MARSBUGS:

The Electronic Exobiology Newsletter

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Co-editors:

David Thomas, Life Sciences Department, Belleville Area College, Belleville, IL 62221, USA, thomasd@basenet.net (basegrp.com).

Julian Hiscox, Microbiology Department, BBRB 17, Room 361, University of Alabama at Birmingham, Birmingham, AL 35294-2170, USA, julian_hiscox@micro.microbio.uab.edu.

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CONTENT

SPACE STATION COMPLETES MAJOR LIFE SUPPORT SYSTEM TESTS

NASA press release: 95-61

The international Space Station's water purification system has passed a series of tests designed to evaluate new components and configurations of the Water Recovery System and to challenge the system's capability to remove bacteria, fungi and for the first time, live viruses.

The test series, begun in August 1994 at NASA's Marshall Space Flight Center, Huntsville, AL, characterized the physical, chemical and microbiological composition of the Space Station's expected waste water (shower water, oral hygiene, urine distillate, wet shave, human perspiration). The tests produced recycled water using new performance procedures and hardware dictated by changes in Space Station requirements and lessons learned during earlier water system testing.

The tests featured the first use of a new fully- integrated water processor which automatically tested for the presence of chemical substances, such as organic carbons, iodine and overall water purity. Also, special computer software was developed for automated control very similar to that planned for use on the Space Station.

"This test allowed design engineers to assess the water purification system under the operating conditions that would be expected on the international Space Station," explained Don Holder, life support design engineer in Marshall's Thermal Control and Life Support Systems Division and principal investigator for the test. "Overall, the system was very effective in producing high quality potable water from waste water," said Holder.

"The purification equipment effectively removed high concentrations of microbes in the waste water and provided water with little detectable bacteria and fungi," explained Monsi Roman, life support system microbiologist. "The test series was very challenging, and we are very pleased with the excellent results and overall efficiency of the system."

The final phase of the water purification tests included, for the first time, an assessment of the system's capability to eliminate viral particles. During the five- day viral test, high concentrations of viruses were steadily introduced in the system. While special filters are used to remove larger contaminants such as skin particles and hair fragments, the smaller viral organisms, along with fungi and bacteria, were destroyed by exposure to the purification system's synthetic cleaning resins and high temperature processor. Throughout the viral test, water samples were collected in order to study the effectiveness of each element of the system and evaluate its role in viral removal.

The viruses selected for the test, MS2, T-1, VD13 and 23356-B1 can only infect specific bacteria. These viruses are common and non-pathogenic for humans. MS2 is frequently used by the Environmental Protection Agency as an indicator for determining the viral effectiveness of drinking water disinfection processes.

"The viral removal capability of the water recycling system appears excellent based upon our preliminary test results," said Christon Hurst, a virologist of the Environmental Protection Agency's Drinking Water Research Division in Cincinnati, OH. Hurst provided on-site support to the viral tests series and supervised post-test evaluation of the data.

Additional testing of the water purification system is planned to determine the actual lifespan of some system hardware, such as filters. The water processor is scheduled to be launched in the U.S. habitation module in 2002.

Marshall is conducting a variety of water purification tests in support of the Space Station Program Office.

LOCAL STUDENTS WIN NATIONAL AEROSPACE COMPETITIONS

NASA press release

Several local students are national winners in NASA's 15th annual Space Science Student Involvement Program competition. Twenty- six national winners will present their projects at the National Space Symposium, May 6-10, Hotel Washington, 515 15th St., N.W., Washington, DC.

In the Mars Expedition competition, the following eight semi-finalists will compete for first place by presenting proposals of a trip to Mars to a panel of scientists on Monday, May 8, at 1:30 p.m. EDT:
Kathleen Cusick, Glastonbury H.S., Glastonbury, CT Amita Danak, Parma Senior H.S., Parma, OH
Sara Shelton, Robinson Secondary School, Fairfax, VA Brian Pierce, Bonnabel H.S., Metairie, LA
Travis Caddell, Springtown H.S., Springtown, TX Michelle DeDecker, Davis H.S., Kaysville, UT Bryn Daisy, East Anchorage H.S., Anchorage, AK Luke Bergmann, Montgomery Blair H.S., Silver Spring, MD

On Monday, May 8 at 9 a.m., students in the following competition categories will present their award winning projects.

Interplanetary Art (artwork will be displayed)
Gregory Metcalf, Quail Summit Elementary School, Diamond Bar, CA Jon Frey, Precious Blood Middle School, Dayton, OH Jaime Behrens, Rosemount H.S., Rosemount, MN

Future Aircraft/Spacecraft Design
Ariel Overstreet, Jerick Graves, Megan Brewer, Daniel Karlin, Big Timber Grade School, Big Timber, MT

Mission To Planet Earth
Laura Elliott, Angela Feuerborn, Stephanie Spiegal, Holy Trinity Elementary School, Paola, KS

Aerospace Internships
Supercomputer: Raffi Krikorian, Clarkstown South H.S., West Nyack, NY
Space Station: Rose Koba, Parma Senior H.S., Parma, OH
Wind Tunnel: Jason Ernst, Montgomery Blair H.S., Silver Spring, MD
Microgravity: Nathan Hulse, Davis H.S., Kaysville, UT
Spacelab: Rachel Mandel, Montgomery Blair H.S., Silver Spring, MD
Space Telerobotics: Alex Epstein, Montgomery Blair H.S., Silver Spring, MD
Space Astronomy: Brendan Connell, Montgomery Blair H.S., Silver Spring, MD
Launch Operations: Brian Blum, Shoreham-Wading River H.S., Shoreham, NY

At 6:30 p.m. on May 9, the students and their teachers will be honored at a banquet at the Hotel Washington. The banquet speaker will be Col. Charlie Bolden, former astronaut and currently the Deputy Commandant of the U.S. Naval Academy.

The Space Science Student Involvement Program is a national competition, co-sponsored by NASA and the National Science Teachers Association, to promote science, mathematics and technology achievement. Over 4,000 students in elementary, junior high and high school competed in five competition categories.

MARS PATHFINDER STATUS

Tony Spear, Mars Pathfinder Project Manager
From *The Martian Chronicle*

By this time next year--only 8 months from launch--the Mars Pathfinder project will be just over 3 years old, having completed 19 months of pre-project activities and 18 months of full-scale development in a record inception-to-launch timeframe. The Project is now changing from design activities to subsystem fabrication. Detailed designs are complete for the spacecraft structure, power system, attitude control system, command and data finding system, and most of the entry, descent, and landing hardware. Most fabrication will be completed by June 1995, at which time spacecraft assembly, test, and launch operations (ATLO) will begin.

Initial tests of the retrorocket system were completed successfully in March 1995 at the China Lake Naval Testing Station in California. These tests showed that the retrorocket system was conceptually sound and could provide the required performance on Mars. This testing is required to ensure that Pathfinder is ready for launch.

Testing is critical to the success of Pathfinder. ATLO planning is underway to assemble the spacecraft quickly and maximize the amount of test time before launch. The ATLO phase will take about 18 months, more than twice the primary mission duration (7 months of cruise time plus 1 month of surface operations). The flight system will acquire up to 2000 hours of testing, effectively "burning in" the electronics before the launch.

In the Spring of 1996, system-level environmental tests will be performed, including thermal/vacuum, acoustic, and static load tests. The rover will be included in all flight system tests and will also be subjected to surface operations tests in a simulated Mars environment at JPL.

There are also plans for an extensive series of entry, descent, and landing tests. Pioneer Aerospace will test the low-altitude parachute. At the NASA Lewis Research Center's Plum Brook vacuum chamber in Ohio, ILC Dover will test the airbag drop in a simulated Mars atmosphere. And JPL will conduct final tests of the retrorocket system, as well as airbag retraction and lander uprighting.

[The latest issue of the Martian Chronicle has been released, and this is one of the articles from that issue. If you would like to see other articles and the images associated with the articles, then you can view them from the Martian Chronicle home page: http://www.jpl.nasa.gov/mars/.]

AVIONICS HARDWARE ENGINEERING MODEL COMPLETED
David H. Lehman
From *The Martian Chronicle*

On February 24, 1995 the Mars Pathfinder Attitude and Information Management (AIM) completed the "build" phase of its engineering model hardware. This milestone represents a significant step on the road to launching the Pathfinder lander in early December of 1996. The AIM subsystem is the electronics and control center (or "brain") of the Mars Pathfinder flight system. Its performance is critical to the collection, storage, processing, and distribution of the mission's engineering and science data. This subsystem is also responsible for issuing commands for all other subsystems, performing attitude control, and for operating the lander's interfaces with the micro-rover and the mission operations system.

This engineering model allows Pathfinder's AIM engineers to fully test the electronics and control center. When all testing is finished, the actual flight subsystem will be delivered in June 1995 and then integrated with the remainder of the spacecraft.

The AIM subsystem is built around a low-cost, centralized system architecture using a radiation-hardened IBM RS 6000 computer. The computer operates at speeds of up to 22 million instructions per second (MIPS), contains 128 megabytes of memory, and has a total mass of 0.9 kg. As the "brain" of the spacecraft, its functions are complex, providing the following operations:

Control of power, propulsion, telecommunications, and attitude control during Pathfinder's cruise to Mars
Sequencing, pyro firing, and telecommunications control during Entry, Descent, and Landing (EDL)Power and telecommunications control for lander operations once on the surface
Process engineering, rover, and instrument data for transmission back to scientists and engineers on Earth
Support rover surface operations
Flight system fault management and safety functions during cruise, EDL, and lander surface operations

The subsystem is also used to point the high-gain antenna to track the Earth from the Mars surface in order to maintain communications with the Pathfinder operations team at JPL.

The AIM subsystem has a total mass of 29 kg during the cruise to Mars; after separation from the cruise stage of the spacecraft, where it leaves some of its electronics behind, it has a mass of 16 kg. During cruise its maximum power usage is 52 W. While on the surface it consumes up to 33 W during normal day operations and 8 W at night. It also has the capability, in an emergency, to operate in a "hibernation" mode, where it consumes only 1 W of power. This mode of operation is used only if there is insufficient sunlight on the surface of Mars to charge the lander's batteries.

The AIM subsystem is now well along in the development phase, having passed the critical design review point in June of 1994.

MARS GLOBAL SURVEYOR STATUS
Glenn E. Cunningham, Mars Global Surveyor Project Manager
From *The Martian Chronicle*

The Mars Global Surveyor (MGS) project is finishing up the design of the mission and the spacecraft, and is beginning to build new hardware for the spacecraft and two science instruments.

Project engineers have now specified what path the spacecraft will take on its journey to Mars, the characteristics of the orbit it will fly around the planet, and how NASA's deep space tracking network of antennas will send commands and receive data from the spacecraft. One of the biggest pieces of work is developing the aerobraking techniques that will be used to slow the spacecraft's speed around Mars, lowering the spacecraft's orbit into the desired circular orbit from which to map the surface. A group of experts in the sciences and technologies required for aerobraking has advised the project on this effort (also see the aerobraking model article in this issue).

With less than 2 years until launch, scientists and engineers who will do the imaging science experiments have just completed assembly of the very high resolution camera that will take pictures of the Martian planet surface, and are readying the camera for its environmental tests. Assembly has also started on the Thermal Emission Spectrometer and the Mars Orbital Laser Altimeter, the two inherited instruments from the Mars Observer mission that have to be rebuilt because no spare units existed.

The project's principal industrial partner, Martin Marietta, has just completed building an "engineering development unit" structure assembly. This is a full-size test model of the large box-like honeycomb and composite material structure that houses the electronic heart of the spacecraft and provides the mounting surface for the science instruments. It will be used very soon for a series of special tests that will demonstrate how the spacecraft attaches to the Delta II launch rocket.

Most of the electronic assemblies that regulate the spacecraft's electrical power, control the pointing of the science instruments toward the planet's surface (as well as the solar panels toward the sun and the radio communications antennas toward the Earth), provide communications, and sequence the spacecraft's activities are being upgraded and retested by their manufacturers.

The project has just successfully demonstrated to NASA that plans for building and operating the spacecraft are affordable within the budget that has been approved by Congress, and that there is sufficiently high probability of mission success to continue to work toward launch.

The project is moving ahead rapidly with a very enthusiastic team of people who are working very hard. We even have a new logo! While small design and manufacturing problems crop up on an almost daily basis, the ingenuity of the team has been successful in overcoming them, and there are no significant problems in MGS's path at this time.

WATER: THE COMMON THREAD OF A MARS EXPLORATION STRATEGY
Donna Shirley
From *The Martian Chronicle*

The "Water Strategy"

NASA Administrator Dan Goldin and NASA Associate Administrator for Space Science Wes Huntress have agreed on a strategy for the exploration of Mars for the next 10 years. The strategy is to explore and study Mars in three areas:

Evidence of past or present life
Climate (weather, processes and history)
Resources (environment and utilization)

Each of these areas is connected with the search for water on Mars. When and where was water present in the past, and what is its current form and amount? We know from previous missions that the Martian polar caps include water ice as well as frozen carbon dioxide. The Viking and Mariner 9 orbiter images show evidence of past great floods (the Pathfinder lander is planning to land in such an area), and of dry rivers and lake beds. Where did the all the water go?

If life ever did arise on Mars it would almost surely have been connected with water. And understanding the processes which led (or didn't lead!) to life on Mars will help us understand the potential for life elsewhere in the Universe.

Water is a key to climate, both on Earth and Mars, and understanding the history of the Martian climate will help us better understand the Earth's climate change processes.

Water will be a major resource for future human exploration of Mars, and if we understand how the solid Mars evolved (including what happened to produce water and make it disappear), we may be able to predict or find reservoirs of water available for human use.

How do we go about finding out about water on Mars? Dan McCleese of JPL, the Mars Exploration Program Scientist, and Steve Squyres of Cornell, the head of the Mars Science Working Group, led that group to define a strategy for the "water search." They looked at how small Mars orbiters, landers, "networks" of landers, and sample returns could be combined in a logical progression of missions that will build up an understanding of how water existed and exists now on Mars.

The small orbiter missions will search for accessible water (we know that ice is accessible at the poles, but are there reserves underground or in the soil?). They will search for ancient sediments and hydrothermal deposits (dry lake beds and geysers). They will provide data to understand the present Mars climate and study how water escapes from the atmosphere into space. The orbiters will also study the surface of Mars and identify good landing sites for the landers, and will provide a radio link between the landers and the Earth.

The small lander missions will search for carbonates and evaporites, minerals that could only have formed in the presence of water. Landers can investigate water reserves in detail/ for example they can measure the amount of water that has been bonded to the soil, or drill into the polar ice caps to see how many layers of snow have been built up. Investigation of surface chemistry and how the rocks and soil have "weathered" due to water will tell us about the past climate. And the landers may be able to find organic compounds or even evidence that life may have been present at one time in Mars' past.

"Networks" of more than a dozen very small landers scattered over the planet could be used as weather stations to see how the Martian weather changes over the whole planet and the whole Martian year. If the networked landers have seismometers on board, and if they detect "marsquakes," that information will tell us about what Mars is like deep inside, and how it might have evolved.

Finally, sample return missions can bring back rocks and soil for analysis on Earth with very sensitive instruments (too large to take to Mars) which can tell us about the climate history, the dates of different rocks, and may even allow us to detect compounds that could have led to life, or which are evidence of past life. (The odds of being able to select a rock with a fossil, however, are very low, even if fossils exist on Mars.)

A "Strawman" Mission Set

All of these missions must be done within the very tight cost constraints of the Mars Exploration Program (about $100M per year). The Mars Science Working Group laid out a "strawman" strategy for fitting the science goals into a set of missions which can gradually build up our knowledge of Mars over the next 10 years, following the themes of life, climate, and resources.

First Mars Global Surveyor, which will orbit Mars from 1997 through 2002, will study the surface of the planet and acquire information on the weather, the magnetic and gravity fields, and the mineralogy. The 1997 landing of Mars Pathfinder, with its stereo camera and rover, will send back to Earth information on the geology and surface chemistry of a specific site.

Next, in 1998, another orbiter and lander (half the size and cost of Mars Global Surveyor and Pathfinder) will be launched. The orbiter will carry either a surface measuring instrument (the Gamma Ray Spectrometer - GRS) or an atmospheric instrument (the Pressure Modulated Infrared Radiometer - PMIRR), plus a small camera and a radio relay for the '98 lander. The lander will carry the first of a series of lander payloads specifically designed to carry out the "water strategy." The payloads will be selected as total packages in a competition between science and engineering teams. They may look for certain chemicals that give information on the history and existence of water, they may analyze rocks to tell the history of the climate, they may (if the lander is targeted to one of the poles), drill into polar ice. In 2001 and 2003 there are opportunities to send additional landers, which can continue to carry out the "water" investigations.

Any of these landers could be targeted to ancient lake beds to search for "fossil slime." They could be sent to river valleys to investigate how water once flowed on Mars. The landers could include rovers and/or sampling arms to put instruments on the surface or retrieve samples for analysis.

In 2003 an alternative to sending more "large" landers would be to send a network of meteorology/seismology stations, or a network of penetrators that can make chemical measurements below the surface all over the planet.

And finally, in 2005, the Mars Science Working Group recommended that the Mars Exploration Program attempt a Sample Return Mission--very challenging within the cost constraint of about $200M!

An Augmented Mission Set

Even better opportunities for the "water strategy" will occur if we can form teams with international partners. We are still exploring the possibilities of "Mars Together " in 1998 with the Russians, which would allow the U.S. to fly both the GRS and the PMIRR instruments on the U.S. orbiter. This would let us study both the atmosphere and the surface in a very complementary way starting in 1999. In 2003 the European Space Agency (ESA) is proposing to send a joint ESA/U.S. mission to orbit Mars and land three or four of the "large" U.S. landers, supported with a radio link on a European orbiter.

And more instruments can be carried, or more landers sent, if new technology improvements can be introduced into U.S. spacecraft to make them smaller, lighter, and cheaper. A program called "New Millennium" is currently being planned to develop and demonstrate a new generation of space technologies to do this for both planetary and Earth missions. The Mars Exploration Program will be a "customer" for this new technology, and some of the New Millennium demonstrations may "piggyback" on Mars missions.

EOSDIS WANTS INPUT FROM USERS
From Usenet sci.bio.

The EOSDIS Core System (ECS) Project is seeking input from potential users of EOSDIS to ensure that the system meets the needs of its users. The user community consists of scientists, educators, students, state and federal agency personnel, policy- makers, and commercial users. Specifically, we are seeking input regarding the Earth Science data products that will be of interest to users in the 1998-2000 timeframe.

Currently, we are inviting scientists to complete our EOSDIS Product Use Survey that has been implemented on the World-Wide Web. The results of the survey will aid developers in the design of data servers and communication networks, and in estimating the load on the system resulting from user activity. The results of this survey will NOT be used to change the list of planned data products; changes to the data product list are not within the authority of ECS.

The survey takes approximately 15 to 30 minutes to complete. Please take the time to help the ECS Project ensure that its system will meet your individual needs, as well as the needs of its overall user community.

URL: http://observer.gsfc.nasa.gov/egsus/intro.html or
http://ecsinfo.hitc.com/egsus/intro.html

MISSION AND PAYLOAD SPECIALISTS NAMED FOR LIFE, MICROGRAVITY FLIGHT
NASA press release: 95-63

NASA has named mission and payload specialists for a 16-day flight aboard the Space Shuttle Columbia in the summer of 1996 to conduct life and microgravity science experiments. Designated STS-78, the mission will have astronauts Susan J. Helms (Lt. Col, USAF), Dr. Richard M. Linnehan and Dr. Charles E. Brady, Jr. (Commander, USN), as the mission specialists. Also on the flight will be Dr. Jean-Jacques Favier, of the French Atomic Energy Commission (CEA) and astronaut of the French Space Agency (CNES), and Dr. Robert Brent Thirsk, of the Canadian Space Agency. Both will serve as payload specialists on the mission. Helms will serve as the flight engineer and Linnehan, Brady, Favier and Thirsk will serve as the payload crew. The commander and pilot will be named later.

NASA has designated Dr. Pedro Duque of the European Space Agency and Dr. Luca Urbani of the Italian Space Agency to serve as alternates to Favier and Thirsk. As alternates, Duque and Urbani will undergo the same training as Favier and Thirsk and will be ready to serve on the mission crew if necessary.

The mission's experiments will build on previous Shuttle spacelab flights dedicated to life sciences and microgravity investigations (Spacelab Life Sciences 1 and 2 -- STS-40 and STS-58, and International Microgravity Laboratory 1 and 2 -- STS-42 and STS-65).

Helms, 37, has flown two previous Shuttle missions, STS-54 in January 1993 and STS-64 in September 1994. She received a master of science degree in aeronautics/astronautics from Stanford University in 1985. Helms considers Portland, OR, her hometown.

Linnehan, 37, will be making his first flight. He is a member of the astronaut class of 1992. Linnehan earned his doctor of veterinary medicine degree from the Ohio State University College of Veterinary Medicine in 1985. He was born in Lowell, MA.

Brady, 43, also is a member of the astronaut class of 1992 and STS- 78 will be his first flight. He received his doctorate in medicine from Duke University in 1975. He considers Robbins, NC, his hometown.

Favier, 46, earned a Ph.D. in engineering at the Mining School of Paris and a Ph.D. in metallurgy and physics from the University of Grenoble. He is advisor to the director of the CEA's Center for Materials Studies and Research. Detailed to CNES, Favier currently is working at NASA's Marshall Space Flight Center, Huntsville, AL, in the Payload Operations Laboratory and the Space Station Furnace Facility area. Favier was an alternate payload specialist for STS-65, the International Microgravity Laboratory-2 mission.

Thirsk, 41, earned a Doctor in Medicine from McGill University Medical School, Montreal, Canada and a Master of Science in mechanical engineering from the Massachusetts Institute of Technology. He is an adjunct professor of mechanical engineering at the University of Victoria and continues to practice clinical medicine in Canadian hospitals. Thirsk was an alternate payload specialist for the STS-41G mission.

End *Marsbugs* Vol. 2, No. 6.