Department of Energy, Washington, DC. Office of Energy Research.
ACTIVITIES OF THE DIVISION OF ENERGY BIOSCIENCES Annual Summary Report, FY 1994
Sep. 1994 172 p
(DE95-001046; DOE/ER-0621P) Avail: CASI HC A08/MF A02

The Energy Biosciences program was initiated in 1979 for the purpose of fulfilling the need of basic information about plants and microorganisms relating to varied energy matters. The program generates basic information that contributes significantly to future technologies involving alternate fuel generation, petroleum replacements, sustained industrial activities along with means of improving environmental conditions. The Energy Biosciences program during Fiscal Year 1994 received 139 new research applications following the screening of numerous preapplications. Of the applications received, 21 projects were funded. DOE

52
AEROSPACE MEDICINE

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

A95-65873
CHARACTERIZATION OF FRACTURE TOUGHNESS OF RENAL CALCULI USING A MICROINDENTATION TECHNIQUE
P. ZHONG Univ. of Texas Southwestern Medical Center at Dallas, Dallas, TX, C. J. CHUONG, and G. M. PREMINGER Journal of Materials Science Letters (ISSN 0261-8028) vol. 12, no. 18 September 15, 1993 p. 1460-1462 refs
(BTN-94-EIX94361122293) Copyright

We report our results on the characterization of fracture toughness of renal calculi of various compositions. A microindentation technique was used to determine stone hardness. The results showed distinct differences in fracture toughness of renal calculi which confirms the observations of clinical experience: viz. COM and brushite stones are much more resistant to shock-wave fragmentation than MAPH and CA stones. EI

A95-65904
FLUID FLOW AND HEAT TRANSFER IN THE CRESCENT-SHAPED LUMEN CATHETER
M. A. EBADIAN Florida Inst. Univ., Miami, FL and H. Y. ZHANG Journal of Applied Mechanics, Transactions ASME (ISSN 0021-8936) vol. 60, no. 3 September 1993 p. 721-727
(BTN-94-EIX94361122408) Copyright

This paper presents a numerical investigation of fluid flow, frequency response in the fully developed region, and convective heat transfer in the entrance region of the crescent-shaped lumen catheter. The catheter is commonly used in the biomedical field to clinically diagnose heart disease and also to treat vessel blockage in surgery. The catheter is subjected to a constant wall temperature. The solution to discretization of the momentum and energy equations is obtained by using the numerically generated boundary fitted coordinate system. According to this method, the complex domain in the physical plane is transformed into a regular square domain in the computational plane. The control volume-based finite difference method is then used to discretize the transformed governing equations. Results for the thermal entry region flow, frequency response, and heat transfer are presented in graphical form. The representative curves illustrating variations of the flow rate, frequency response, damping coefficient, bulk temperature, and the Nusselt numbers with pertinent parameters in the entire thermal entry region are plotted. The optimized catheter design for diagnostic use in the medical industry is also presented graphically. Author (EI)

A95-65949
MAXIMALLY SMOOTH IMAGE RECOVERY IN TRANSFORM CODING
YAO WANG Polytechnic Univ, Brooklyn, NY, QIN-FAN ZHU, and LEONARD SHAW IEEE Transactions on Communications (ISSN 0090-6778) vol. 41, no. 10 October 1993 p. 1544-1551 refs
(BTN-94-EIX94361135047) Copyright

This paper considers the reconstruction of images from partial coefficients in block transform coders and its application for packet loss recovery in image transmission over ATM networks. The proposed algorithm makes use of the smoothness property of common image signals and produces a maximally smooth image among all those with the same coefficients and boundary conditions. It recovers each damaged block by minimizing the intersample variation within the block and across the block boundary. The optimal solution is achievable through two linear transformations, where the transform matrices depend on the loss pattern and can be calculated in advance. The reconstruction of contiguously damaged blocks is accomplished iteratively, using the previous solution as the boundary conditions in each new step. This technique is applicable to any unitary block-transform and is very effective for recovering the DC and low-frequency coefficients. When applied to still image coders using the discrete cosine transform (DCT), high quality images have been reconstructed in the absence of many DC and low-frequency coefficients over spatially adjacent blocks. When the damaged blocks are made isolated by the use of block interleaving, satisfactory results have been obtained even when all the coefficients are missing. Author (EI)

A95-65976
QUANTITATIVE SPECT BRAIN IMAGING: EFFECTS OF ATTENUATION AND DETECTOR RESPONSE
D. R. GILLAND Duke Univ Medical Cent, Durham, NC, R. J. JASZCZAK, J. E. BOWSHER, T. G. TURKINGTON, Z. LIANG, and K. L. GREER IEEE Transactions on Nuclear Science (ISSN 0018-9499) vol. 40, no. 3 June 1993 p. 295-299 refs
(BTN-94-EIX94361133479) Copyright

The purpose of this work was to implement two reconstruction methods that compensate for attenuation and detector response, a 3D maximum likelihood-EM method (ML) and a filtered backprojection method (FB) with Metz filter and Chang attenuation compensation, and compare the methods in terms of quantitative accuracy and image noise. The methods were tested on simulated data of the 3D Hoffman brain phantom. The simulation incorporated attenuation and distance-dependent detector response. Bias and standard deviation of reconstructed voxel intensities were measured in the grey and white matter regions. The results with ML showed that in both the grey and white matter regions as the number of iterations increased. In both regions, ML had smaller standard deviation than FB for a given bias. Reconstruction times for the ML method have been greatly reduced through efficient coding, limited source support, and any computing attenuation factors only along rays perpendicular to the detector. Author (EI)

A95-68268* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RADIATION EXPOSURE PREDICTIONS FOR LONG-DURATION-STAY MARS MISSIONS
SCOTT A. STRIEPE, LISA C. SIMONSEN, and JOHN E. NEALY Journal of the Astronautical Sciences (ISSN 0021-9142) vol. 42, no. 2 April-June 1994 p. 131-142 refs
(BTN-95-EIX95032453043) Copyright

In this study, the ionizing radiation environment is estimated, using the Mission Radiation Calculation (MIRACAL) program, for several long-duration-stay Mars missions proposed for early in the 21(sup st) century. Both minimum energy and fast transfer missions are evaluated and their 30-day maximum, annual maximum, and total slab skin and blood-forming organ (BFO) doses are compared. When large flares were included while the astronauts were on the surface, the delivered dose did not significantly contribute to the total dose (less than 4 cSv BFO dose, or 8 percent of the guideline annual limit, for the most energetic event simulated) due to the substantial protection provided by the Martian atmosphere. However, dose delivered by large flares during transit is dependent on vehicle shielding and distance from the Sun. All of the fast transfer missions studied had lower total and annual maximum doses than the corresponding minimum energy transfer missions (on average, 30% less for missions having no large flares and the shielding thicknesses evaluated in this study). For all the missions studied, having the astronauts spend one-third of their day during transit in a 10 g/sq cm storm shelter resulted in an approximate 10% reduction in the total mission dose. Author (EI)

A95-69746
A MULTIMODAL METHOD FOR ASSESSING AND TREATING AIRSICKNESS
R. JEFFREY JACKSON U.S. Air Force Academy, Colorado Springs, CO, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 1 1994 p. 85-96
(HTN-95-90719) Copyright

Airsickness is a disruptive phenomenon in military flight train-

ing and operational settings. Despite its occurrence, several studies have demonstrated efficacy in treating this syndrome. Although generally successful, these treatment strategies appear to be guided by their presumed effectiveness rather than by theoretical rationale. In support of these varied treatments, a multimodal conceptual model is proposed. This model attempts to integrate those factors bearing on the etiology of airsickness and, based on a careful assessment, directs and explains the treatment efforts.

Author (Herner)

N95-19537# Physics and Electronics Lab. TNO, The Hague (Netherlands).

HIGH PERFORMANCE COMPUTING FOR MEDICAL IMAGE INTERPRETATION

A. C. DUMAY Oct. 1993 72 p

(AD-A285457; FEL-93-B160; TDCK-93-2783) Avail: CASI HC A04/MF A01

Medical image processing aims at improvement of the image quality in order to support the medical diagnosis and therapy. Globally, there can be four subjects distinguished for image processing, including: (1) data fusion, (2) object/feature extraction, (3) analysis, and (4) visualization. Data fusion, or registration, concerns the combination of images acquired with various imaging modalities into a single image. Object/feature extraction, or segmentation, aims at the recognition and extraction of objects and object features from image data. And the analysis involves the interpretation of the object features from which conclusions can be drawn. Visualization is of utmost importance for each of the forementioned subjects. With the introduction of computer tomography (CT) and magnetic resonance imaging (MRI) three-dimensional images can be acquired from patients. The processing of 3D images such that the time required for that purpose is in acceptable limits makes the use of high performance computing (HPC) techniques desirable. Currently (commercially) available implementations do not satisfy the performance requirements for routine use in a clinical setting. As a result, such systems will not be used at all or at high costs of personnel. High performance computing medical image interpretation includes data fusion, object/feature extraction, analysis, and visualization of 3D medical images. Modules for these purposes may be integrated in existing medical systems to support interactive visualization, quantitative analysis, radiotherapy planning, and neurosurgery planning. Integrated into a high performance computing medical image interpretation system (HPMI(sup 2)S), one has the tools for developing anatomical models for simulation and training for example minimal access surgery (MAS) and triage. DTIC

N95-19695# Keele Univ. (England). Dept. of Chemistry.

PHOTOBIOLOGY IN MEDICINE Final Proceedings Report, 30 Sep. - 13 Oct. 1993

T. GEORGE TRUSCOTT, ed. 13 Oct. 1993 200 p Sponsored by European Office of Aerospace Research and Development

(AD-A284843; CSP-93-1041) Avail: CASI HC A09/MF A03

Man has recognized an association of light with life and medicine for over 3000 years. Today the major challenges to this topic include the elucidation of photochemical reactions involved in photobiology at the molecular level. This includes the use of a variety of modern probing techniques that directly measure the reactivity of excited states and free radicals involved in biological reactions. This textbook is based on such an approach and has arisen from some of the lectures delivered at the NATO ASI held at Hotel Capo Caccia near the Centre for Advanced Research in Photobiology (CARP) in Cardegia, Italy. The ASI took place from 30 Sep. - 13 Oct. 93 and involved a total membership of 90. Photobiology in medicine is a wide-ranging subject that obviously cannot be totally covered comprehensively in one book alone. Rather, chosen topics of current interest in photomedicine were focused upon and these are linked to the major underlying themes and techniques in photophysics and photochemistry. DTIC

N95-19698# Alabama Univ., Birmingham, AL.

CUMULATIVE EFFECTS OF REPEATED BRIEF CEREBRAL ISCHEMIA Final Report

H. P. HETHERINGTON and K. A. CONGER 1994 48 p

(Contract(s)/Grant(s): F49620-92-J-0362)

(AD-A284234; AFOSR-94-0481TR) Avail: CASI HC A03/MF A01

The purpose of this grant was to investigate the metabolic and physiological factors determining the extent of the ischemic damage in a model of brief repetitive cerebral ischemia. The model is intended to simulate the effects of Gz induced blackout experienced by fighter pilots undergoing high gravitational stress maneuvers. To achieve this goal a rat model was developed whereby the ischemia was remotely induced by inflation (under computer control) of an occlusive cuff placed about the common carotid artery. Metabolic parameters were determined using in vivo NMR spectroscopy measurements throughout the ischemic and reflow periods. Lactate production was found to be highly reproducible and not limited by blood glucose levels. High energy phosphate decreases were correlated with loss of high frequency EEG. To evaluate the correlation between histologic damage and measures of regional metabolism we have carried out H-1 spectroscopic imaging experiments with histologic evaluations of the brain three hours after reperfusion. These studies were acquired with 5 minute (two dimensional mapping across the cortex) and 16 sec time resolution (one dimensional mapping) during the ischemia and reflow. Preliminary results of regional clearance kinetics of lactate shows a strong correlation with the presence of histologic damage. DTIC

N95-19714# Rothe Development, Inc., San Antonio, TX.

ECHO IMAGING TECHNIQUES DETERMINE THE SIZE OF INTRAVASCULAR BUBBLES IN DECOMPRESSION SICKNESS Final Report

ROBERT M. OLSON Jul. 1994 30 p

(Contract(s)/Grant(s): F33615-89-D-0604)

(AD-A284849; AL/CF-TR-1994-0033) Avail: CASI HC A03/MF A01

The size of altitude induced intravenous bubbles was determined. These bubbles, referred to as venous gas emboli (VGE), are thought to be a major factor in the onset and severity of decompression sickness (DCS). Ten volunteer subjects were monitored for altitude induced VGE in the inferior vena cava (IVC) with a HP Sonos 1000 echo imaging system. Bubble size was determined indirectly and by in-vitro sizing methods because ultrasonic images do not necessarily represent true VGE size. Stratification of bubbles of known size in a water filled mechanical analog of the IVC determined the upper size limit, which was 300 microns in these experiments; bubbles larger than 300 microns roll along the top of the vessel. The lower size limit was the size of the smallest bubbles which the Sonos 1000 could image, determined indirectly by in-vitro microbubble flotation rates and survival times measured ultrasonically and calibrated microscopically. The diameter of the smallest VGE which echo imaging systems can detect in the IVC was found to be 30-40 microns. Used in this determination was the fact that these microbubbles are too small to float; they survive less than a minute. In conclusion, the size of the ultrasonically detected VGE in the interior of the IVC of decompressed subjects can be measured; for subjects at 29,500 ft. bubble size varied from 30-300 microns. DTIC

N95-19746* National Aeronautics and Space Administration, Washington, DC.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 397)

Jan. 1995 57 p

(NASA-SP-7011(397); NAS 1.21:7011(397)) Avail: CASI HC A04

This bibliography lists 122 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Jan. 1995. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance.

Author

N95-19811 Army Research Inst. of Environmental Medicine, Natick, MA.
DISTRIBUTED MEDICAL DATABASE SYSTEM FOR REAL-TIME MONITORING OF THE HEALTH AND RISK EXPOSURE OF MILITARY RESEARCH STUDY VOLUNTEERS AT USARIEM
MATTHEW J. REARDON and DONNA CARDINAL May 1994 67 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A279193; USARIEM-T94-13) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This report describes a computerized medical database system designed to track the health and study related risk exposures and adverse incidents of soldiers participating as volunteer test subjects in USARIEM human-use research studies. This database system was implemented as an Oracle application on the USARIEM DEC VAX. The data collected at remote computer terminals are transmitted via modem and LAN to secure digital storage media at USARIEM. Database file access is controlled using methods to ensure test subject confidentiality and anonymity with regard to medical information. Only physician users are allowed access to medical details in the database. This database system was designed to improve the tracking of research study related risks and medical incidents as well as improve the coordination of medical care provided to test subjects by USARIEM physicians. DTIC

N95-19827 Army Research Inst. of Environmental Medicine, Natick, MA.
ANNUAL HISTORICAL REPORT, CALENDAR YEAR 1993
Apr. 1994 174 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
(AD-A280178) Avail: CASI HC A08

This report contains information concerning the mission, organization, key staff, overall funding and significant research accomplishments of the US Army Research Institute of Environmental Medicine, a subordinate element of the US Army Medical Research and Development Command, for calendar year 1992. Also included are listings of published reports, abstracts, presentations and key briefings for each Research Division of the Institute and significant accomplishments and appointments of the professional staff.
DTIC

53
BEHAVIORAL SCIENCES

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

A95-69742* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
PILOT INTERACTION WITH COCKPIT AUTOMATION 2: AN EXPERIMENTAL STUDY OF PILOTS' MODEL AND AWARENESS OF THE FLIGHT MANAGEMENT SYSTEM
NADINE B. SARTER Ohio State University, Columbus, OH, US and DAVID D. WOODS Ohio State University, Columbus, OH, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 1 1994 p. 1-28
(Contract(s)/Grant(s): NCC2-592)
(HTN-95-90715) Copyright

Technological developments have made it possible to automate more and more functions on the commercial aviation flight deck and in other dynamic high-consequence domains. This increase in the degrees of freedom in design has shifted questions away from narrow technological feasibility. Many concerned groups, from designers and operators to regulators and researchers, have begun to ask questions about how we should use the possibilities afforded by technology skillfully to support and expand human performance. In this article, we report on an experimental study that addressed these questions by examining pilot interaction with the current generation of flight deck automation. Previous results on pilot-automation interaction derived from pilot surveys, incident reports, and training observations have produced a corpus of features and contexts in which human-machine coordination is likely to break down (e.g., automation surprises). We used these data to design a simulated flight scenario that contained a variety of probes designed to reveal pilots' mental model of one major component of flight deck automation: the Flight Management System (FMS). The events within the scenario were also designed to probe pilots' ability to apply their knowledge and understanding in specific flight contexts and to examine their ability to track the status and behavior of the automated system (mode awareness). Although pilots were able to 'make the system work' in standard situations, the results reveal a variety of latent problems in pilot-FMS interaction that can affect pilot performance in nonnormal time critical situations.
Author (Herner)

A95-69743
USING KNOWLEDGE EXPLORATION TOOLS TO STUDY AIRSPACE COMPLEXITY IN AIR TRAFFIC CONTROL
RICHARD H. MOGFORD CTA Incorporated, Pleasantville, NJ, US, ELIZABETH D. MURPHY CTA Incorporated, Pleasantville, NJ, US, and JEREMY A. GUTTMAN CTA Incorporated, Pleasantville, NJ, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 1 1994 p. 29-45 Research sponsored by the Federal Aviation Administration
(HTN-95-90716) Copyright

A study was conducted at the Federal Aviation Administration's (FAA's) Jacksonville en route air traffic control center to identify factors that contribute to airspace complexity. Direct (verbal reports) and indirect (multidimensional scaling) procedures were used to identify potential factors. A list of candidate factors was created by combining the data from the direct and indirect knowledge exploration methods. Important complexity factors were identified by determining their simple and multiple correlations with overall sector complexity as judged by a group of Traffic Management Unit personnel (flow controllers). A final list of 16 complexity factors was developed and is suggested as a reference for future research in the area. An evaluation of the knowledge extraction techniques indicated that, although little unique information was generated by the indirect procedure, it was useful for the identification of complexity factors when combined with data from direct sources. Further research to validate the identified sector complexity factors is recommended. Author (Herner)

A95-69744
USE OF WORKLOAD REDLINES: A KC-135 CREW-REDUCTION APPLICATION
JUSTIN D. RUEB U.S. Air Force Academy, Colorado Springs, CO, US, MICHAEL A. VIDULICH Armstrong Laboratory, Wright-Patterson AFB, OH, US, and JOHN A. HASSOUN Crew Station Evaluation Facility, Wright-Patterson AFB, OH, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 1 1994 p. 47-64
(HTN-95-90717) Copyright

In recent years, workload assessment has played an increased role in system design and evaluation. However, one concern in workload assessment has been the identification of how much workload is too much. This study established and used workload redlines in determining the feasibility of a two-person (no navigator) KC-135 conceptual cockpit design. Ten KC-135 crews and 2 KC-10 crews were required to fly several simulator missions over a period of 1 week. Objective and subjective measures of performance and workload were taken during and after each flight. The various performance measures and the subjective-workload measures provided convergent results supporting the feasibility of the conceptual design. Recommendations on the use of redline procedures and their future application are discussed. Author (Herner)

A95-69745* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COGNITIVE REPRESENTATIONS OF FLIGHT-DECK INFORMATION ATTRIBUTES
WENDELL R. RICKS NASA. Langley Research Center, Hampton, VA, US, JON E. JONSSON McDonnell Douglas Aerospace-West, Long Beach, CA, US, and WILLIAM H. ROGERS Bolt Beranek and Newman, Inc., Cambridge, MA, US International Journal of Aviation Psychology (ISSN 1050-8414) vol. 4, no. 1 1994 p. 65-83
(HTN-95-90718) Copyright

A large number of aviation issues are generically being called fligh-deck information management issues, underscoring the need for an organization or classification structure. One objective of this study was to empirically determine how pilots organize flight-deck information attributes and — based upon that data — develop a useful taxonomy (in terms of better understanding the problems and directing solutions) for classifying flight-deck information management issues. This study also empirically determined how pilots model the importance of flight-deck information attributes for managing information. The results of this analysis suggest areas in which flight-deck researchers and designers may wish to consider focusing their efforts. Author (Herner)

N95-19538# Institute for Human Factors TNO, Soesterberg (Netherlands).
LEARNING EFFECTS ON STRATEGY SELECTION IN A DYNAMIC TASK ENVIRONMENT AS A FUNCTION OF TIME PRESSURE
J. H. KERSTHOLT Jun. 1994 17 p
(AD-A285458; TNO-TM-1994-B-12; TDCK-94-0055) Avail: CASI HC A03/MF A01

Previous research on strategy selection in dynamic task environments indicated that subjects preferred to request information first, before an action was applied, even when the straightforward application of actions would have resulted in more optimal performance. Furthermore, this strategy was also used when subjects only had limited time for diagnosis. In the present experiment it was investigated whether the amount of training could account for the limited use that subjects made of the task dynamics. Subjects were required to monitor the changing fitness level of an athlete, by means of a graph on a computer screen, and to apply treatments whenever necessary. They could request various symptoms that would provide an indication for the cause underlying a possible fitness decline. The subjects either received limited training or elaborate training and they had either sufficient time for diagnosis, or worked under time pressure. The results showed that the amount of training did not affect the strategy that subjects used: half of the subjects used a judgment-oriented strategy and the other half used an action-oriented strategy in both training conditions. However, the well trained subjects were superior in selecting information and they processed the information at a faster rate than the subjects with only minimal training. The time pressure effects replicated previous findings: subjects used the same strategy and speeded up information processing. A high level of time pressure only deteriorated the information integration processes of the subjects who had received only minimal training, but not that of the well-trained subjects.
DTIC

N95-19564# Army Aeromedical Research Lab., Fort Rucker, AL. Aircrew Health and Performance Div.
COLLECTION OF REAL-TIME, MULTICHANNEL EEG DATA FROM HELICOPTER PILOTS IN FLIGHT: A FEASIBILITY STUDY Final Report
JOHN A. CALDWELL, JR., JAMES A. LEWIS, STEPHEN R. DARLING, ROBERT M. DILLARD, and PARLEY P. JOHNSON May 1994 61 p
(AD-A285050; USAARL-94-26) Avail: CASI HC A04/MF A01

An initial assessment of whether valid electroencephalographic (EEG) data could be collected on helicopter pilots in flight was conducted using 20 volunteers. Each subject provided a brief eyes-open and eyes-closed EEG in the laboratory and then in a helicopter. During helicopter flights, data were monitored and recorded on the ground in real-time via a radio telemetry system. Initial hardware problems resulted in the exclusion of several records, but these problems were resolved toward the end of the study. Analysis of the remaining acceptable EEG records indicated that the typical increase in alpha activity (7.5-13.0 Hz) due to eye closure was clearly observable at every analyzed electrode site regardless of whether the testing occurred in the laboratory or in the helicopter. Further examinations of delta, theta, and beta bands showed that the EEG data were not overly contaminated by artifacts, although it was much more difficult to find 'clean' segments on records collected in the helicopter than in the laboratory. It was concluded that it is possible to record and telemeter useable EEG from the in-flight helicopter environment. DTIC

N95-19583# Prins Maurits Lab. TNO, Rijswijk (Netherlands).
MULTIPLE-TASK PERFORMANCE: A CRITICAL REVIEW OF THE LITERATURE AND A COGNITIVE NEUROSCIENCE FRAMEWORK
J. E. KORTELING 10 Mar. 1994 91 p
(AD-A285133; IZF-1994-B-5; TDCK-94-0043) Avail: CASI HC A05/MF A01

In our modern society, technological developments have altered the nature of jobs and tasks. In many work situations, operators are required to monitor, control, and manipulate information via complex technological systems. Such systems typically involve performance of several tasks in a limited period of time. In order to be able to optimize such technological systems, knowledge with regard to complex-task performance is needed, based on which technical products, processes, and systems involved in daily life can be matched to the capabilities and limitations of people. DTIC

N95-19602# New York Univ., New York, NY. Dept. of Psychology.
FACILITATION AND INTERFERENCE IN IDENTIFICATION OF PICTURES AND WORDS Final Report, 1 Dec. 1991 - 31 May 1994
JOAN G. SNODGRASS 5 Oct. 1994 54 p
(Contract(s)/Grant(s): F49620-92-J-0119)
(AD-A285882; AFOSR-94-0670TR) Avail: CASI HC A04/MF A01

This research is concerned with long-term facilitation and short-term interference and facilitation in identification of pictures and words. The long-term facilitation occurs when subjects are exposed to some representation of the item during a study episode, and then show improved identification of that item during a retention test. This type of facilitation is known as priming (or long-term priming) and the retention test is known as an implicit or indirect test because subjects are not instructed to think back to the prior study episode during the test. Much of our recent research has concerned the relationship between performance on the implicit test of picture fragment completion and the explicit test of recognition memory. Our major interest has been on the importance of maintaining the same surface features between study and test on performance in both implicit and explicit tests. Contrary to previous findings that explicit tests are impervious to surface changes and only sensitive to changes in meaning, we have found performance decrements from changes in surface features in explicit as well as implicit tests. These surface changes have been as subtle as differences in the level of fragmentation between study and test and as extreme as differences in the form of item (picture vs. word) between study and test. The research carried out under the grant has exploited this similarity between explicit and implicit tests within a components-of-information model of memory which accommodates both associations and dissociations between the two classes of tests. DTIC

N95-19740 Rice Univ., Houston, TX.
COMPARING PERFORMANCE ON IMPLICIT MEMORY TESTS Annual Technical Report, 1 Aug. 1993 - 31 Jul. 1994
HENRY ROEDIGER, III 31 Aug. 1994 9 p Limited Reproducibility: More than 20% of this document may be affected by

microfiche quality
(Contract(s)/Grant(s): F49620-92-J-0437)
(AD-A284861; AFOSR-94-0577TR) Avail: CASI HC A02

The second year of this grant saw progress on nine projects. In particular, in the past year five papers or chapters have been published, six are in press, three are in preparation, and data are being collected on several new projects. We have completed projects on the following topics: (1) effects of imagery on nonverbal implicit tests; (2) effects of high priority events on implicit tests; (3) specificity of priming on verbal and nonverbal perceptual tests; (4) direct comparison of two methods of testing for contamination of implicit tests by conscious recollection; (5) the experimental basis of serial position effects; and (6) a new paradigm for the study of false memories. Four or five other projects should be completed during the final year of the grant. DTIC

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

A95-68263
ATMOSPHERIC PRESSURE WITHIN LUNAR STRUCTURE
PAUL S. NOWAK Gonzaga Univ., Spokane, WA, JEFFREY JANAKUS, and CHARLES E. MITCHELL Journal of Aerospace Engineering (ISSN 0893-1321) vol. 7, no. 4 October 1994 p. 398-410 refs
(BTN-95-EIX95032452326) Copyright

Design and construction of a structure on the Moon requires addressing a host of issues not encountered on Earth. Since there is no atmosphere on the Moon, a lunar structure must contain an artificial atmosphere. One critical design issue is the magnitude of the pressure of this atmosphere. Much of the current literature on the design of lunar structures assumes a pressure of 101.3 kPa (14.7 psi), corresponding to that at sea level on Earth, which is an order of magnitude larger than any other loading on the structure. An assessment of the outcome of lowering the internal pressure for a lunar structure is presented that accounts for human physiology, plant growth, mechanical equipment for gas circulation, structural aspects, leak rate, decompression, flammability, combustion, and economic issues. Options for the magnitude and content of an internal atmosphere for a lunar structure are given. Results clearly show that there is a great savings if the pressure is lowered by an amount that does not greatly affect the inhabitants' physiology or safety. Author (EI)

A95-68265
DESIGN AND CONSTRUCTION OF SHIELDED LUNAR OUTPOST
S. D. JOLLY Univ. of Colorado, Boulder, CO, J. HAPPEL, and S. STURE Journal of Aerospace Engineering (ISSN 0893-1321) vol. 7, no. 4 October 1994 p. 417-434 refs
(BTN-95-EIX95032452328) Copyright

The construction of an outpost on the Moon in which humans can live and work for periods exceeding six months will require special countermeasures to adapt to the hostile environment present at the lunar surface. Various inherent dangers such as meteoroids, galactic cosmic radiation, solar proton events, and large thermal extremes will drive the design configuration of the outpost. Other considerations such as lunar soil mechanics, equipment performance, mass delivery, risk, reliability, and tele-operability act strongly as constraints that shape and control the design alternatives. Analysis of these fundamental relationships have resulted in lunar civil engineering guidelines, which are unique to this domain, and these in turn have pointed to research areas needing further attention. A preliminary design is presented for a lunar outpost shelter. Additionally, the design methodology is explored, and early enabling technologies are identified to facilitate an understanding of lunar shelter designs from an integrated system standpoint. Author (EI)

A95-68277
MINIMIZING HUMAN-MACHINE INTERFACE FAILURES IN HIGH RISK SYSTEMS
JOHN J. SUDANO Government Electronic Systems, Moorestown, NJ and MARTIN MARIETTA IEEE Aerospace and Electronic Systems Magazine (ISSN 0885-8985) vol. 9, no. 10 October 1994 p. 17-20 refs
(BTN-95-EIX95042474623) Copyright

Technology now permits the building of very complex man-machine systems with centralized controls, with the result that many processes can be run by relatively few individual workers. Studies of failures within these complex systems indicate that they are usually the consequence of a series of highly complex coincidences. There is an institutional neglect or misunderstanding of the implications of low-probability, high-consequence events for the design of complex man-machine systems. Bhopal, Challenger, Chernobyl, the Swiss Chemical Spill, the Exxon Valdez, Seveso, Tenerife Airplane Crash, Three Mile Island - incidents like these emphasize the need to better understand the mechanisms of disasters in complex, high-risk systems. Hardware failures are the best understood component of failures in such systems. Software has historically been less well understood, but great strides are presently being made in understanding interactions between software design errors in these systems. Human error is the most complex and least understood factor in the failures of complex systems, accounting for as much as 60% to 80% of complex system failures and as much as 96% of simple system failures. We must stop designing systems in which we virtually guarantee that operator errors will occur with catastrophic consequences. The greatest payback in reducing high risk system accidents is to reduce catastrophes induced or exacerbated by human error. This paper discusses some task breakdowns between the human element and software/hardware. These task allocations allow the complex man-machine system to be designed more robustly and prevent human error so as to reduce possible catastrophic consequences. Author (EI)

A95-68352
OXYGEN SENSOR DEVELOPMENT FOR LIFE SUPPORT
JEFFERY T. CHEUNG Rockwell Science Center and SCOTT R. JOHNSON Aerospace Engineering (Warrendale, Pennsylvania) (ISSN 0736-2536) vol. 14, no. 9 September 1994 p. 7-9
(BTN-95-EIX95042477107) Copyright

Metal-oxide semiconductor thin films offer advantages as oxygen detection devices. Unlike potentiometric cells with a solid electrolyte, such as those in the space shuttle orbiter, these thin films have low to medium operating-temperature range to minimize power use and maximize longevity, satisfying requirements for space mission applications. Moreover, the entire sensor could be patterned into a miniaturized, integrated, solid-state package with a linear response in the oxygen concentration range of interest (10-30%). ZnO thin film is particularly touted as the active sensing material able to meet all abovementioned attributes, aside from exhibiting selectivity and long-term selectivity. EI

A95-69223
FEASIBILITY STUDY OF INFLATABLE STRUCTURES FOR A LUNAR BASE
PAUL S. NOWAK Colorado State Univ, Fort Collins, CO, United States, WILLY Z. SADEH, and JEFFREY JANAKUS Journal of Spacecraft and Rockets (ISSN 0022-4650) vol. 31, no. 3 May-June 1994 p. 453-457
(BTN-95-EIX95041503792) Copyright

The design of a structure on the moon requires addressing a host of issues not encountered on earth. A modular inflatable structure consisting of thin membranes of composite material integrated with supporting columns and arches is proposed. An initial linear analysis of the structure is briefly reviewed. The actual

response of an inflatable membrane is nonlinear and, hence, a nonlinear numerical analysis of the stresses and displacements was undertaken. Results indicate that an inflatable structure is a feasible concept for a lunar structure. Author (EI)

N95-19627*# Kent State Univ., OH.
ON THE DEVELOPMENT OF AN EXPERT SYSTEM FOR WHEELCHAIR SELECTION
GREGORY R. MADEY, CHARLOTTE A. BHANSIN (Cleveland Clinic Foundation, OH.), SULAIMAN A. ALARAINI, and MOHAMED A. NOUR *In* NASA. Johnson Space Center, Third CLIPS Conference Proceedings, Volume 1 p 2-12 Nov. 1994
Avail: CASI HC A03/MF A03

The presentation of wheelchairs for the Multiple Sclerosis (MS) patients involves the examination of a number of complicated factors including ambulation status, length of diagnosis, and funding sources, to name a few. Consequently, only a few experts exist in this area. To aid medical therapists with the wheelchair selection decision, a prototype medical expert system (ES) was developed. This paper describes and discusses the steps of designing and developing the system, the experiences of the authors, and the lessons learned from working on this project. Wheelchair Advisor, programmed in CLIPS, serves as diagnosis, classification, prescription, and training tool in the MS field. Interviews, insurance letters, forms, and prototyping were used to gain knowledge regarding the wheelchair selection problem. Among the lessons learned are that evolutionary prototyping is superior to the conventional system development life-cycle (SDLC), the wheelchair selection is a good candidate for ES applications, and that ES can be applied to other similar medical subdomains. Author

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A95-66751* National Aeronautics and Space Administration, Washington, DC.
LIFE SCIENCES AND SPACE RESEARCH 24 (4): PLANETARY BIOLOGY AND ORIGINS OF LIFE; TOPICAL MEETING OF THE COSPAR INTERDISCIPLINARY SCIENTIFIC COMMISSION F (MEETING F3) OF THE COSPAR PLENARY MEETING, 29TH, WASHINGTON, DC, AUG. 28-SEP. 5, 1992
J. M. GREENBERG, editor Univ. of Leiden, Leiden, Netherlands, J. ORO, editor Univ. of Houston, Houston, TX, US, A. BRACK, editor CNRS, Orleans, France, D. L. DEVINCENZI, editor NASA. Ames Research Center, Moffett Field, CA, US, A. BANIN, editor Hebrew Univ., Rehovot, Israel, E. I. FRIEDMANN, editor Florida State Univ., Tallahassee, FL, US, J. D. RUMMEL, editor Marine Bilogical Lab., Woods Hole, MA, US, F. RAULIN, editor Univ. de Paris, Creteil, France, C. P. MCKAY, editor NASA. Ames Research Center, Moffett Field, CA, US, H. BALTSCHEFFSKY, editor Stockholm Univ., Stockholm, Sweden et al. Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 449 p. Research sponsored by NASA
(ISBN 0-08-042540-2; HTN-95-10500) Copyright

The proceedings include sessions on extraterrestrial organic chemistry and the origins of life; life on Mars: past, present and future; planetary protection of Mars missions; chemical evolution on Titan; origins and early evolution of biological (a) energy transduction and membranes (b) information and catalysis; and carbon chemistry and isotopic fractionations in astrophysical environ-ments. For individual titles, see A95-66752 through A95-66807. Herner

A95-66752
CIRCUMSTELLAR CHEMISTRY FROM MICROWAVE AND MM-WAVE SPECTROSCOPY
J. H. BIEGING Univ. of Arizona, Tucson, AZ, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 3-14
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Stars in their late stages of evolution often shed matter in the form of a cool wind which is molecular in composition. These winds are a major source of replenishment of the interstellar gas and dust, so they furnish a large part of the raw materials for new generations of stars and planets. The chemistry of the circumstellar envelope depends strongly on the photospheric abundances of the elements, especially C and O. If C/O greater than 1, a rich organic chemistry is observable in the microwave and mm-wavelength emission lines of the reaction products. This paper reviews the observational evidence for the presence of organic molecules and their formation pathways in circumstellar envelopes, with special emphasis on rotational spectra at microwave and millimeter wavelengths. Author (Herner)

A95-66764
ORIGIN OF AMINO ACIDS IN THE EARLY SOLAR SYSTEM
J. F. KERRIDGE UCLA, Los Angeles, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 107-111
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Synthesis of meteoritic amino acids probably took place in the aqueous sub-surface regions of none or more asteroid-sized parent bodies. Starting material for those reactions apparently consisted of a population of more simple compounds including a suite of aliphatic precursors characterised by (1) complete structural diversity, (2) prevalence of branched- over straight-chain species, (3) exponential decrease in abundance with increasing C number, (4) large enrichment in D, and, probably, (5) systematic decrease in C-13/C-12 with increasing C number. Those properties were apparently acquired during synthesis of the precursors by ion-molecule reactions in a presolar molecular cloud. Author (Herner)

A95-66766
FORMATION OF BIOORGANIC COMPOUNDS IN PLANETARY ATMOSPHERES BY COSMIC RADIATION
K. KOBAYASHI Yokohama National Univ., Hodogaya, Yokohama, Japan, T. KANEKO Yokohama National Univ., Hodogaya, Yokohama, Japan, M. TSUCHIYA Yokohama National Univ., Hodogaya, Yokohama, Japan, T. SAITO Univ. of Tokyo, Tanashi, Tokyo, Japan, T. YAMAMOTO Inst. of Space and Astronautical Science, Sagamihara, Japan, J. KOIKE Tokyo Inst. of Tech., Midori, Yokohama, Japan, and T. OSHIMA Tokyo Inst. of Tech., Midori, Yokohama, Japan Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 127-130 Research sponsored by the Institute of Space and Astronautical Science
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Simulated planetary atmospheres (mixtures of simple gases) were irradiated with high energy particles to simulate an action of cosmic rays. When a mixture of carbon monoxide, nitrogen and water was irradiated with 2.8-40 MeV protons, a wide variety of bioorganic compounds including amino acids, imidazole, and uracil were identified in the products. The amount of amino acids was proportional to the energy deposit to the system. Various kinds of simulated planetary atmospheres, such as 'Titan type' and 'Jovian

type', were also irradiated with high energy protons, and gave amino acids in the hydrolyzed products. Since cosmic rays are a universal energy source in space, it was suggested that formation of bioorganic compounds in planetary atmospheres is inevitable in the course of cosmic evolution. Author (Herner)

A95-66768* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXOBIOLOGY RESEARCH ON SPACE STATION FREEDOM
J. L. HUNTINGTON NASA. Ames Research Center, Moffett Field, CA, US, D. M. STRATTON NASA. Ames Research Center, Moffett Field, CA, US, and T. W. SCATTERGOOD NASA. Ames Research Center, Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 135-138
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The Gas-Grain Simulation Facility (GGSF) is a multidisciplinary experiment laboratory being developed by NASA at Ames Research Center for delivery to Space Station Freedom in 1998. This facility will employ the low-gravity environment of the Space Station to enable aerosol experiments of much longer duration than is possible in any ground-based laboratory. Studies of fractal aggregates that are impossible to sustain on Earth will also be enabled. Three research areas within exobiology that will benefit from the GGSF are described here. An analysis of the needs of this research and of other suggested experiments has produced a list of science requirements which the facility design must accommodate. A GGSF design concept developed in the first stage of flight hardware development to meet these requirements is also described. Author (Herner)

A95-66770* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXOBIOLOGICAL EXPLORATION OF MARS
H. P. KLEIN Santa Clara Univ., Santa Clara, CA, US and D. L. DEVINCENZI NASA. Ames Research Center, Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 151-156
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Of all the other planets in the solar system, Mars remains the most promising for further elucidating concepts about chemical evolution and the origin of life. Strategies were developed to pursue three exobiological objectives for Mars exploration: determining the abundance and distribution of the biogenic elements and organic compounds, detecting evidence of an ancient biota on Mars, and determining whether indigenous organisms exist anywhere on the planet. The three strategies are quite similar and, in fact, share the same sequence of phases. In the first phase, each requires global reconnaissance and remote sensing by orbiters to select sites of interest for detailed in situ analyses. In the second phase, lander missions are conducted to characterize the chemical and physical properties of the selected sites. The third phase involves conducting 'critical' experiments at sites whose properties make them particularly attractive for exobiology. These critical experiments would include, for example, identification of organics, detection of fossils, and detection of extant life. The fourth phase is the detailed analysis of samples returned from these sites in Earth-based laboratories to confirm and extend previous discoveries. Finally, in the fifth phase, human exploration is needed to establish the geological settings for the earlier findings or to discover and explore sites that are not accessible to robotic spacecraft. Author (Herner)

A95-66771* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SITE SELECTION FOR MARS EXOBIOLOGY
J. FARMER NASA. Ames Research Center, Moffett Field, CA, US, D. DES MARAIS NASA. Ames Research Center, Moffett Field, CA, US, R. GREELEY Arizona State Univ., Tempe, AZ, US, R. LANDHEIM Arizona State Univ., Tempe, AZ, US, and H. KLEIN Santa Clara Univ., Santa Clara, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 157-162 Research sponsored by NASA
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The selection of sites on Mars that have a high priority for exobiological research is fundamental for planning future exploration. The most immediate need is to identify targets for high resolution orbital imaging during the Mars Observer and Mars '94/'96 missions that can be used to refined site priorities for surface exploration. We present an objective approach to site selection whereby individual sites are selected and scored, based on the presence of key geological features which indicate high priority environments. Prime sites are those that show evidence for the prolonged activity of liquid water and which have sedimentary deposits that are likely to have accumulated in environments favorable for life. High priority areas include fluvio-lacustrine (stream-fed lake systems), springs, and periglacial environments. Sites where mineralization may have occurred in the presence of organisms (e.g. springs) are given high priority in the search for a fossil record on Mars. A systematic review of Viking data for 83 sites in the Mars Landing Site Catalog (MLSC) resulted in the selection of 13 as being of exobiological interest. The descriptions of these sites were expanded to address exobiological concerns. An additional five sites were identified for inclusion in the second edition of the MLSC. We plan to broaden our site selection activities to include a systematic global reconnaissance of Mars using Viking data, and will continue to refine site priorities for exobiological research based on data from future missions in order to define strategies for surface exploration. Author (Herner)

A95-66772* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LIFE ON MARS? 1: THE CHEMICAL ENVIRONMENT
A. BANIN Hebrew Univ., Rehovot, Israel and R. L. MANCINELLI NASA. Ames Research Center, Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 163-170
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The origin of life at its abiotic evolutionary stage, requires a combination of constituents and environmental conditions that enable the synthesis of complex replicating macromolecules from simpler monomeric molecules. It is very likely that the early stages of this evolutionary process have been spontaneous, rapid and widespread on the surface of the primitive Earth, resulting in the formation of quite sophisticated living organisms within less than a billion years. To what extend did such conditions prevail on Mars? Two companion-papers will review and discuss the available information related to the chemical, physical and environmental conditions on Mars and assess it from the perspective of potential exobiological evolution. Author (Herner)

A95-66773* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
LIFE ON MARS? 2: PHYSICAL RESTRICTIONS
R. L. MANCINELLI NASA. Ames Research Center, Moffett Field, CA, US and A. BANIN Hebrew Univ., Rehovot, Israel Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th,

Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 171-176

The primary physical factors important to life's evolution on a planet include its temperature, pressure and radiation regimes. Temperature and pressure regulate the presence and duration of liquid water on the surface of Mars. The prolonged presence of liquid water is essential for the evolution and sustained presence of life on a planet. It has been postulated that Mars has always been a cold dry planet; it has also been postulated that early Mars possessed a dense atmosphere of CO2 (greater than or equal to 1 bar) and sufficient water to cut large channels across its surface. The degree to which either of these postulates is true correlates with the suitability of Mars for life's evolution. Although radiation can destroy living systems, the high fluxes of UV radiation on the martian surface do not necessarily stop the origin and early evolution of life. The probability for life to have arisen and evolved to a significant degree on Mars, based on the postulated ranges of early martian physical factors, is almost solely related to the probability of liquid water existing on the planet for at least hundreds of millions to billions of years. Author (Herner)

A95-66774
CHEMICAL STUDIES ON THE POSSIBLE EXISTENCE OF LIFE ON MARS
C. PONNAMPERUMA Univ. of Maryland, College Park, MD, US, R. NAVARRO-GONZALEZ Universidad Nacional Autonoma de Mexico, Mexico, Mexico, and Y. HONDA Naruto Univ. of Education, Naruto City, Japan Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 177-184

Although there is no direct evidence yet for the existence of life on Mars, it is reasonable to conclude that the emergence of life on Earth, which appears to have been controlled by universal laws of physics and chemistry, may have been repeated elsewhere in the universe. The dual approach of synthesis and analysis in our experimental studies has provided ample evidence in support of this hypothesis. Author (Herner)

A95-66775
PHOSPHORUS AS A POTENTIAL GUIDE IN THE SEARCH FOR EXTINCT LIFE ON MARS
G. WECKWERTH Deutsche Forschungsanstalt fuer Luft-und Raumfahrt, Linder Hoehe, Koeln, Germany and M. SCHIDLOWSKI Max-Planck-Institut fuer Chemie, Mainz, Germany Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 185-191

In contrast to the search for extant organisms, the quest for fossil remains of life on Mars need not be guided by the presence of water and organic compounds on the present surface. An appropriate tracer might be the element phosphorus which is a common constituent of living systems. Utilizing terrestrial analogues, it shoud preferentially exist in the form of sedimentary calcium phosphate (phosphorites), which would have readily resisted changing conditions on Mars. Moreover, higher ratios of Phosphorus/Thorium (P/Th) in phosphorites in comparison to calcium phosphates from magmatic rocks give us the possibility to distinguish them from inorganically formed phosphorus deposits at or close to the Martian sufrace. Identification of anomalous phosphorus enrichments by remote sensing or in situ analysis could be promising approaches for selecting areas preferentially composed of rocks with remains of extinct life. Author (Herner)

A95-66776* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SEARCH FOR LIFE ON MARS: EVALUATION OF TECHNIQUES
D. E. SCHWARTZ NASA. Ames Research Center, Moffett Field, CA, US, R. L. MANCINELLI NASA. Ames Research Center, Moffett Field, CA, US, and M. R. WHITE NASA. Ames Research Center, Moffett Field, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 193-197

An important question for exobiology is, did life evolve on Mars? To answer this question, experiments must be conducted on the martian surface. Given current mission constraints on mass, power, and volume, these experiments can only be performed using proposed analytical techniques such as: electron microscopy, X-ray fluorescence, X-ray diffraction, a-proton backscatter, g-ray spectrometry, differential thermal analysis, differential scanning calorimetry, pyrolysis gas chromatography, mass spectrometry, and specific element detectors. Using prepared test samples consisting of 1% organic matter (bovine serum albumin) in palagonite and a mixture of palagonite, clays, iron oxides, and evaporites, it was determined that a combination of X-ray diffraction and differential thermal analysis coupled with gas chromatography provides the best insight into the chemistry, mineralogy, and geological history of the samples. Author (Herner)

A95-66782
A PHYSICAL AND CHEMICAL CHARACTERIZATION OF MARTIAN PERMAFROST AS A POSSIBLE HABITAT FOR VIABLE MICROORGANISMS
V. OSTROUMOV Russian Academy of Sciences, Moscow, Russia Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 229-236

Data from experiments with model samples show that ion transfer coefficients in the water-rich permafrost on Mars must be three orders of magnitude less than those of terrestrial permafrost. The effects of low temperatures and of carbon dioxide have been accounted for. Exchange between cells and the environment is impeded in Matian permafrost. The microscopic distributional heterogeneity of concentration, pH, Eh, and other physicochemical parameters may be more pronounced in the permafrost of Mars. We present a classification of unfrozen water types in the permafrost that is based on the structures of unfrozen water films and on their functions with respect to cells. Any viable microorganisms on Mars probably exits with minimum metabolism in compact zones with energy carriers and high transfer coefficients. These zones may be microvolumes of unfrozen water in which cells accumulate. Author (Herner)

A95-66785
MODERN ASPECTS OF PLANETARY PROTECTION AND REQUIREMENTS TO STERILIZATION OF SPACE HARDWARE
V. V. DEMIDOV Russian Academy of Sciences, Moscow, Russia, A. A. GONCHAROV Russian Academy of Sciences, Moscow, Russia, V. B. OSIPOV Scientific Industrial Association Biotechnology, Moscow, Russia, and V. I. TROFIMOV Scientific Industrial Association Biotechnology, Moscow, Russia Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 251-255

The viewpoint of a working group of Russian experts on the problem of planetary protection for future manned and unmanned

Mars mission is presented. Recent data on Martian environment and on survival of terrestrial microorganisms in extreme conditions were used for detailed analysis and overview of planetary protection measures in regard to all possible flight situations including accidental landing. The special emphasis on 'Mars-94' mission was done. This analysis resulted in revised formulation of spacecraft sterilization requirements and possible measures for their best implementation. New general combined approach to spacecraft sterilization is proposed. It includes penetrating radiation and heat treatment of spacecraft parts and components which is to be carried out before the final assembly of spacecraft and gaseous radiation sterilization of the whole spacecraft during the flight to Mars (or from Mars for return mission). Author (Herner)

A95-66786* Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA.

DESIGNING PLANETARY PROTECTION INTO THE MARS OBSERVER MISSION

T. H. SWEETSER Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, US, C. A. HALSELL Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, US, and R. J. CESARONE Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, US Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 257-260 Research sponsored by NASA

Planetary protection has been an important consideration during the process of designing the Mars Observer mission. It affected trajectory design of both the interplanetary transfer and the orbits at Mars; these in turn affected the observation strategies developed for the mission. The Project relied mainly on the strategy of collision avoidance to prevent contamination of Mars. Conservative estimates of spacecraft reliability and Martian atmosphere density were used to evaluate decisions concerning the interplanetary trajectory, the orbit insertion phase at Mars, and operations in orbit at Mars and afterwards. Changes in the trajectory design, especially in the orbit insertion phase, required a refinement of those estimates. Author (Herner)

A95-66787

PLANETARY ENVIRONMENT PROTECTION ID NO: F3.3 - M.1.05 IMPLICATIONS FOR THE DEVELOPMENT OF A NETWORK OF SURFACE STATIONS ON MARS

G. E. N. SCOON Directorate of Scientific Programmes, Noordwijk, Netherlands, A. CHICARRO Directorate of Scientific Programmes, Noordwijk, Netherlands, G. H. SCHWEHM Directorate of Scientific Programmes, Noordwijk, Netherlands, and F. SPIERO ESA ESTEC, Noordwijk, Netherlands Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 261-272

The European Space Agency's (ESA) studies of a Comet Nucleus Sample Return mission (ROSETTA) as its Planetary Cornerstone in its long-term program 'Horizon 2000' and the Marsnet mission, a potential contribution of the Agency to an international network of surface stations on Mars, has revived the interest in the present state of Planetary Protection requirements. MARSNET was one of the four candidate missions selected in April 1991 for further Design Feasibility (Phase A) studies. Furthermore, of all space agencies participating in planetary exploration activities only the United States National Aeronautics and Space Administration (NASA) had a well established Planetary Protection Policy on Viking and other relevant planetary missions, whereas ESA is considering the feasibility and potential impact of a planetary protection policy on its Marsnet mission, within the framework of a tight budgetary envelope applicable to ESA's Medium (M) class missions. This paper will discuss in general terms the impact of Planetary Protection measures, its implications for Marsnet and the issues arising from this for the implementation of the mission in ESA's scientific program. Author (Herner)

A95-66788

THE EXPERIMENTAL STUDY OF MICROBIAL CONTAMINATION OF THE SPACE HARDWARE

V. B. VASIN Scientific Industrial Association Biotechnology, Moscow, Russia and V. I. TROFIMOV Scientific Industrial Association Biotechnology, Moscow, Russia Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 273-276

The role of potential contaminants of design materials and products of space technology - aerobic and anaerobic prokaryotes (myxobacteria, eubacteria, corinebacteria, actinomyces), and eukaryotes (micromyces), psychrophilic, mesophilic and thermophilic forms, and chemolythotrophic microorganisms is discussed in this paper. The methods of analysis of microbial contamination in the solution of problem of planetary protection are considered. The necessity of the use of ultrasound at the evaluation of surface and subsurface contamination of speciments is demonstrated; methods of determination of buried contamination (with the use of organic solvents and mechanical pulverization) are discussed. The data on buried and subsurface contamination for some materials and electronic parts together with microflora resistivity to sterilizing treatment are given. Author (Herner)

A95-66789

PLANETARY PROTECTION CONSIDERATIONS FOR MARSNET AND MARS SAMPLE RETURN MISSIONS

C. LINDBERG DLR, Linder Hoehe, Koeln, Germany and G. HORNECK DLR, Linder Hoehe, Koeln, Germany Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 277-280

The European Space Agency (ESA) MarsNet mission proposal consists most probably of a trio of Mars landers. These landers each contain a variety of scientific equipment. The network of stations demands for a definition of its planetary protection requirements. With respect to the MarsNet mission only forward contamination problems will be considered. Future involvement of European efforts in planetary exploration including sample returns will also raise the problem of back contamination. A tradeoff study for the overall scientific benefit with respect to the approximative cost is necessary. Planetary protection guide-lines will be proposed by an interdisciplinary and international board of experts working in the fields of both biology and planetary science. These guide-lines will have to be flexible in order to be modified with respect to new research results, e. g. on adaptation of microorganisms to extreme (space) conditions. Experiments on the survival of microorganisms at conditions of simulated Mars surface and subsurface will have to be conducted in order to obtain a baseline data collection as a reference standard for future guide-lines. Author (Herner)

A95-66792

TITAN'S ATMOSPHERE COMPOSITION: CERTAINTIES AND SPECULATIONS

D. GAUTIER Observatoire de Paris-Meudon, Meudon, France Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 295-301

Firm resutls concerning the thermal structure, the composition, the seasonal effects of the atmosphere of Titan, as well as the superotation of its stratosphere are reviewed. The nature of the surface of the satellite, the possible presence of argon in the atmosphere and the structure and composition of clouds and aerosols are, among other topics, still speculative. The implications of the observed deuterium enrichment on the origin of ices in the outer part of the nebula are controversial. Author (Herner)

A95-66795
RAINDROPS ON TITAN
R. D. LORENZ Univ. of Kent, Canterbury, UK Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 317-320 Research sponsored by the UK Science and Engineering Research Council (SERC) and the Univ. of Kent
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Some of the aspects of methane precipitation on Titan are considered. In particular, descent velocities are computed. It is found that raindrops fall much slower than on Earth. Additionally, the maximum size of raindrops on Titan is over 9mm, compared with under 6mm on Earth. The composition of drops will vary with altitude. Implications of these properties for Titan and the Huygens mission are considered. Author (Herner)

A95-66796
THE LOW TEMPERATURE ORGANIC CHEMISTRY OF TITAN'S GEOFLUID
F. RAULIN Univ. Paris - Val de Marne, Creteil, France, P. BRUSTON Univ. Paris - Val de Marne, Creteil, France, P. PAILOUS Univ. Paris - Val de Marne, Creteil, France, and R. STERNBERG Univ. Paris - Val de Marne, Creteil, France Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 321-333 Research sponsored by the Centre National d'Etudes Spatiales and the Programme National de Planetologie
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Organic chemistry on Titan and prebiotic chemistry on Earth involve the same N-containing organics: nitriles and their oligomers. Couplings of their chemistry in the three parts of Titan's geofluid (atmosphere, aerosols and surface) seem to play a key role in the organic chemical evolution of the planet. If liquid water was present on Titan, then a prebiotic chemistry, involving eutectics, similar to that of the early Earth, may have occurred. However, liquid water is currently absent and a prebiotic chemistry based only on N-organics may be evolving now on Titan. The other consequence of the low temperatures of Titan is the possible formation of organics unstable at room temperatue and very reactive. So far, these compounds have not been systematically searched for in experimental studies of Titan's organic chemistry. C4N2 has already been detected on Titan. Powerful reactants in organic chemistry, CH2N2, and CH3N3, may be also present. They exhibit spectral signatures in the mid-IR strong enough to allow their detection at the 10-100 ppb level. They may be detectable on future IR spectra (ISO and Cassini) of Titan. Author (Herner)

A95-66801
PRODUCTION AND EVOLUTION OF CARBONACEOUS MATERIAL BY ION IRRADIATION IN SPACE
G. STRAZZULLA Univ. di Catania, Catania, Italy, G. A. BARATTA Citta Univ., Catania, Italy, and F. SPINELLA Citta Univ., Catania, Italy Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 385-399 Research sponsored by the IDP Raman Spectra and the Italian Space Agency (ASI)
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We review recent experimental studies concerning the evolution, driven by ion irradiation, of carbonaceous material from frozen gas to a refractory molecular solid. Under further irradiation the latter changes to a polymer-like material and ultimately to amorphous carbon. Most of the results have been obtained by 'in situ' and remote Infrared (IR) and Raman spectroscopy. The results have been applied to demonstrate that molecular solids may be easily formed by irradiation of frozen mantles in dense interstellar clouds. Polymer-like material and amorphous carbons may result by further irradiation of organic mantles on grains in the diffuse interstellar medium. Those grains, during the aggregation to form extended bodies like comets (T-Tau phase of the Sun), are further modified. These latter are also irradiated, after the comet formation, during their long stay in the Oort cloud. In particular it has been suggested that comet may develop an ion-produced cometary organic crust that laboratory evidences show to be stable against temperature increases experienced during passages near the Sun. The comparison between the Raman spectra of some IDP (Interplanetary Dust Particles) and the Raman spectra of some ion-produced amorphous carbons, is also discussed. Author (Herner)

A95-66803
CARBONACEOUS MATTER IN COMETARY DUST AND COMA
F. R. KRUEGER Engineering Office, Darmstadt, Germany Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 407-411
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The analysis of carbonaceous matter in p/Halley's dust and coma via mass spectrometry of positive ions is reviewed. Dust impact generated ions were analyzed by the PUMA instrument aboard VEGA I, and coma plasma ions by the PICCA instrument aboard GIOTTO. For the organic molecules results an overall C:H:O:N ratio of 1.:1.4:0.6:0.1. Most of this polymer material can formally be understood as an aggregation of monomers C2H2, CH2O, and HCN. Special emphasis is given to possible aromatic, especially heterocyclic, and other unsaturated ions, and their importance for abiotic chemical and prebiotic evolution. Aspects of the potential heterogeneous catalysis in liquid water at the inorganic grain backbone structure found by this analysis, too, are also treated. Author (Herner)

A95-66806
ISOTOPIC RATIOS IN PLANETARY ATMOSPHERES
C. DE BERGH Observatoire de Paris, Meudon, France Life sciences and space research 24 (4): Planetary biology and origins of life; Topical Meeting of the COSPAR Interdisciplinary Scientific Commission F (Meeting F3) of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. A95-66751 Advances in Space Research (ISSN 0273-1177) vol. 15, no. 3 March 1995 p. 427-440
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Recent progress on measurements of isotopic ratios in planetary or satellite atmospheres include measurements of the Deuterium/Hydrogen (D/H) ratio in the methane of Uranus, Neptune and Titan and in the water of Mars and Venus. Implications of these measurements on our understanding of the formation and evolution of the planets and satellite are discussed. Our current knowledge of the carbon, nitrogen and oxygen isotopic ratios in the atmospheres of these planets, as well as on Jupiter and Saturn, is also reviewed. We finally show what progress can be expected in the very near future due to some new ground-based instrumentation particularly well suited to such studies, and to forthcoming space missions. Author (Herner)

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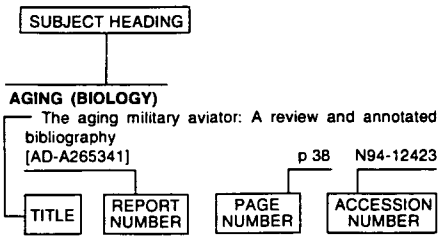

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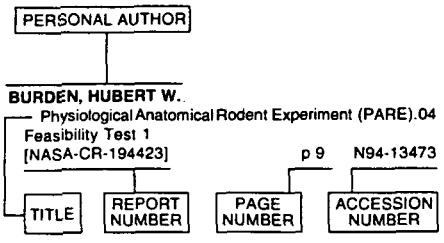

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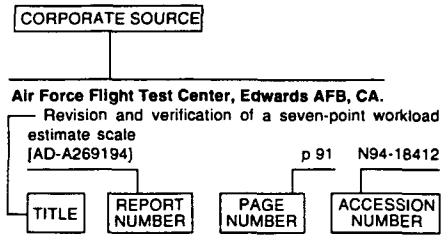

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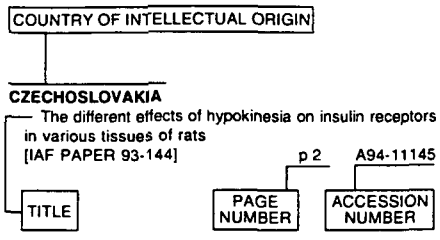

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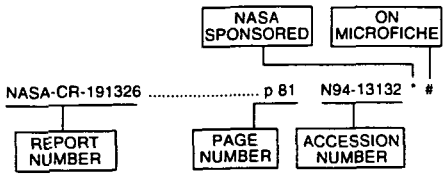

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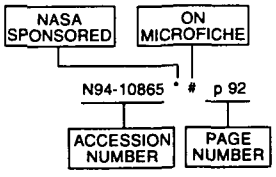

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REPORT DOCUMENT PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7011 (401)		

4. Title and Subtitle	5. Report Date
Aerospace Medicine and Biology A Continuing Bibliography (Supplement 401)	May 1995
	6. Performing Organization Code JT
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address NASA Scientific and Technical Information Office	11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546-0001	13. Type of Report and Period Covered Special Publication
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report lists 140 reports, articles and other documents recently announced in the NASA STI Database.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerospace Medicine Bibliographies Biological Effects	Unclassified - Unlimited Subject Category - 52

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	72	A04/HC

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