MARSBUGS:

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CONTENTS

LOCKHEED MARTIN ASTRONAUTICS TO BUILD MARS '98 SPACECRAFT
JPL press release

Two small spacecraft--an orbiter and lander--to be launched in 1998 to help scientists trace the evolution of the planet's climate and search for water in the Martian soil will be built for NASA by Lockheed Martin Astronautics of Denver, Colo. Dr. Edward C. Stone, director of NASA's Jet Propulsion Laboratory, announced the selection today after a fast-paced, industry-wide competition lasting only two months. The estimated value of the contract is $92.2 million.

"Lockheed Martin Astronautics presented a very compelling case for its selection, in light of NASA's rigorous demands for two very complicated planetary missions in 1998," Stone said. "These requirements--to develop and operate two spacecraft at the same level of funding that was previously allocated for a single mission--brought in excellent designs for the orbiter and lander spacecraft from Lockheed Martin. This will result in significant savings because they will both be developed under the same roof."

The pair of spacecraft, currently called the Mars Surveyor 1998 orbiter and lander, continues NASA's efforts to cut costs by building smaller, less expensive planetary spacecraft. The 1998 orbiter will be just one-half the weight of Mars Global Surveyor, an orbiter that will be launched in 1996. The 1998 lander, similarly, will be just half the weight of the 1996 Mars Pathfinder, the smallest planetary lander yet constructed.

The new missions will be the second set of spacecraft in NASA's decade-long program of Mars exploration, known as the Mars Surveyor Program. The spacecraft will be launched from Cape Canaveral, Fla., during the 1998 Mars launch opportunity, which falls between December 1998 and February 1999.

"The pair of spacecraft will be designed to continue exploring the history of climate change on Mars and initiate a search for water in the Martian soil," said Project Manager Dr. John McNamee of JPL. "Lockheed Martin Astronautics has demonstrated its commitment to our goals of continued exploration and forming a teaming relationship with industry by its willingness to invest internal funds to reduce some of the costs associated with building spacecraft for Mars Surveyor and other programs.

"In addition, Lockheed Martin demonstrated a commitment to mission success," he added, "by its willingness to forego all potential award fees in the event either spacecraft fails to perform its mission at Mars."

Science instruments for the 1998 lander will be selected following an announcement of opportunity planned for release by NASA in May. The 1998 orbiter will carry a camera (also to be selected through the May announcement of opportunity) and one of the two remaining science instruments from the former Mars Observer mission that could not be carried on the 1996 Mars Global Surveyor mission.

The new pair of spacecraft will return information that builds upon the goals of the 1996 missions, which seek to answer key questions about Mars's early history. The 1998 missions, however, will take that scientific quest a step further, initiating a search for water in the Martian soil and delving into longstanding theories about whether primitive life ever existed early in the planet's history.

During and after its primary science mission, the 1998 Mars Surveyor orbiter also will serve as a data relay satellite for the companion lander and for future NASA and international lander missions to Mars.

The extremely light weights of the new lander and orbiter will allow them to be launched on a newly designed launch vehicle, called the Med-Lite, which is roughly half the size of the Delta II launch vehicles being used for the 1996 Mars Global Surveyor and Mars Pathfinder missions. A Med-Lite will be capable of delivering about 450 kilograms (1,000 pounds) of hardware to Mars.

JPL manages the Mars Surveyor Program for NASA's Office of Space Science, Washington, D.C.

HUBBLE MONITORS WEATHER ON NEIGHBORING PLANETS
NASA press release

"The weather on Mars: another cool and clear day. Low morning haze will give way to a mostly sunny afternoon with high clouds. The forecast for Venus: hot, overcast, sulfuric acid showers will continue. Air quality is slightly improved as smog levels subside."

That kind of weathercast is now possible as NASA's Hubble Space Telescope serves as an interplanetary weather satellite for studying the climate on Earth's neighboring worlds, Mars and Venus.

To the surprise of researchers, Hubble is showing that the Martian climate has changed considerably since the unmanned Viking spacecraft visited Mars in the mid-1970s, which was the last time astronomers got a close-up look at weather on the Red Planet for more than just a few months. Hubble images of clouds and spectroscopic detection of an ozone abundance in Mars' atmosphere, all indicate that the planet is cooler, clearer and drier than a couple of decades ago.

In striking contrast, Hubble's spectroscopic observations of Venus show that the atmosphere continues to recover from an intense shower of sulfuric "acid rain" triggered by the suspected eruption of a volcano in the late 1970s. This is similar to what happens on Earth when sulfur dioxide emissions from coal power plants are broken apart in the atmosphere to make acid rain. On Venus, this effect takes place on a planetary scale.

Although the close-up visits by numerous unmanned spacecraft provided brief glimpses of weather on these planets, the long- term coverage offered by Hubble has never before been possible. Knowledge about the weather is critical to planning future missions to these worlds. In the case of Mars, being able to predict the weather will be critical prior to human exploration of the planet.

Studying conditions on Mars and Venus might also lead to a better understanding of Earth's weather system. Apparently, processes that occurred early in the solar system's history sent terrestrial planets along very different evolutionary paths. The neighboring planets are grand natural laboratories for testing computer models that will lead to a general theory of the behavior of planetary atmospheres.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc. (AURA) for NASA, under contract with the Goddard Space Flight Center, Greenbelt, MD. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA).

NASA TESTS PAINLESS WAYS OF MEASURING INTRACRANIAL PRESSURE
NASA press release

NASA scientists are testing two diagnostic devices to measure pressure inside the head, or intracranial pressure (ICP), without penetrating the skull or skin. Scientists at NASA's Ames Research Center, Mountain View, CA, hope the technology will help them determine whether increased ICP contributes to the headaches, nasal congestion and space motion sickness that some astronauts experience during space flight. There currently is no direct evidence that the space environment increases ICP because there is no way to accurately and non-invasively measure changes in ICP in humans.

Improved means of measuring intracranial pressure may benefit victims of trauma to the head, as well as astronauts. "Early non-invasive measurements of ICP may help reduce both the mortality and morbidity associated with head trauma," said Alan R. Hargens, Ph.D., of Ames Life Sciences Division. A severe blow to the head, as may result from a car or motorcycle accident, may cause swelling of the brain and increased intracranial pressure.

Hargens said NASA and the National Institutes of Health recently identified non-invasive ICP measurements as a critical parameter in investigating problems of astronauts in space and in head trauma patients on Earth. Current clinical techniques for measuring pressure in the head require invasive surgical procedures to implant a pressure sensor.

Hargens is leading Ames' effort to provide a clinical evaluation of the two devices' ability to measure changes in ICP in humans. One device, developed by Dr. John Cantrell and Dr. Tom Yost at NASA's Langley Research Center, Hampton, VA, measures distances across the skull. This system is based on the assumption that increased pressure will cause slight distention, or swelling of the skull. An ultrasound wave is transmitted through the front of the skull by a small disk secured to the forehead. The wave passes through the brain tissue, reflects off the opposite side of the skull, and is received by a sensor in the disk.

The second technique uses a very light mechanical stimulus applied to the forehead. "It's equivalent to dropping an eraser from a standard pencil onto the forehead from a height of 6 inches (15 centimeters)," Hargens said. The stimulus is transferred through the skull and is received by sensors placed strategically on the scalp. Changes in pressure inside the head can then be measured by examining changes in the response signal. Scientific Atlanta Inc., of Atlanta, GA, and CytoProbe Corp. of San Diego, developed and patented this system, which they provided to Ames for testing.

"If this research is successful, we will be able to validate non-invasive techniques for measuring intracranial pressure," Hargens said. "This could lead to their use as diagnostic tools both for clinical applications on Earth and for astronauts during space flight. We hope this will lead to commercial development of the devices and eventually to future space flight experiments."

ON THE ISOLATION OF HALOPHILIC MICROORGANISMS FROM SALT DEPOSITS OF GREAT GEOLOGICAL AGE
By Helga Stan-Lotter.

In many parts of the world, salt deposits are found which originated from early periods of the geological history of the Earth. Particularly large sediments were deposited during the Permian and Triassic era (280 to 195 million of years before present). Microscopic examinations revealed the presence of bacteria in thin sections or dissolved rock salt samples (see Sonnenfeld 1984 for references). Rather sensational were claims about thirty years ago, stating that bacteria from Permian or older salt sediments had been brought back to life (Dombrowski 1963, Reiser and Tasch 1960). Other workers did not believe or could not confirm these findings. Recently, extremely halophilic bacteria were isolated from Triassic and Permian salt mines in Britain (Norton et al. 1993) and Austria (Denner et al.1994). One coccoid isolate represented a novel strain and was named Halococcus salifodinae (Denner et al.1994). One of the English isolates (Br3) showed a protein composition and partial 16S ribosomal RNA sequence, which were similar to those of Hc. salifodinae. These strains were found in the Zechstein formation and Alpine basin, respectively; evaporites, which, due to continental drift, were not far from the paleoequator during their formation (Zharkov 1981).

Extremely halophilic bacteria belong to the Archaebacteria, a group of microorganisms thought to have diverged early from the main line of prokaryotic evolution (Woese 1987). A comparison of known Archaebacteria with similar isolates from ancient sediments might provide a time scale for mutational events, since the bacteria, which were included in the salt sediments, have not evolved for a few hundred million years, in contrast to all other living organisms. The significance of viable organisms from paleozoic times would extend to other areas of scientific study, such as the search for extraterrestrial life. Were these bacteria deposited at the time of evaporite sedimentation, or did they enter the salt sediments at some later date, or do they represent present-day bacterial contaminants which were introduced during handling of the samples? If the first scenario is correct and the mine isolates are the remnants of populations that originally inhabited the paleozoic brines, they would provide a unique repository of biomolecules. If bacteria can remain viable in a dry state for very long periods, it would be feasible to look for evidence of such life forms in sedimentary formations on other planets, e.g. on Mars. In lunar soil, minerals such as halite (NaCl) and sylvite (KCl) have been detected (Ashikmina et al. 1978); on Mars, surface features were seen which suggested the presence of a liquid, probably water, at some earlier period of its history (Carr 1987).

Thus, the possibility of "halophilic life" in extraterrestrial environments might be realistic and should be worth of further exploration. Direct determination of the age of microorganisms from rock salt is not easy because of the scarcity of organic material in the samples and the lack of suitable isotope dating methods. An indirect method is the analysis of pollen and spores from extinct plants, which has been performed with Austrian rock salt and revealed a Permian origin of the sediments. However, the possibility that the bacteria entered at a later time by unknown processes cannot be rigorously excluded at present. The third problem, contamination with present-day halophilic microorganisms, can be excluded with proper isolation techniques, such as flaming the salt samples and/or treatment with bactericidal agents.

A different approach to study long term survival of halophilic microorganisms was taken by Norton and Grant (1988), who showed that cells remained viable after at least six months of storage in fluid inclusions of salt crystals. Interest in long-term preservation and revival of microorganisms is a developing field; for a recent compilation of examples see Kennedy et al.(1994).

References

Ashikmina, N.A., Gorshkov,A.I., Mokhov,I.A. and Obronov,V.G. (1978) Dokl.Akad. Nauk SSSR, 243, 1258-1260.

Bien, E. and Schwartz, W. (1965) Z. Allg. Mikrobiol., 5, 185-205.

Carr, M.H. (1987) Nature, 326, 30-35.

Denner, E., McGenity, T.J., Busse, H.J., Grant, W.D., Wanner, G. and Stan- Lotter, H. (1994) Int. J. System.Bact., 44, 774-780.

Dombrowski, H.J. (1963) Ann. New York Acad. Sci., 108, 477-484.

Kennedy, M.J., Reader, S.L. and Swierczynski, L.M. (1994) Microbiology, 140, 2513-2529.

Norton, C.F. and Grant, W.D. (1988) J. Gen. Microbiol., 134, 1365-1373.

Norton, C.F., McGenity, T.J. and Grant, W.D.(1993) J. Gen. Microbiol., 139, 1077-1081.

Reiser, R. and Tasch, P. (1960) Trans. Kansas Acad. Sci., 60, 31- 34.

Sonnenfeld, P. (1984) Brines and Evaporites. Academic Press, Orlando, Florida.

Zharkov, M.A. (1981) History of Paleozoic Salt Accumulation. Springer Verlag, Berlin, Heidelberg, New York.

About the author:
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NATIONAL ASSOCIATION OF SPACE SIMULATING EDUCATORS ANNOUNCES ORGANIZATIONAL MEETING

The National Association of Space Simulating Educators, a national organization of educators who are simulating outer space in their schools and classrooms, announces a summer organizational meeting. The major goals of this organization are to facilitate the exchange of ideas, information, and technical enhancements in space simulation; to assist teachers in developing space simulators; to provide consultation services to teachers and schools; and to provide assistance in finding materials and equipment.

The meeting will be hosted by University School in Shaker Heights, Ohio (suburban Cleveland) and will take place on Thursday, July 6 and Friday, July 7, 1995. All educators who are interested in space shuttle and space environment simulation of any kind and at any level of education are invited. The agenda includes the actual organizational meeting (including election of officers), presentations by space simulating educators from around the country, and presentations by NASA officials and members of the aerospace community.

Startup funding for the organization was made possible by a grant from the Alice and Patrick McGinty Foundation of Cleveland, Ohio.

For more information on membership or on attending the organizational meeting, contact Robert Morgan, Director of Computer and Space Science Programs, University School, 216-321- 8260. Email via: rem@nptn.org

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EXPLORER SCOUTS TO TACKLE DESIGN OF HUMAN COLONY ON VENUS
JPL Press release.

Explorer Scouts and high school students from the Southern California area will gather at the Jet Propulsion Laboratory April 7-9 to design a realistic proposal for establishing a human colony on Venus. The weekend competition--called Spaceset '95--is the centerpiece of the 10th annual Space Settlement Design Competition, sponsored by the Space Exploration Scout Post 509.

About 120 participants will split into working groups and spend the weekend designing a surface colony for their newly habitable planet. Spaceset '95 builds on last year's Spaceset '94 competition, in which high school students ages 15 to 19 were asked to build a space station in orbit around Venus. Now Venus has undergone some unusual changes which have transformed the planet's oven-like atmosphere into an environment that would be hospitable for human settlement.

JPL technical staff and representatives from the aerospace industry will coach the groups of students this year as they formulate blueprints for the next step--establishing a Venusian colony of human settlers.

"We hope to instill a sense of excitement and challenge in students who are showing an interest in science and engineering at this point in their educations," said Dr. Peter Mason, committee chairman for the JPL-affiliated Explorer Scout post. "The goal is to show them that science and engineering can be fun and can lead to rewarding careers later in life."

At the end of the competition the students will make a formal presentation of their designs to a panel of judges comprised of managers and engineers in the aerospace industry.

All high school students between the ages of 15 and 19 years old are welcome to participate in Spaceset '95. Cost of the event is $52, which includes housing and meals for the weekend. Spaceset '95 is sponsored by the post's members and adult advisors.

For further information, contact the Spaceset Hotline at (818) 447-8694.

HUBBLE SEES OXYGEN-RICH SUPERNOVA DEBRIS IN NEARBY GALAXY
NASA press release.

A new image showing the tattered debris of a star that exploded 3,000 years ago--revealing the building blocks of stars and planets--will be available via the Internet and NASA's Imaging Branch on Monday, April 10. Obtained by NASA's Hubble Space Telescope, this image of the supernova remnant called N132D, lies 160,000 light- years away in the Large Magellanic Cloud, a satellite galaxy to Earth's Milky Way Galaxy.

The image shows the complex collisions as material, including abundant amounts of oxygen seen as blue-green filaments in the Wide Field Planetary Camera-2 image, is thrown out from the interior of the exploded star at more than four million miles per hour (2,000 kilometers per second). This material slams into nearby cool, dense interstellar clouds, crushing and heating them to create luminescent shock fronts. Hubble spectroscopic observations will determine the material's exact chemical composition, and thereby test theories of stellar evolution.

Imaging Branch Photo numbers:
Color: 95-HC-141
B&W: 95-H-145

Internet addresses:
ftp: ftp.stsci.edu (IP address: 130.167.1.2)
WWW URL: http://www.stsci.edu
Gopher: www.stsci.edu
Via anonymous ftp: (GIF, JPEG) /pubinfo/gif/N132D.gif or /pubinfo/jpeg/N132D.jpg

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NASA ANNOUNCES MICROGRAVITY RESEARCH GRANTS
NASA release 95-46.

NASA has selected 47 researchers to receive four-year grants for microgravity biotechnology research totaling more than $38 million. This ground-based research will continue to build the

foundation for research on the international Space Station. Sponsored by NASA's Office of Life and Microgravity Science and Applications, this research is aimed at improving understanding of physical and chemical processes in the areas of protein crystal growth, tissue culture and fundamental biotechnology.

These research grants are the first awarded since the expansion of cooperative programs in biotechnology with the National Institutes of Health (NIH), which was made possible by Congressional appropriations in Fiscal Years 1994-95. The President's Fiscal Year 1996 budget request, under consideration by the Congress, contains a request for additional funding to extend this collaboration into the Space Station era.

To accelerate the transfer of NASA's biotechnology expertise to university researchers, financial support has been included for two research centers, the Massachusetts Institute of Technology, Cambridge, MA, and the Wistar Institute, Philadelphia, PA. In addition, NASA and the NIH have established a joint cooperative program to exploit NASA's bioreactor technology for researchers at NIH's Institute for Child Health and Human Development, Bethesda, MD.

NASA's bioreactor is an apparatus which simulates the microgravity conditions of space by using rotation to suspend cell cultures in a growth medium. This improves tissue or cell sample growth outside the human body. This technique has already been successfully used to study cancer growth.

Protein crystal growth research supported by NASA has important applications to the fields of medicine, drug design and agriculture. Proteins are important, complex biochemicals that serve a variety of purposes in living organisms. Determining the molecular structure of proteins will lead to a greater understanding of how organisms function. Knowledge of these structures also can help the pharmaceutical industry develop disease-fighting drugs.

The researchers selected for funding will have NASA's microgravity research facilities PP drop-tubes, drop-towers, aircraft flying parabolic trajectories and sounding rockets PPat their disposal. Their work may eventually lead to flight experiments aboard the Space Shuttle or Space Station.

NASA received 141 proposals in response to its microgravity research announcement. These proposals were peer reviewed by non-NASA scientific and technical experts, including reviewers suggested by the National Institutes of Health. A list of the grant recipients follows.

Funded Principal Investigators
NRA-94-OLMSA-02
Microgravity Science and Applications Division, OLMSA
National Aeronautics and Space Administration

ALABAMA
Dr. Lawrence J. DeLucas
University of Alabama at Birmingham
Birmingham, Alabama
"A Comprehensive Investigation of Macromolecular Transport During Protein Crystallization"
"Development of Robotic Techniques for Microgravity Protein Crystal Growth"

Dr. Marc Pusey
NASA Marshall Space Flight Center
Huntsville, Alabama
"Isolation of the Flow, Growth and Nucleation Rate, and Microgravity Effects on Protein Crystal Growth"

Dr. Franz Rosenberger
CMMR, University of Alabama in Huntsville
Huntsville, Alabama
"Nucleation and Convection Effects in Protein Crystal Growth"

Dr. Craig D. Smith
University of Alabama at Birmingham
Birmingham, Alabama
"Robotic Acquisition and Cryogenic Preservation of Single Crystals of Macromolecules for X-ray Diffraction"

Dr. William K. Witherow
NASA Marshall Space Flight Center
Huntsville, Alabama
"Phase Shifting Interferometric Analysis of Protein Crystal Growth Boundaries and Convective Flows"

ARIZONA
Dr. Bruce Towe
Arizona State University
Tempe, Arizona
"Development of Microflow Biochemical Sensors for Space Biotechnology"

CALIFORNIA
Dr. Rajendra S. Bhatnagar
University of California, San Francisco
San Francisco, California
"Expansion and Differentiation of Cells in Three Dimensional Matrices Mimicking Physiological Environments"

Dr. Ellen R. Dirksen
University of California, Los Angeles
Los Angeles, California
"Use of Microgravity-Based Bioreactors to Study Intercellular Communication in Airway Cells"

Dr. Don J. Durzan
University of California, Davis
Davis, California
"Microgravity Thresholds for Anti-Cancer Drug Production on Conifer Cells"

Dr. Robert S. Feigelson
Stanford University
Stanford, California
"Laser Scattering Tomography for the Study of Defects in Protein Crystals"

Dr. Alexander J. Malkin
University of California, Riverside
Riverside, California
"Ground-Based Program for the Physical Analysis of Macromolecular Crystal Growth"

Dr. Alexander McPherson
University of California, Riverside
Riverside, California
"Enhanced Dewar Program"

Dr. Eugene H. Trinh
Jet Propulsion Laboratory
Pasadena, California

"Experimental Studies of Protein Crystal Growth Under Simulated Low Gravity Conditions"

COLORADO
Dr. Larry Mason
Martin Marietta Astronautics Group
Denver, Colorado
"Membrane Transport Phenomena"

Dr. Paul Todd
University of Colorado
Boulder, Colorado
"Preparation and Analysis of RNA Crystals"

FLORIDA
Dr. Bruce R. Locke
Florida A&M University/Florida State University
Tallahassee, Florida
"Analysis of Electrophoretic Transport of Macromolecules Using Pulsed Field Gradient NMR"

ILLINOIS
Dr. James R. Norris
Argonne National Laboratory
Argonne, Illinois
"Mechanisms for Membrane Protein Crystallization: Analysis by Small Angle Neutron Scattering"

INDIANA
Dr. D. James Morre
Purdue University
West Lafayette, Indiana
"Biological Particle Separation in Low Gravity"

IOWA
Dr. Carole A. Heath
Iowa State University
Ames, Iowa
"Determining the Conditions Necessary for the Development of Functional Replacement Cartilage Using a Microgravity Reactor"

Dr. David W. Murhammer
University of Iowa
Iowa City, Iowa
"Continuous, Noninvasive Monitoring of Rotating Wall Vessels and Application to the Study of Prostate Cancer"

LOUISIANA
Dr. Kim O'Connor
Tulane University
New Orleans, Louisiana
"Insect-Cell Cultivation in Simulated Microgravity"

MARYLAND
Dr. Travis Gallagher
Center for Advanced Research in Biotechnology (CARB)
Rockville, Maryland
"Protein and DNA Crystal Lattice Engineering"

MASSACHUSETTS
Dr. Lisa E. Freed
Massachusetts Institute of Technology
Cambridge, Massachusetts
"Microgravity Tissue Engineering"

Dr. J. Milburn Jessup
Harvard Medical School
Boston, Massachusetts
"Growth, Metabolism, and Differentiation of MIP-101 Carcinoma Cell"

Dr. Daniel A. Kirschner
Children's Hospital & Harvard Medical School
Boston, Massachusetts
"Fibril Formation by Alzheimer's Disease Amyloid in Microgravity"

Dr. Peter J. Quesenberry
University of Massachusetts
Worcester, Massachusetts
"Stem Cell Expansion in Rotating Bioreactors"

Dr. F. Marc Stewart
University of Massachusetts
Worcester, Massachusetts
"Influence of Microgravity Conditions on Gene Transfer into Expanded Populations of Human Hematopietic Stem Cells"

MISSISSIPPI
Dr. W. William Wilson
Mississippi State University
Mississippi State, Mississippi
"A Rational Approach for Predicting Protein Crystallization"

NEW YORK
Dr. George T. DeTitta
Medical Foundation of Buffalo, Inc.
Buffalo, New York
"Macromolecular Crystallization: Physical Principles, Passive Devices, and Optimal Protocols"

Dr. Andreas Martin
Mount Sinai School of Medicine
New York, New York
"Thyroid Follicle Formation in Microgravity: Three-Dimensional Organoid Construction in a Low-Shear Environment"

NORTH CAROLINA
Dr. Charles W. Carter
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina
"Quantitative, Statistical Methods for Pre-Flight Optimization, and Post-Flight Evaluation of Macromolecular Crystal Growth"

Dr. William E. Kraus
Duke University Medical Center
Durham, North Carolina
"Regulation of Skeletal Muscle Development and Differentiation In Vitro by Mechanical and Chemical Factors"

OHIO
Dr. John H. Hughes
Ohio State University
Columbus, Ohio
"The Effects of Microgravity on Viral Replication"

PENNSYLVANIA
Dr. Portonovo S. Ayyaswamy
University of Pennsylvania
Philadelphia, Pennsylvania
"The Use of Bioactive Glass Particles as Microcarriers in Microgravity Environment"

Dr. John A. Frangos
Pennsylvania State University
University Park, Pennsylvania
"Role of Fluid Shear on 3-D Bone Tissue Culture"

Dr. Elliot M. Levine
The Wistar Institute
Philadelphia, Pennsylvania
"Multidisciplinary Studies of Cells, Tissues, and Mammalian Development in Simulated Microgravity"

TEXAS
Dr. Leland W. K. Chung
University of Texas MD Anderson Cancer Center
Houston, Texas
"Microgravity Simulated Prostate Cell Culture"

Dr. Gerard L. Cote
Texas A&M University
College Station, Texas
"Noninvasive Near-Infrared Sensor for Continual Cell Glucose Measurement"

Dr. S. Dan Dimitrijevich
University of North Texas, Health Science Center at Fort Worth
Fort Worth, Texas
"The Effect of Microgravity on the Human Skin Equivalent"

Dr. Thomas J. Goodwin
NASA Johnson Space Center
Houston, Texas
"Lymphocyte Invasion into Tumor Models Emulated Under Microgravity Conditions in Vitro"

Dr. Paul E. Oefinger
University of Texas Medical School at Houston
Houston, Texas
"Use of Rotating Wall Vessel (RWV) to Facilitate Culture of Norwalk Virus"

Dr. Neal R. Pellis
University of Texas M.D. Anderson Cancer Center
Houston, Texas
"Microgravity and Immunosuppression: A Ground-Based Model in the
Slow Turning Lateral Vessel Bioreactor"

Dr. Glenn F. Spaulding
Houston, Texas
"Automated Cell Culture Systems for Tissue Engineering"

WASHINGTON
Dr. Viola Vogel
University of Washington
Seattle, Washington
"Two-Dimensional Protein Crystallization at Interfaces"

WASHINGTON, D.C.
Dr. Keith B. Ward
Naval Research Laboratory
Washington, D.C.
"Investigation of Protein Crystal Growth Mechanisms in Microgravity"

WISCONSIN
Dr. Timothy G. Hammond
University of Wisconsin Medical School
Madison, Wisconsin
"Differentiation of Cultured Normal Human Renal Epithelial Cells in Microgravity"

STUDENT SPACE STATION™
USENET Announcement

... for youth with the right stuff!

Do you know a student between the ages of 13 and 16 who likes to solve problems and can take responsibility? Can this youth pull his or her weight on a team that's out to get results? Does the student like science and math? If so, that youth may be among the select group eligible for Mississippi's top flight science program for junior and senior high school students. Participants are housed in a college dormitory and receive in-depth laboratory experience in a branch of physical or life science.

Research fields currently offered include animal science, botany, human physiology, material science, microbiology, and planetary science/remote sensing. Ten days of laboratory work allow each student to develop one or more flight experiments, while gaining proficiency in an assigned mission specialty. A realistic 96- hour spaceflight simulation concludes the program. Employing high fidelity spacecraft and mission control simulators, the students follow mission procedures patterned after NASA's own flight operations. The youth conduct dozens of "flight experiments," manage mission routines, and solve critical problems that could result in mission aborts. There are no scripts. Each mission is different, depending on the quality of the students' decisions and their attention to their own specialized tasks and responsibilities to determine the outcome.

Mission dates for summer 1995 are July 18-July 1, July 9-22, and July 30-August 12. The cost is $895.00 per participant, which includes tuition, room and board, supplies and materials, and tee-shirt. A flight suit and mission insignia are loaned to the students, but may be purchased for $50.00 additional. Some need- based financial assistance may be available. (Corporations interested in sponsoring a student should request the special sponsors information package.) Admission to the program is by competitive application and interview. Application packets are available now from the Davis Planetarium, P.O. Box 22826, Jackson, MS, 39225-2826, USA. This program is operated by the Davis Planetarium Foundation, Inc., a 501 (c) (3) educational institution.

For information about internet access to information and applications for the Student Space Station™ Project, follow these instructions: 1) Begin an email message. 2) Place the word "sss" (without the quotes) in the subject-line. 3) It is not necessary for there to be a body to the message, unless your mailing program requires it. It may never be seen. 4) Send the mail to <eos@inst.com>. 5) A response will be processed immediately after your mail is received. Depending on the speed of your mail system and the net, the reply could be delivered within seconds. 6) Any problems, questions, suggestions, direct them to Noby Nobriga <eos@inst.com>.

End *Marsbugs* Vol. 2, No. 4.