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THE MAGAZINE OF THE NATIONAL SPACE SOCIETY

WINTER 2005

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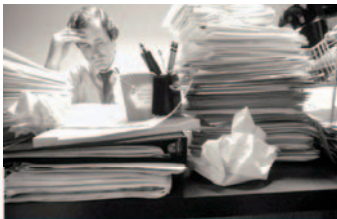
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NSS members Maria Thome, Grant Anderson and Adam London aboard the inaugural NSS Zero-G charter flight on Sept. 17. Thome is the chapter president from Brasilia, Brazil; Anderson and London are space entrepreneurs.

AD ASTRA, which means "to the stars" in Latin, is the motto of the National Space Society, an international membership group dedicated to furthering the exploration and development of space. Our quarterly magazine, **AD ASTRA**, is only one of many NSS activities aimed at creating a space-faring civilization. For more information on NSS call (202) 429-1600 or visit www.nss.org on the internet.

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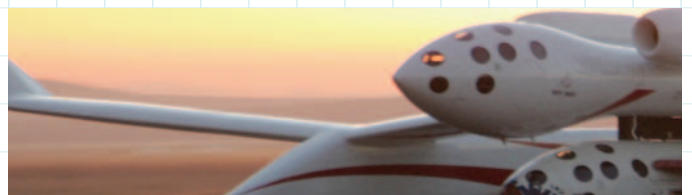


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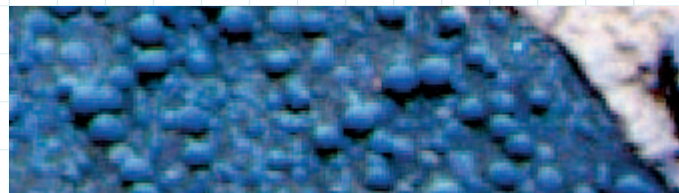
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Production Services
Mercury Publishing Services, Inc.
http://www.mercurypubs.com

Ad Astra (ISSN 1041-102X) is published quarterly by the National Space Society. Editorial offices are located at 1620 I Street, Suite 615, Washington, DC 20006. No material in this magazine may be reproduced without permission. Periodicals postage paid at Washington, DC, and additional entry. Membership inquiries (\$45/yr, \$20/yr for students under 22) should be sent to the National Space Society, 1620 I Street, Suite 615, Washington, DC 20006. Postmaster: Send address changes to Ad Astra, 1620 I Street, Suite 615, Washington, DC 20006.

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If you interested in any of the above, please send your email address via an email message to Bruce Janele at NSS headquarters at bruce@moinc.com. Thanks.

FACING A COSMIC CONUNDRUM

In the last issue of *Ad Astra* I laid out the case that we must develop space to save ourselves from ourselves. Assuming we manage to survive the expanding proliferation of weapons of mass destruction we still need to develop space in order to survive.

Eventually the fate of mankind will be sealed with utter destruction from comets and asteroids if we fail to venture into deep space. If we just sit on this third rock from the sun, another rock will check us out long before the sun becomes a threat to Earth.

The occurrence of impacts that could destroy a city are much higher than the occurrence of impacts which could wipe out a civilization. These probabilities are in dispute, with estimates ranging from three per century to three per millennium.

The 1908 Tunguska explosion leveled 800 square miles of trees in Siberia. Such an impact over a city would make 9/11 look like a picnic. Damage could be in the hundreds of billions or even trillions of dollars. There would be an untold loss of life. In a world where nations like Pakistan and India are on a hair-trigger we must consider that one of these events could trigger a nuclear war. Even one of the much more numerous high atmospheric explosions, such as one that occurred over the Mediterranean during one of the high points of the Indian-Pakistani tension, could cause a nightmare.

Every 3,000 to 5,000 years an impact occurs in one of Earth's ocean basins large enough to create tsunamis more than 300 feet high, moving at the speed of sound in water that could leave that ocean basin with absolute destruction. It happened 90,000 years ago when a tsunami deposited more than 1,000 feet of coral on the Hawaiian Islands. Hundreds of millions, maybe even a couple of billion people could die. Property damage could be in the hundreds of trillions of dollars.

In order to defend Earth from impact we need to establish the means to send humans and equipment to these Near-Earth Objects (NEOs). A means of rapid response needs to be established, on the ready to go to protect life on Earth. City-buster class impactors are difficult to detect. Currently no one is looking for anything smaller than one kilometer in diameter. Even if one did map out all the NEOs capable of impacting Earth, there is no expectation that we could map the potential impacts from comets on long orbits to the Kuiper belt region and beyond. This is why we will eventually want a capability ready to divert an asteroid or comet with less than one year's notice time. Many of the unmanned asteroid-divert scenarios may simply take too long to be effective against the threat from city-buster class asteroids and comets.

The new exploration program that NASA is developing as it begins to evolve toward Mars-capable missions could indeed be a first step toward achieving these capabilities. The price is very small compared to the potential costs of even just one small impactor. This establishes ample reason to send humans beyond low-Earth orbit.

The technical solutions that can enable us to avert NEO and comet impacts on Earth also can enable the means for us to tap into the resources of these heavenly bodies, potentially enabling us to establish an economy in the boundless skies of space. Instead of crying about the sky falling on our heads, let's put that stuff to good use.

Support going back to the moon and on to Mars!



Greg Allison
Chairman of the
NSS Executive
Committee

Greg Allison

MISSION CONTROL

spacebeat

BY JOHN KROSS

orbiter update

NASA ASPIRE(s) TO BLISS, SPIRIT AND MORE

As part of its Astronomical Search for Origins Program, the U.S. space agency has given the green light to nine feasibility studies of future mission concepts ranging from a billion-star census to an ultraviolet replacement for the Hubble Space Telescope (HST). Over the next six months, proponents will develop and refine concepts for missions addressing big questions such as “How did we get here?” and “Are we alone?”

Among the proposals are two sure to bring blissful smiles to infrared astronomers. BLISS aims to focus on infrared spectroscopy of far-away galaxies and chart the creation of heavy elements over time, while SPIRIT’s (Space Infrared Interferometric Telescope) goal is to take high-resolution far infrared images of star and planet formation.

No sky survey would be complete without a census and OBSS (Origins Billion Star Survey) is touted as “star taller” and cosmic counter par excellence. OBSS’s goal is to complete a census of giant extrasolar planets and the demographics of stars within 30,000 light years of the sun. Meanwhile, CIP (Cosmic Inflation Probe) backers promise to measure the cosmic inflation potential with a near-infrared redshift survey of early galaxies. Closer to home, the proponents of HORUS (High ORbit Ultraviolet-visible Satellite) hope to conduct a systematic investigation of star formation in the Milky Way, nearby galaxies and the high-redshift universe. Hawk-eyed HORUS also aims to investigate the origin, structure and composition of the

extended atmospheres of extrasolar planets.

For astronomers aspiring to detect organic compounds, there is ASPIRE (the Astrobiology SPace InfraRed Explorer). More broadly, the Baryonic Structure Probe aims to bolster cosmological theories by detecting, mapping and characterizing the web of matter in the early universe. Among the other proposals is GEOP (the Galaxy Evolution and Origins Probe), which will take a bead on more than five million galaxies to study their assembly and history of star formation. Lastly, fans of HST can take some comfort in Johns Hopkins University’s proposed Hubble Origins Probe, a mission that utilizes instruments built for the fifth HST servicing mission (the Cosmic Origins Spectrograph and Wide Field Camera 3). NASA cancelled the Hubble servicing mission after the Columbia accident.

DELTA 4 HEAVY READIES FOR DEMO

The new Delta 4 Heavy launch vehicle, intended to shoulder the lion’s share of future launches for rocket-builder Boeing, was rolled out to the launch pad with a hefty burden already aboard: the rocket is up against Lockheed Martin’s Atlas 5 for future NASA and U.S. Air Force business.

After months of tests, Boeing was poised for a mid-November launch of its Delta 4 Heavy booster under the Evolved Expendable Launch Vehicle (EELV) program. The demo flight for the U.S. Air Force has been postponed several times because of hurricanes striking Central Florida and minor adjustments to the vehicle.

With three massive side-by-side common booster cores (CBCs), the orange-and-white Delta 4 Heavy is one of the largest expendable rockets launched from Cape Canaveral since the giant Saturn 5 moon rockets 30 years ago. When topped off by its upper-stage booster and five-meter (16.7-foot) diameter payload fairing, the heavyweight rocket will stand about 72 meters (235 feet) tall — 15 meters (50 feet) taller than a shuttle. Powered by newly designed Rocketdyne RS-68 liquid oxygen/liquid hydrogen engines, the Delta 4 Heavy can boost up to 13,130 kg (28,950 lb.) into geosynchronous transfer orbit (GTO).

The U.S. Air Force, which will be one of the new rocket’s main customers, began pushing for more reliable launch vehicles with greater flexibility about 10 years ago. The results were stripped-down versions of Lockheed Martin’s Atlas 5 and Boeing’s Delta 4, which made an earlier flight. But another customer is in the market for heavy lift — NASA. The space agency is considering both the Delta 4 Heavy and the Atlas 5 for carrying its Orbital Space Plane to the International Space Station

“We’re putting the best of Boeing into it,” Ed Memi, a spokesman based at Boeing NASA Systems, told *Florida Today*. “It is a priority for us.”

The Delta 4 Heavy also is in the running, along with the Heavy Atlas 5 and shuttle-derived variants, to play a key roles in the Bush Administration’s Space Exploration Initiative announced earlier this year.

THE END OF THE BEGINNING

What was supposed to be a new beginning for solar science turned instead into a violent end to the Genesis mission as the return capsule – bearing precious solar samples – slammed into the ground due to a parachute malfunction.

The genesis of the Genesis mission was a desire by researchers to capture tiny slivers of the sun - ions and elements in the solar wind - and bring samples back to Earth for study. To capture the precious solar cargo Genesis journeyed to the L1 Lagrangian Point – where the gravitational and centrifugal pull of the sun and Earth are balanced – and collected samples of charged solar particles for three years.

The sample of solar matter was supposed to allow scientists to address fundamental questions about the solar and nebular compositions, and test theories about the origin of the sun and the planets. Once Genesis entered its halo-like orbit, 1.5 million kilometers from Earth, the spacecraft extended special collector arrays to capture a few millionths of a gram of ions and particles, which were carefully stowed in a contamination-proof canister.

Instead of a spectacular airborne capture over Utah's Air Force Testing and Training Range on Sept. 8, the out-of-control return capsule – sans parachute – slammed into the Utah desert at 309 kilometers per hour (193 mph).

Later that day, the science canister was dug out of the muck and flown by helicopter to a specially constructed clean room on the Army



The Genesis spacecraft slammed into the desert floor after a failed parachute return to Earth.

base where a team of specialists plucked out pieces of dirt and mud. As *Ad Astra* went to press, scientists picking through Genesis' remains at NASA's Johnson Space Center curation facility were increasingly optimistic about the prospects for salvaging useful science from the recovered samples.

"We cheered the news from the science team about the recovery of a significant amount of the precious samples of the sun," said Ghassem Asrar, deputy associate administrator for the Science Mission Directorate at NASA Headquarters. "Despite the hard landing, Genesis was able to deliver."

A board investigating the accident has pointed an accusing finger at a design error in gravity-switch devices, which sense the braking caused by atmospheric entry, and initiate a sequence leading to deployment of the drogue parachute and parafoil.

"This single cause has not yet been fully confirmed, nor has it been

determined whether it is the only problem within the Genesis system," said Michael Ryschkewitsch, head of the investigation team. "The board is working to confirm this proximate cause, to determine why this error happened, why it was not caught by the test program and an extensive set of in-process and after-the-fact reviews of the Genesis system."

The investigators determined the gravity-sensing switches probably were installed upside-down. Also worrisome is the fact that the same switches were used on NASA's Stardust probe, which has collected comet particles for a parachute return to Earth in 2006. Investigators are looking at design drawings to see if there is a problem.

"While the switches are the same, the installation ... is quite different," said Ryschkewitsch.

The board expects to wrap up its investigation of the Genesis failure by the end of November.

TITANS FALL

With much attention focused on the future of space endeavors, the deaths of two titans – Maxime Faget and Gordon Cooper – are a reminder of the achievements of the early space age. Faget designed the original spacecraft for Project Mercury and contributed to the designs of every U.S. government human spacecraft from Mercury to the space shuttle. He was 83.

“Without Max Faget’s innovative designs and thoughtful approach to problem solving, America’s space program would have had trouble getting off the ground,” NASA administrator Sean O’Keefe said. “He also was an aeronautics pioneer. In fact, it was his work on supersonic flight research that eventually led to his interest in spaceflight. The thoughts and prayers of the entire agency are with his family.”

Also passing away in October was Leroy Gordon Cooper, one of the original Mercury 7 astronauts who rode the Faget-designed capsule into orbit during the sixth and last flight of the Mercury program. The mission, in May 1963, lasted 34 hours — more than three times than any previous human spaceflight in the United States. Cooper later commanded the Gemini 5 mission during which he and crewmate Charles “Pete” Conrad tested a prototype fuel cell that became a vital element in future space flights.

Problems with the fuel cell precluded rendezvous with a radar evaluation “pod,” but the astronauts were able to put the spacecraft through a series of orbit changes, aiming at a hypothetical target. Cooper and Conrad splashed into the Atlantic after 120 orbits, proving that a round-trip voyage to the moon was

within the physical capability of trained astronauts.

“As one of the original seven Mercury astronauts, Gordon Cooper was one of the faces of America’s fledgling space program. He truly portrayed the right stuff, and he helped gain the backing and enthusiasm of the American public, so critical for the spirit of exploration,” said O’Keefe.

Cooper was the youngest of the Mercury 7 astronauts, who were selected in 1959 as America embarked on a space race with the former Soviet Union. Mercury brethren Gus Grissom, Alan Shepard and Deke Slayton preceded Cooper in death.

“We seven were bonded like brothers, maybe even closer if that’s possible,” said Wally Schirra, one of the three remaining Mercury astronauts.

“There are thousands of memories from our early space days,” added Mercury astronaut and former senator John Glenn. “Gordo was one of the most straight-forward people I have ever known. What you saw was what you got. Pride in doing a great job, whatever his assignment, was his hallmark. You could always depend on Gordo. It’s hard to believe that he will no longer be with us in person. I know he’ll be with us in spirit.”

Cooper died at his home in Ventura, Calif., of heart failure. He was 77.



Mercury 7 astronaut Gordon Cooper.



Mission Control celebrates the successful conclusion of Apollo 11. At left is Mercury spacecraft designer Maxime Faget.



THE DAY THE SUN STOOD STILL

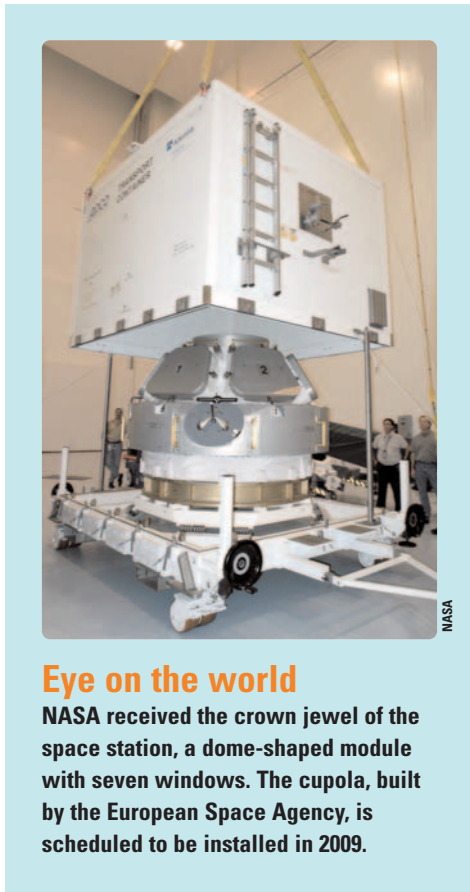
For the first time in six years, astronomers looked at images of the sun and found ... nothing. Not a sin-

gle sunspot. The sun's face was clear only for a day or two – this image was taken by the Solar and Heliospheric Observatory on Oct. 11

– but it served as a poignant statement that the sun is well on its way to the quietest time in its 11-year cycle. That's good news for all the

satellite operators as well as for crews aboard the International Space Station. [▶](#)

Riders on the Storms



Eye on the world

NASA received the crown jewel of the space station, a dome-shaped module with seven windows. The cupola, built by the European Space Agency, is scheduled to be installed in 2009.

Storms' toll

Panels from the exterior walls of the Vehicle Assembly Building are recovered after Hurricane Frances blasted by the Kennedy Space Center. On its heels came Hurricane Jeanne which peeled off more panels from the VAB.



Redstone falls

A Mercury/Redstone rocket on display at the Pass and Identification Building at the entrance to Kennedy Space Center lies on its side after the hurricanes.

Tile workers relocate

The second floor of the Thermal Protection System Facility sustained significant damage from Hurricane Frances. The storm's path over Florida took it through Cape Canaveral and KSC property during Labor Day weekend. The facility is used to manufacture tiles and insulation for the shuttle fleet.

WHEN DREAMS TAKE WING

BY IRENE MONA KLOTZ, *EDITOR IN CHIEF, AD ASTRA*

When my son was six, he used to look longingly at the boxes of sugary cereals lining the supermarket shelves and inform me that they were part of a complete breakfast. As he's gotten older, I mostly tune out his advertising-inspired advice on how to have a better life. But the other day he came out with a new jingle: "The power of the Dali Lama compels you."

His singsong spoof of a line from a movie got me thinking about what compels us, what we find compelling and the difference between the two. This issue of *Ad Astra* is dominated by two projects that have compelled a man well known in the space community – Peter Diamandis, a Harvard-trained medical doctor who never got as far as starting a residency, much less a practice. Instead, Diamandis stayed true to his passion and embarked on what seemed at times a fool's quest to develop a private sector access to space.

This fall, two projects that Diamandis had been coaxing into existence for nearly a decade, blasted into public consciousness. First was Zero Gravity Corp., a Florida-based firm operating the country's only commercially available parabolic flight service. Freelance writer and author Frank Sietzen, who usually favors stories of space politics, lays out the details of the business and its unexpectedly successful debut. NSS member Loretta Hidalgo, now moonlighting as a flight attendant for Zero Gravity Corp., cuts to the chase in a first-person account of the weightless wonderland.

While Zero Gravity Corp. was giving armchair astronauts a simulated space experience, across the country a highly trained team of engineers and test pilots flew a private spaceship to sub-orbital altitude twice within a mind-boggling five-day period. That's nearly three times better than what Diamandis and his colleagues at the St. Louis-based X Prize Foundation had required the contenders in their \$10 million space race to do.

Many times, many people told Diamandis his plan to award a cash prize for a private spaceflight would never work. He would listen politely, then move on to more fertile fields. Always, as if by magic, someone would come through and save the day.

Contributing editor John Kross recaptures the magic of SpaceShipOne's journeys into black sky and the triumphant conclusion of the Ansari X Prize, which sprang, Athena-like, from Diamandis' consciousness while reading of Charles Lindbergh's flight across the Atlantic.

The X Prize flights left many speechless, but not NSS member Lonnie Schorer, who parlayed her happiness at seeing SpaceShipOne fly into an essay about the power of dreams.

While the X Prize has rekindled dreams for many aspiring astronauts, the prospect of remotely exploring alien worlds is rich enough fodder for others. Bill Ferrand, a researcher at the Space Science Institute in Boulder, Colo., shares his behind-the-scenes perspective on the engaging Mars rover missions as a member of the science team.

Our guest columnist, Randa Milliron, a newcomer to the pages of the *Ad Astra*, poses an interesting question relevant to the long-term goal of space settlement. While prevailing thought and national space policy currently is directed at eventual human settlement on Mars, Milliron outlines an attractive plan for a terraformed Venus. After the planet makeover, the best place to live may be in the clouds.

A bit closer to Earth, the NSS chapter in Mexico is drawing up plans for a simulated lunar habitation module, reports our projects' columnist Gail Leatherwood

And finally, as the year draws to a close, we offer some suggestions for holiday gifts for the space buffs in your life. May the trinkets and technology we hold in our hands always align with what is in our hearts. Happy holidays.



TERRAFORMING EARTH'S EVIL TWIN: THE FLOATING CITIES OF VENUS

By RANDA RELICH MILLIRON

TERRAFORMING ANOTHER PLANET — IS IT ETHICAL? IS IT even possible? Is it folly to consider? Or is it simply a practical exercise to facilitate human expansion throughout the solar system?

Living a complacent life on the home world, ignorant of the precarious nature of their existence, average Earthlings think that “space” is something “out there,” some nebulous concept that has no bearing on their lives. What they don’t realize is that we ARE in space. As the X-Files creator Chris Carter says, people are “but visitors on this rock; hurtling through space and time at 66,000 miles an hour, tethered to a burning sphere by an invisible force.”

If the sheer thrill of engaging in interplanetary exploration doesn’t motivate people to move beyond Earth’s bounds, perhaps planning for doomsday catastrophes such as asteroid collisions, magnetic shield disruption and rampant overpopulation could catalyze our species into preparing for off-world colonization. Thinking ahead about cloning a vacation home for humanity is not such a bad idea. Developing planetary evacuation and species survival scenarios is in fact a prudent activity. One proposed exit strategy is terraforming — the process of converting an entire planet into a nearly Earth-like, human-friendly environment.

Where would planet-tamers look to find possible surrogate Earths? To terraform the nearest destinations — the moon, Mars, or Venus — to suitably adapt one of these hostile spots would require centuries of work, so NOW is definitely the time to begin. Building a second home for humanity is simply good advance planning, but exactly how does one do it? The terraforming community is split in terms of approach. How does the transformation process work? What’s in the average terraformer’s toolkit? Engineering methods include using massive solar shades; removing or converting the existing atmosphere; and directly applying nanotechnology.

Which of these worlds would be the best choice to become an Earth-twin? Both the moon and Mars offer similar problems for future inhabitants: a need for shielding from radiation and the requirement to construct and heat an Earth-like atmosphere. There’s a reason why the moon and Mars don’t have much of an atmosphere anymore — because of their low gravity and escape velocity, they simply can’t hold one for long! It would be extremely foolish to start a process that would release soil/regolith-trapped oxygen and water — resources that could sustain a colony’s population — and allow the precious life-sustaining molecules to drift off into space, just like the ancient Martian atmosphere did. Many proponents of interplanetary exploration and settlement suggest that we leave both Mars and the moon untouched, pristine, and intact: replete with their treasures of captive oxygen and water, waiting for harvest by future settlers.

A far better choice, and the real candidate for terraforming, is our nearest planetary neighbor, luminous Venus. The thought of visiting Venus causes potential spacefarers to recoil in horror and ask, “Isn’t that the place with the poisonous atmosphere, crippling pressures, and temperatures of nearly 900 degrees Fahrenheit?” For good reason, Venus has even been referred to as “Earth’s evil twin.” But then, in terms of climate, Mars and the moon are no garden spots, either!

Shrouded in a thick mass of carbon dioxide/sulfuric acid cloud cover, Venus absorbs only about 20 percent of the sunlight directed at the planet, reflecting 80 percent back into space. But even that small amount of solar radiation helps to rev up the Venusian atmosphere into working like an overly efficient greenhouse, trapping the planet’s heat and causing the hellish temperatures and pressures to broil and crush the surface of what may have once been a wet world like Earth. Cooling and depressurizing Venus are the tasks at hand. Could terraforming ever be effective in performing these two pre-colonization requirements?

Venus’ seeming drawbacks can actually be used to the terraformer’s advantage. Rather than trying to build an atmosphere — as one would have to do on the moon or Mars — the habitat-sculptors of Venus would have a different problem to solve: what to do with an over-abundance of atmosphere, excessive heat and high pressure. The solution is simply to deconstruct the atmosphere, thereby cool the planet, and reduce the nearly 90 atmospheres of surface pressure to a more hospitable level.

Blasting off the Venusian atmosphere with a directed asteroid impact or with a thermonuclear device is a method that has its supporters, though detractors state that the planet’s escape velocity would prevent significant dispersal of the nagging cloud deck. Still, partial annihilation of the carbon dioxide/acid cloak would do much to relieve the dual plagues of super-heating and unendurable atmospheric pressure.

Others, Carl Sagan among them, have suggested that converting the atmosphere of Venus by precipitating out the carbon from the carbon dioxide gas through a biological method like using algae or bacteria to work as conversion agents, would be the correct path to follow. Opponents feel that algae would succumb to the torrid environment, or that the captured carbon would simply revert to a gaseous form as it descended toward the planet’s surface. Some feel that isolating the carbon would create another problem: the explosive potential of oxygen under pressure.

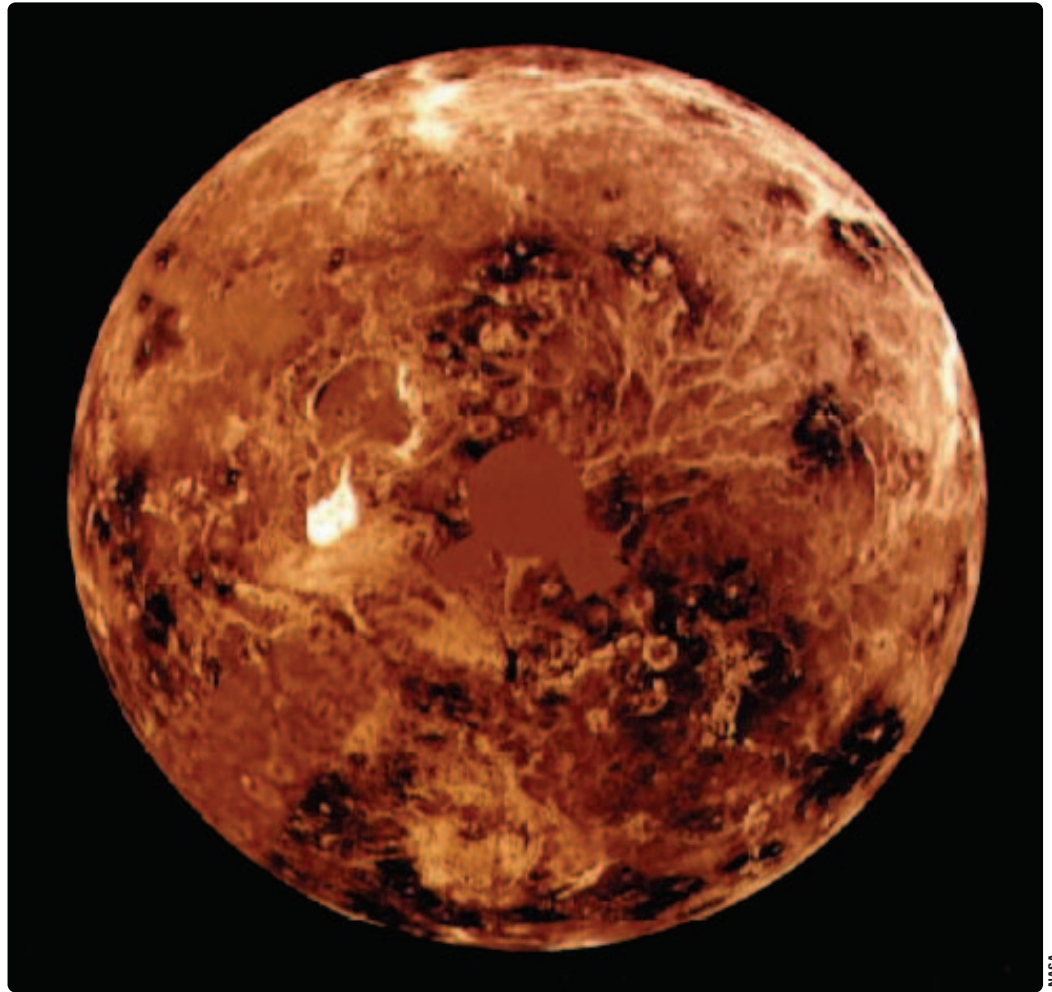
By far the most intriguing method in the terraformer’s arsenal is nanotechnology or the deployment of self-replicating machine systems to effect a chemical conversion of the atmosphere. This method could yield in a carbonate snow, or at least capture the

excessive carbon dioxide with continually replicating nanomachines arrayed as a planet-wide chemical factory.

In a scenario known as “paraterraforming,” practitioners of the art would create islands of encapsulated Earth-like environment. The Venusian real estate that cries out for this type of development is the “Cloud Zone.” In the roiling atmosphere 30 miles (50 kilometers) above the surface is the temperate zone, with weather in the 86 to 176 degree Fahrenheit (30-80 Celsius) range, and an Earth-like, one atmosphere of pressure. In this thin habitable band, settlers could construct floating cities that would ply our sister planet’s navigable atmosphere. This region, suitable in terms of atmospheric pressure, complete with harvestable hydrogen, carbon, nitrogen, sulfur, oxygen and water from the remnants of Venus’ ancient oceans, and offering a no-doubt dramatic view, could serve as a home-away-from-home, a foothold for humanity in the thick Venusian skies.

Planetary scientist Geoffrey Landis reveals a coincidental, yet remarkable fact: our human life-support gas systems of oxygen and nitrogen work as lifting gases in the denser carbon dioxide atmosphere of Venus. Therefore, the sky cities of Venus will float by virtue of the lifting power their own life support systems. Also, the atmosphere provides a benevolent shield from solar and cosmic radiation and the planet delivers 90 percent of Earth’s gravity. Additionally, Venus is only half the Martian travel time away from Earth. These factors put Venus very high on the short list of terraforming targets.

These floating cities, tropical oases in the clouds, could live up to the visions of humanity’s pre-Venera/Mariner probe imagination: when lush, prehistoric flowering jungles festooned the Venus of early science fiction. These suspended ports-of-call could serve as gateways for surface exploration during the ter-



A global of Venus from Magellan, Pioneer and Venera data.

NASA

raforming process. And perhaps most intriguing of all, as astrobiologists like David Grinspoon suggest, these same skies might already host vast armadas of Venusian lifeforms.

In the future, when “the big one” is on its way for imminent Earth impact, or when humans willingly get up and go to claim their destiny in the rest of the solar system, the floating cities of Venus will call to us as a safe haven for displaced or migrating humanity. They will be the ace up our collective sleeve, the temporary replacements for our old world, and the balconies from which we can watch our new world materialize below. 🏠

Randa Milliron is chief executive officer of Mojave, Calif.-based Interorbital Systems Corp., which is developing low-cost passenger space vehicles and systems.



Brian Binnie, a former Navy test pilot, was in the cockpit during SpaceShipOne's finale Oct. 4. He made his victory lap atop the spaceship wrapped in an American flag he had carried aboard.

Once upon a time, men with the “right stuff” traveled to the high desert of California and strapped on rocket planes to battle demons high above the Earth. Far above the arthritic Joshua trees and piping flocks, men with names like Kincheloe and Crossfield and Yeager lit the candle of needle-nosed rocket planes marked with an “X.”

Today, 45 years later, a newer generation armed with engineering smarts, visionary support, and the same burning desire have again blistered the sky above the fabled Mojave desert and pushed the envelop to beyond the boundary of space. And a rocket plane called SpaceShipOne (SS1) has joined the pantheon of the most righteous stuff.

On June 21, 2004, with test pilot Mike Melvill at the controls, SpaceShipOne rocketed to 328,491 feet (approximately 62 miles or 100 km), making Melvill the first civilian to fly a privately owned and operated vehicle into space. An hour before, SpaceShipOne had climbed to about 15,000 meters tucked under the belly of its carrier craft, White Knight.

After a stomach-churning release and short glide, Melvill ignited the N₂O-HTBP-hybrid rocket motor and reached Mach 3 in a vertical climb. During the pull-up and climb, he encountered G-forces three to four times stronger than the pull of gravity on Earth. From the ground, spectators, including NSS members, watched as SS1 serenely

Prize Ends in Desert Drama

BY JOHN KROSS

Jim Campbell, Aero-News Network



split the blue Mojave skies. But inside the cockpit, Melville needed a healthy dollop of the right stuff to wrestle control of his rolling ship. Along the way, he also heard a loud bang emanating from the craft's nozzle fairing.

Because of the unexpected roll and trim problems, SS1 barely passed the threshold of space, but once there, Melville celebrated by releasing a bag of M&Ms in the pressurized cockpit and savoring the view.

"The sky was jet black above," Melville told reporters after the flight. "Looking out that window, seeing the white clouds in the LA Basin, it looked like snow on the ground...The Earth is so beautiful...It was like nothing I've ever seen before.

You really do get the feeling that you've touched the face of God."

There was little time for sight-seeing though, as minutes later Melville flipped SS1's tail section into a high-drag configuration to slow the vehicle down as it nosed back toward Earth. However, the so-called "care-free" reentry wasn't so care-free after all, as the roar of a dozen hurricanes beat against the ship's hull. Once the hyper-speed had been scrubbed away, SpaceShipOne's tail flipped into glide mode and Melville made a perfect three-point landing on the same runway he had left 90 minutes earlier. "I was so glad to get it back down and make a decent landing that didn't break anything," Melville said. "I had to land with what I had."

As millions watched worldwide, the newly minted astronaut climbed out of SpaceShipOne's cockpit to be greeted by SS1 designer Burt Rutan, benefactor Paul G. Allen – the co-founder of Microsoft—and Apollo moonwalker, Buzz Aldrin. "Today's flight marks a critical turning point in the history of aerospace," Rutan said. "We have redefined space travel as we know it...Our success proves without question that manned space flight does not require mammoth government expenditures."

NEXT STOP: THE ANSARI X PRIZE

In the wake of SS1's ground-breaking success, Rutan and his team at Mojave-based Scaled Composites geared up to snag the \$10-million Ansari X Prize by flying to 100 kilometers twice within a two week span. With Melville again at the controls, SpaceShipOne coasted to 337,500 feet on Sept. 29th, successfully completing the first of two X Prize flights, but not before a hair-raising series of



Jim Campbell, Aero-News Network

White Knight and SpaceShipOne take off for the prize-winning flight.

Right: NSS Executive Director George Whitesides rubs shoulders with X Prize contender Brian Feeney, head of a Toronto-based team, who was at Mojave to witness the competition's win.



Jim Spellman

29 rolls that Melville, in true “right stuff” fashion, called “victory rolls.”

However, the unexpectedly wild ride of the laughing gas-fueled speedster was no laughing matter and Melville shut the motor down after 77 seconds when the altitude predictor exceeded the 100-kilometer mark. A press release posted on the Scaled Composites website claimed Melville was monitoring the apogee predictor during the initial rolls and was in the process of shutting down the motor when he heard the advisory call to terminate the burn. Because SS1 was exiting the atmosphere there was little aerodynamic damping, so Melville elected to wait until the boom-tail was feathered before using the reaction control thrusters to dampen the rolls.

Despite the unanticipated rolls, Rutan’s team refueled SpaceShipOne on Oct. 4, strapped in a new pilot, and rocketed into history to snatch the Ansari X Prize. In addition to taking home the \$10-million award, pilot Brian Binnie broke the 40-year old X-15 world altitude record by reaching 367,442 feet (69.6 miles) above the Earth’s surface.

“It’s very hard for me to express how proud I feel of Burt and his team, the pilot, the guys in mission control and the other people at Scaled who made this happen. It’s really an incredible feat of technology,” Allen said. “I’ve been involved with technology for a while, but this is really amazing . . . This is real first-class, top-line rocket science executed with an incredible degree of precision. This flight couldn’t have been any smoother.”

SPACESHIPONE... GOVERNMENT ZERO

“Burt Rutan, Paul Allen and the rest of the SpaceShipOne team are to be congratulated for this important achievement. They successfully demonstrated a new human spacecraft, a new propulsion system and a new high-altitude airborne launch platform,” NASA Administrator Sean O’Keefe said in a statement. “The spirit of determination and innovation demonstrated today show that America is excited about a new century of exploration and discovery.”

Rutan, who said he had had no contact with NASA until shortly before SpaceShipOne’s debut spaceflight in June, took advantage of the media swarm to poke a little fun at what he calls “that other space agency.”

“Quite frankly, I think the big guys, the Boeings, the Lockheeds, the nay-say people at Houston, they probably . . . think we’re a bunch of home-builders who put a rocket in a Long Easy,” Rutan said, referring a recreational aircraft he designed. “But if they . . . got a look at how this flight was run and how we developed the capabilities of this ship and showed its safety, I think they’re looking at each other now and saying, ‘We’re screwed.’ “

Eyeing public enthusiasm to the X Prize, NASA plans to pump up its cash incentives for the Centennial Challenge program and drive explorers and inventors to the edge of space and beyond. NASA reportedly is toying with the idea of cash prizes to land a craft on the moon or retrieve a piece of an asteroid.


Meanwhile, entrepreneur and aspiring space guru Robert Bigelow, broke his silence about development work at his heavily guarded Las Vegas base to announce a \$50 million prize for the first privately developed passenger carrying orbital spaceflight. And the X Prize Foundation hopes to keep the creative sparks burning with an annual exhibition and space race called the X Prize Cup.

"It's not enough to be flying once a week or even once a day," said X Prize Foundation head Peter Diamandis "We need ships flying every hour, dozens of times a day ... We need to have a competitive market. We need to have not only the Apple, but the Dell and Gateway and HP of space."

The X Prize Cup, to be held in New Mexico, is modeled after several annual exhibitions including the Experimental Aircraft Association's highly successful airshow in Oshkosh, Wisc., the National Championship Air Races & Air Show in Reno, Nev., the National Association for Stock Car Auto Racing's Formula One competition and the America's Cup.

Cash prizes will be awarded in several areas, including the most number of flights within a two-week period, the highest altitude, the fastest climb to space, the maximum number of people flown during a single flight as well as the maximum number of people flown throughout the two-week venue. Contenders will be scored and prizes awarded in each category. The team with the highest number of points overall will win the X Prize Cup.

As for SpaceShipOne, Rutan plans to use the vehicle as a test platform for his next creation: a fleet of five-passenger suborbital spaceships for what is expected to be the world's first commercial spaceliner, Virgin Galactic. Rutan pledged that SpaceShipTwo will be "at least 100 times safer than anything that's ever flown man to space."

Rutan said he and Virgin Group chairman Richard Branson will be aboard the debut flight of SpaceShipTwo, scheduled for 2007. Ticket prices are expected to be about \$200,000 for the early flights. 

John Kross is a contributing editor to *Ad Astra*.

FLIGHT REFUELS SPACE DREAMS

Why do we climb the steepest mountains, seek to explore the remote unknown, and long to leave the earth behind in order to see it from the limitless reaches of space? Why would one fly across the country, drive to the Mojave Desert in the dark chill before dawn and stand to turn eyes heavenward with childlike excitement? For the belief in dreams.

Dreams free our minds and lift our personal hopes and current realities beyond what we have experienced and known. Those who have the courage to believe in dreams and have the vision, will and courage to risk bringing them to reality, stand apart. It takes only a few steadfast committed believers to achieve a dream and accelerate a change. On Oct. 4, visionaries working to build a privately funded three-person spacecraft, to send a man (plus the weight equivalent of two others) to suborbital space and bring him safely back home, made their second spaceflight in less than a week. The flight would determine whether they would achieve a milestone in the history of mankind and also win the coveted \$10-million Ansari X Prize.

Arriving as strangers from homes throughout the world, those of us who believed in the dream gathered by the desert runway, shivering with anticipation and predawn cold. As mountaintops on the horizon rimmed with dawn, the atmosphere became charged with excitement. Binoculars emerged, cameras were loaded and strangers began to speak as friends.

The pilots' families, clustered together holding an American flag, watched with us as at 6:53 a.m. the futuristic White Knight took off clutching the whimsical SpaceShipOne protectively to its belly. With eyes strained upward for an hour, watching as White Knight circled upward to an altitude of 47,000 feet, we anxiously awaited the moment when the mother ship would release its load and SpaceShipOne would fire its experimental rubber and laughing gas-fueled rocket motor. Suddenly a contrail appeared, arcing to the north, and a second contrail appeared, shooting in straight-line precision upward, accelerating like a speeding bullet. The silence was broken with cheers of awed amazement as radio contact indicated SpaceShipOne had exceeded the required 62 mile altitude by more than seven miles!

Shielding our eyes from the golden glare of the sun, we tried to catch sight of the plucky little ship, descending to Earth with hinged wings folded upward to create drag. As the star and polka-dot spangled spaceship glided down to a perfect landing on the runway, Rutan's Scaled Composites team achieved our dream of becoming space travelers—and we all felt like winners. We had witnessed a breakthrough in the history of aviation and mankind. Emerging from SpaceShipOne, pilot Brian Bennie said, "I thank God that I live in a country where this is possible."

LONNIE SCHORER, BURKE, VA.
NSS MEMBER



An Affordable Trip to Weightless Space

BY FRANK SIETZEN, JR.

Burt Rutan, center, designer of the world's first private spaceship, X Prize Foundation director Gregg Maryniak, left, board member David Treinis, behind Rutan, and Angel Panlasigui, with Zero Gravity Corp., test their space legs.

Have you ever had the burning desire to experience spaceflight for yourself, up close and personal?

Have you ever dreamed of floating free of Earth's gravity like hundreds of astronauts and cosmonauts have since the dawn of the Space Age?

Have you yearned to see the Earth from high above, while cavorting and cartwheeling in the ultimate freedom?

Have you ever kind of liked that butterflies-in-your-stomach feeling?

Well then, prepare yourself for blastoff, for your chance at something akin to a mini-space flight is about to float within your reach—and you won't need to be a multimillionaire like Dennis Tito to pay for the ticket.

Florida-based Zero Gravity Corp. is offering a taste of spaceflight for less than \$3,000—about the cost for an Earth-bound visit to a large city for just a few days.

The space “experience” isn't in space, though. It's aboard a jet-powered Boeing 727-200 airplane

high above Florida. For your money, the “Zero-G Experience” sends you soaring through about 15 pull-ups and dives through the atmosphere that trigger bouts of weightlessness. The experience is similar to how astronauts train for spaceflight and what movie actor Tom Hanks and crew experienced a decade ago when they filmed the highly successful movie *Apollo 13*.

The project, which marks the first time weightless flights have been made available to commercial customers in the United States, is the brainchild of Peter Diamandis, widely known as the powerhouse behind the successful Ansari X Prize competition.

With the establishment of the Zero Gravity Corp., Diamandis has assembled a crack team of former astronauts, experienced ex-NASA staffers and marketing gurus who are all part and parcel Diamandis' prime passion: opening up space and space-like experiences to the average person. The X Prize and follow-on X Prize Cup exhibition is one



Jim Campbell, Aero-News Network



step in that direction. The Zero-G experience is another.

The company was first established in the mid-1990s. Diamandis and former astronaut Byron Lichtenberg worked to modify the Boeing jet for commercial microgravity missions. The plane required an overhaul and drew careful scrutiny by Federal Aviation Administration officials who were confronted by an entirely new commercial aviation enterprise. A different type of plane, the KC-135

jet, had been NASA's training tool for Apollo and shuttle astronauts. But ironically it wasn't the use of a jet in preparing space travelers that galvanized Diamandis' and Lichtenberg's interest in forging a commercial project. It was the filming of the movie *Apollo 13*.

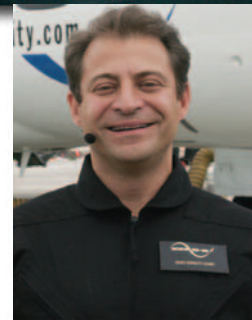
Engineers poured over the jet, and their resulting success received a first-ever FAA Supplemental Type Certificate as well as a U.S. patent for its new role. Testing the craft, Diamandis' company flew its first parabolic flights in 2000, helping with filming of "The Matrix" motion picture series.

Two years later, according to Diamandis, the FAA provided help in developing the plane for commercial flights of private individuals. In 2003, Zero-G signed a deal with AmeriJet International as its operating partner in providing flights aboard the plane.

The plane is maintained out of the Fort Lauderdale-Hollywood International Airport, although flights can be chartered and staged at other locations in the United States for those with pockets deep enough to pay for an entire, full flight. A full planeload of weightless candidates numbers 27.

For everyone else, the \$2,950 upper atmospheric space adventure is a daylong affair that begins with stories by former astronauts, such as Lichtenberg, who flew two missions aboard the space shuttles, Columbia and Atlantis. The Zero-G clients then receive training for his or her upcoming flight, including tips on how to get the most out of the brief weightless experience. Each parabola the airplane flies gives passengers about 30 seconds of weightlessness. Fliers also are briefed on the 727-200 cargo plane. After a light lunch, the mid-air adventure begins.

Following takeoff, the pilots maneuver the jet to an altitude between 24,000 and 32,000 feet above Florida, flying through a corridor about 100 miles long. The maneuvers for the zero-gravity experience start with a roller coaster-like effect as the plane first pulls up to about 45 degrees, then dives toward the ground below. The result is about 25 to 30 seconds of weightlessness, much like what sky divers experience. Only Zero-G fliers and everything aboard their plane are temporarily free of weight. Then pilots slowly flatten out the descent to about 30 degrees, which gently allows occupants to settle down onto the aircraft's floor. Maximum force experienced during the parabolas is about 1.8 times the pull of gravity on Earth. Commercial flights for paying customers began in September.



Top: A Boeing 727-200 jet, leased from AmeriJet International, debuts as the new G-Force-One.

Above: Peter Diamandis and colleagues worked for eight years to set up a commercial parabolic flight service in the United States. Zero Gravity Corp., flies out of Fort Lauderdale-Hollywood International Airport.

"We anticipated that we would fly between 100 and 400 commercial flights per year," Diamandis told *Ad Astra*.

But demand has been brisk. Before Zero-G flights even started, 20 planeloads were booked. Originally, the company planned just two or three flights monthly.

Corporate clients changed Zero-G's business plans. Diet Rite Soda signed up as a major sponsor, using its zero-calorie, zero-caf-feine promotion as a tie-in with the zero-gravity experience.

In early September, with the Zero-G plane repainted in Diet Rite's colors, promotional flights carrying company representatives and others started flying from Newark's Liberty International Airport. The plane hopscotched the country, offering gravity-free experiences in Los Angeles, Dallas and other stops before returning to its Fort Lauderdale home base.

The youngest fliers can be 15 years old, but in the future Diamandis said the age limit might be dropped to 12 if the child flies with a parent.

A typical flight consists of 15 to 20 30-second parabolas aboard the plane. Fliers can experience parabolas that simulate the gravity of Mars, which is one-third Earth gravity, or of the moon, which is one-sixth Earth weight. They also can experience the full weightless effect as well. While no one can guarantee that fliers won't get motion sick during their flights, the weightless sessions start with the less-intrusive Martian gravity

experiences, then gradually ease into the greater degrees of weightlessness.

"We've chosen 20 (parabolas) because that seems to be the average that people can experience before an onset of motion sickness," said Diamandis.

While space tourists like Dennis Tito spent a year in training and underwent extensive medical testing, the zero-gravity fliers simply have to sign a medical form and answer a series of questions about the state of their health. If the candidate flier answers no to the questions, it's blastoff time. If, however, a potential passenger has some of the listed concerns or conditions, then a consultation with a doctor is needed.

During the flights, there is a fully dedicated flight attendant on board to monitor if anyone does get a bout of motion sickness. An experienced former astronaut also is onboard each time. The whole training session fits into the flight day.

Diamandis and company officials believe there are enough arm-chair astronauts ready to sample weightlessness to sustain Zero-G and turn a profit. If successful, it will be another small step for commercial space and a bridge to even higher-flying ventures. 🚀

Frank Sietzen is a Washington, D.C.-based freelance writer and co-author of *New Moon Rising*, an inside story of the making of the Bush administration's space policy.

Freedom From Gravity

BY LORETTA Y. HIDALGO

Aug. 8, 2004. I got my first taste of freedom. I sat on the padded floor of the 727, as the mission director called out, "Zero-1, Zero-1" our internal signal that we were about to enter our first zero-g parabola. As the plane throttled back I slowly started to feel lighter, and soon my feet were no longer touching the floor! At first I felt like a puppy on ice, unsure what to do next. Then all my playground instincts came flooding back. I started to jump and fly and flip around in mid-air like a gold medal gymnast.

It's an amazingly comfortable experience to be weightless, almost womb-like. I guess that is why it feels like you are coming home. It's a feeling that you miss. I suppose that also is why you feel so euphoric. It also helps that all your flight mates and the ZERO-G team around you also are having a ton of fun. There is a buzz in the air from the first moment everyone walks in the training room and starts talking about the magic of space.

I also love how active my brain gets trying to figure out what is happening. It is so far beyond our daily experience! It is not normal to float past someone, or to hang upside down next to someone. Your brain often doesn't quite know how to process everything.

My favorite moment of the flight was when I closed my eyes for a few seconds and just relaxed. I opened my eyes again and was perplexed to find the wall of the aircraft flat. Confused, I looked over to everyone else only to realize with a jolt that what I had been so

sure was a wall was actually a floor. In that moment I was transported to the magical place in human experience where the physical world is just NOT acting in accordance with your accumulated years of experience with it. It is magical because it takes you out of the ordinary and reminds you that you are not too old to be surprised, that there are wonderful dimensions of the universe still secret for us, and that at any age we really are playful beings.

The last time I had that sort of a visceral encounter with the universe was at the total eclipse of the sun in Zambia 2001 as part of the Cosmos Education team. Somehow being totally within the realm of knowable science and yet completely BEYOND the realm of everyday experience is disorienting, awe-inspiring and totally sublime. If you have ever seen all the shadows curve up into long sickles across a field and the sunlight get dim in the middle of a cloudless day, then you know what I mean.

So go and experience one of the aspects of space that make space travel so sublime. It is worth every penny to get to fly like Superman, flip like Mary Lou Retton and fish M&Ms out of the air like an astronaut. It also is great training for those of us who are also planning to add in the 100-kilometer view as well.

You can find out more about parabolic flight in the United States on the Internet at www.nogravity.com.

Loretta Hidalgo is a member of NSS who also is a FAA-certified Flight Attendant for ZERO-G. This account is from her crew's first training flight in Fort Lauderdale, Fla.



INSIDE THE MARS ROVER MISSIONS

Composite Photos: NASA

By BILL FARRAND
PHOTOS: NASA/SSI

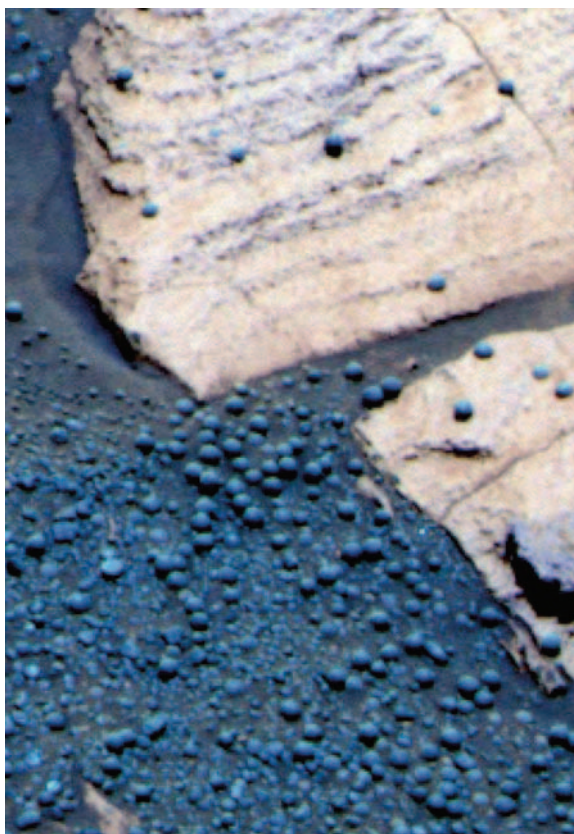
I think the longest 11 minutes I ever experienced in my life were those 11 minutes on the evening of Jan. 3, 2004. I, along with other members of the Mars Exploration Rover science team, were assembled in our science operations working group meeting room at the Jet Propulsion Lab in Pasadena, Calif., awaiting the landing of the rover Spirit in Gusev Crater. We had been listening with anticipation as the mission engineers reported on Spirit's progress in its passage through the Martian atmosphere.

Described to the press as "six minutes of terror," Spirit apparently had survived that perilous journey with flying colors. In fact, the rover had

just sent back a signal saying that its airbag landing system had deployed and that it was bouncing, but then... silence.

Heavy on all our minds were the recent failure of the Beagle 2 lander and the twin failures in 1999 of the Mars Polar Lander and the Mars Climate Orbiter. We had all invested so much time and energy in these two rovers that to lose them was unthinkable. So we waited, and waited, and then... Success! A signal was received that Spirit had rolled to a stop and was safe. An adventure that science principal investigator Steve Squyres of Cornell University in New York has called "the first great

Opportunity's Pancam of the small, round pellets, nicknamed "blueberries," scattered on the ground near the Shoemaker's Patio rock outcrop in Eagle Crater.



mission of exploration of the 21st Century" was ready to begin.

And what an adventure it has been for those of us who have been working with the rovers on a daily basis. While living and working on Earth, we were working and sleeping on the same time scale that the rovers followed. This meant extending our days by 39.24 minutes to match the length of the Martian day. So we would sometimes sleep during the sunlight hours on Earth, come into JPL and greet our co-workers with a chipper "good morning" at 9 p.m. Pacific time.

Checkout of Spirit's systems proceeded apace and we were delighted with the images of the interior plains of Gusev Crater that were spread out around Spirit and its landing platform. Much to our surprise and delight, visible on the horizon were the hills that we would come to call the Columbia Hills in honor of the Columbia space shuttle astronauts. The hills seemed tantalizingly close and yet frustratingly far away. The mission success goal for the rovers was for each of them to drive 600 meters, or 1,968 feet, and the hills were over two kilometers, or 1.24 miles away. Little did we know at the start of the mission how sturdy Spirit would prove to be.

For a heart-stopping series of days, though, we feared that Spirit's mission might end before it really began. Just as Spirit was poised to make its first

in situ measurements on the pyramidal rock "Adirondack," it suffered a serious "anomaly"—"anomaly" being engineer-speak for an "oh no!" problem—which proved to be caused by Spirit "over-feeding" on data and loading its flash memory past capacity. The engineers worked through the problem, but as they struggled with Spirit's glitch another small issue had to be dealt with—the landing of Spirit's twin rover, Opportunity.

LUCKY LANDING

On Jan. 24, Spirit's picture-perfect landing was mirrored by the equally successful landing of its sister on the flat plains of Meridani Planum, located on the other side of the planet. While the first images we had received from Spirit had made us happy, those we received from Opportunity made geologists such as myself ecstatic because in an extraordinary "hole in one," Opportunity's airbag bounce and roll had deposited it in a small 22-meter (72-foot) diameter crater. Even better, there in front of the rover was in-place bedrock. All previous Mars landers had seen plenty of rocks to be sure, but they had all been out-of-place rocks transported from their source regions by impacts or floods. As we studied the images of the "Opportunity Ledge" outcrop that came in from the rover's color Panoramic Camera, or Pancam, and initial thermal infrared measurements of it by its "mini-TES" thermal emission spectrometer, we began to realize that there before Opportunity was what we had come to Mars to find: rocks that by all initial indications were sedimentary in nature.

Sedimentary rocks on Earth come in a variety of forms and textures and often volcanic ash beds can mimic many of the textures and bedding patterns of water-lain sedimentary rocks. We had a good deal of discussion about whether the rocks in the Opportunity Ledge outcrop were in fact produced by the action of water or were volcanic ash beds. The only way to find out for sure was to go up to them and have a close-up look just as any Earth-bound geologist would do with any mysterious rocks he might find in the field. Before reaching the outcrop, Meridani Planum had another surprise in store for us. After rolling off its landing platform and taking a closer look at the floor of the crater with the Pancam, we found that the crater floor (and later we would find the surrounding plains as well) was blanketed with small (on average five millimeters in diameter) spherules. In the color Pancam images they appeared blue and were promptly dubbed as "blueberries."

The mystery of the blueberries took a back seat to the allure of the Opportunity Ledge outcrop. A field geologist will scratch or break a rock to obtain a fresh surface and take a close-up look at the rock texture with a magnifying lens. Opportunity and Spirit were equipped to do much the same thing. Hence when Opportunity made its first measurements of the mysterious light-toned rocks exposed in the inner walls of Eagle Crater, it took a close-up look with the rover's Microscopic Imager, obtained a fresh surface by grinding into the rock with the Rock Abrasion Tool (RAT), and "sniffing" the rock—examining its chemical and iron-bearing mineral composition—with its Alpha Particle X-Ray Spectrometer (APXS) and Mössbauer spectrometer.

The first up-close views of the outcrop indicated that the blueberries were, in fact, weathering out of the outcrop. Moreover, that rock provided yet another set of surprises. First, chemical analysis of the outcrop by the APXS indicated that it was richer in sulfur—up to 40 percent sulfate minerals—than any rock or soil yet analyzed on Mars. The first measurements by the Mössbauer spectrometer provided perhaps an even bigger surprise since they indicated that the outcrop was filled with the mineral jarosite, a hydrated iron sulfate mineral that, on Earth, always forms in the presence of water. So, to use mixed sports metaphors, Opportunity's "hole in one" at Eagle Crater led to a "home run" with its discovery of rocks formed in water.

SEASONED TRAVELER

While Opportunity was busy analyzing the rocks of the Opportunity Ledge outcrop, Spirit, after having been cured of its case of "over eating" on data, was proving to be the long distance voyager of the twin rovers. It rolled across the plains of Gusev Crater to the nearly 200-meter (656-foot) diameter Bonneville Crater, stopping along the way to do its own analysis of rocks and soils. What Spirit found were dark rocks with the composition of basalt—no big surprise there since the presence of basalt on the surface of Mars had been indicated by telescopic observations and measurements by the orbiting Thermal Emission Spectrometer (TES) on-board the Mars Global Surveyor spacecraft. The soil also had an overall basaltic composition, but the Mössbauer spectrometer indicated that it had abundant olivine, a mineral that rapidly breaks down in the presence of water.

So while Opportunity had found evidence of a possible past sea, Spirit had found a disappointing-



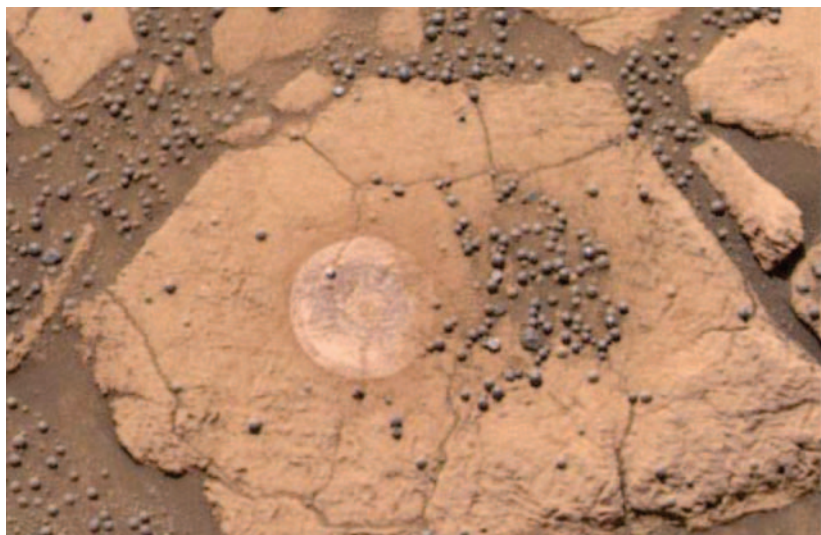
Microscopic Imager view of "blueberries" weathering out from the outcrop rock found at Eagle and Endurance. The blueberries are, on average, about 5 millimeters in diameter.

ly dry desert. While we had hoped that Bonneville Crater might have outcrops of bedrock, but upon reaching it, imaging by the rover's Pancam and remote spectroscopic measurements by its mini-TES indicated that it appeared to be a crater in a big rubble pile with no in-place rock outcrop. While they seemed frustratingly far away, hope for finding evidence of a past lake in Gusev Crater now seemed to rest entirely on Spirit reaching the Columbia Hills. More than one of my colleagues would say, "We've got to get to those hills!"

SCIENTIFIC PAYDIRT

While Opportunity's examination of the rocks outcropping in Eagle Crater had confirmed the presence of jarosite, the multispectral Pancam imagery also indicated the presence of red hematite, the finer grained cousin of the coarse grained gray hematite that had been the reason that Meridiani

A look inside "the Berry Bowl," where the Mars team did a detailed in-situ examination of the odd formations.



COME FLOAT WITH NS

Weightlessness. It's the essence of space travel. Escaping the tyranny of gravity—experiencing a freedom unlike any other. Since the dawn of the space age, there have been only two ways to experience it: in orbit, or onboard a 'parabolic' zero-gravity flight. Parabolic flight is the way that NASA has trained its astronauts for space for decades. It uses modern jets to simulate the weightlessness of space for roughly 30 seconds at a time—and it is a feeling unlike anything else. For decades, such parabolic flight has only been available to astronauts, a few lucky scientists, and those with the time to travel to Russia. Now, for the first time, weightless parabolic flight will be available in the US to the public, via Zero Gravity Corporation.

The National Space Society is proud to offer its members a 5% discount—over \$175—on parabolic flight tickets from ZERO G Corp. It is truly the dawn of the commercial space tourism age, and you can be there!

For more information and reservations, email: members@nss.org, or call (202) 429-1600 and ask for the membership department.

Picture this: You are on an airplane cutting through clouds at over 500 mph. Smoothly, the plane noses over into a steep descent, as if it were a dolphin swimming in the blue sea. Soon you are floating in air and for the next 25 seconds, you are weightless. It's a feeling of true freedom, a place where the impossible becomes real. It's the stuff dreams are made of? it's ZERO-G!

HOW DOES PARABOLIC FLIGHT WORK?

Specially-trained pilots fly the parabolic flight maneuvers between approximately 24,000 and 32,000 feet altitude. The maneuver is somewhat like a roller coaster in that the plane is initially pulled up to approximately 45 degrees 'nose high.' Next the plane is 'pushed over' to begin the zero-gravity segment of the parabolas. For the next 25-30 seconds everything in the plane

is weightless. At approximately 30 degrees 'nose low' a gentle pull-out is started which allows the participants to stabilize on the aircraft floor. Finally, the g-force is increased smoothly to about 1.8 g's until the aircraft reaches a flight altitude of 24,000 feet. The maneuver is then repeated.



NSS!

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NSS Members Charter First Zero Gravity flight

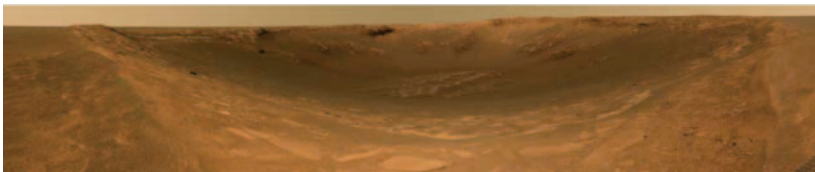
On Friday, Sept. 17, the National Space Society chartered one of the first ever private parabolic flights in the United States. The pioneering NSS members who bought their tickets were, as far as we know, the first private individuals to buy a trip to weightlessness inside the U.S. To them, congratulations! To the rest of us, you're going to love it! (Stay tuned for info on the first ever NSS Zero Gravity sweepstakes, coming soon to a mailbox near you.)

The flight took off from Los Angeles' Burbank airport, with a flight plan that took the plane out over the Pacific Ocean. NSS members from throughout the U.S. and the world flew in for the trip. The Houston chapter sent a large delegation, with Doug and Kim Hall, Murray Clark, Robbie Gaines, and local schoolteacher Jason Hillman. Noted author and actress Vanna Bonta was joined by her space engineer husband Allen Newcomb. Josh Franta vectored in from Chicago, while Bill Bloomfield II came onboard with his son, William Bloomfield III. Bill Boland, current executive director of the Space Frontier Foundation, signed up early. Entrepreneurs Grant Anderson Adam London and Erich Fischer joined in just in time. And winning the distance award was Maria Thome, chapter president flying in all the way from Brazil!

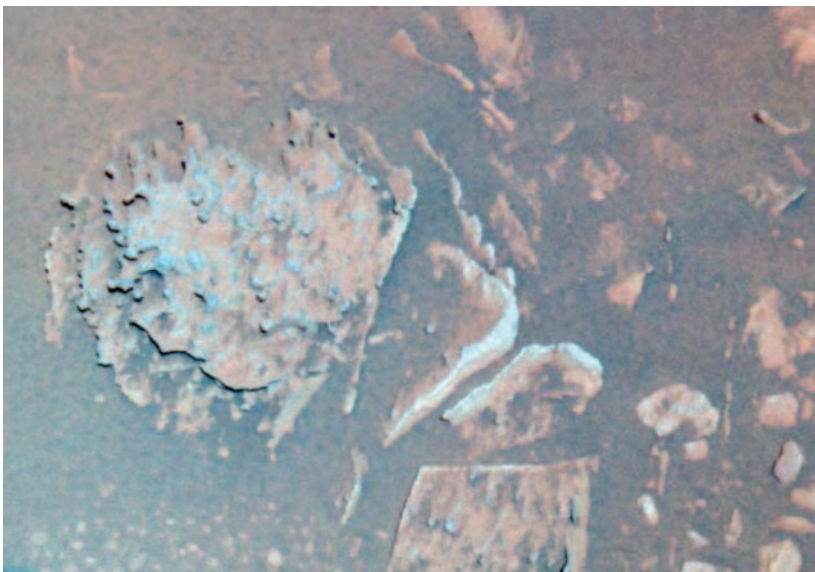
This core team of NSS 'flyers' (the term for passengers onboard a Zero-G flight) was joined by a diverse group of space and entertainment celebs. Brian Binnie, the SpaceShipOne pilot who flew the winning X PRIZE flight, found himself floating with Peter Diamandis, chairman of the X PRIZE and founder of Zero Gravity Corp., who was onboard as a coach. Eugene Roddenberry, director of Trek Nation and the next generation of the Roddenberry family, came onboard to film his experiences. Correspondents for the Ellen Degeneres show, the Jimmy Kimmel show, and the Dennis Miller show were all floating onboard.

Over the course of the flight, approximately two hours long, this team completed 16 parabolas, divided between a mix of Martian, lunar, and zero gravity. It was a blast! The Houston team videotaped zero gravity tricks to show school kids back at home. Pilot Binnie got a last chance to practice for the weightlessness he'd experience just weeks later 60 miles over the Earth's surface. And at the end of the flight, M&Ms were deployed into weightless flight for retrieval without hands.

NSS sincerely thanks this initial group of member-explorers for taking the leap and being the first, and looks forward to more NSS space experiences soon. Come join the fun!



A composite view of Endurance Crater taken by cameras on Opportunity.



Above: Spirit's Pancam images "Pot of Gold," a rock found at the base of the Columbia Hills that displays a distinctive weathering pattern. Scientists believe it is the product of aqueous alteration processes.

Planum was chosen as a rover landing site. The host of the gray hematite, detected from orbit by the TES instrument, remained a mystery until Opportunity was able to take a close-up look at a concentration of "blueberries" in a feature named, appropriately enough, "the Berry Bowl." Measurements by the spectrometers onboard Opportunity indicated that the berries were composed largely of gray hematite. This seemed to indi-



Spirit looks at two holes it carved into the rock "Clovis," located on the west spur of the Columbia Hills. The rock exposed in the Columbia Hills is lighter in tone and is softer than that which was examined out on the plains of Gusev Crater.

cate that they were actually "iron concretions,"—nodules formed by the secondary circulation of fluids within sedimentary rock outcrops. While such concretions are not necessarily rare on Earth, they are not found in the abundance that is apparent on the plains of Meridiani Planum.

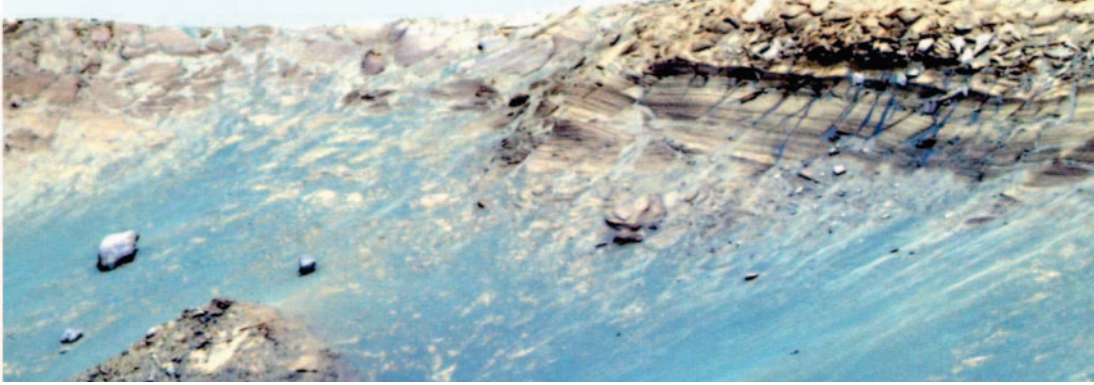
Initial examination of the Opportunity Ledge outcrop in color and high-resolution stereo imagery had revealed distinct layering. It took closer examination, and a search for the best examples, to confirm that in addition to minerals formed in water (which quite plausibly could have formed by the circulation of ground waters), the layers in these rocks formed distinct cross beds in places. Cross bedding is a form of sedimentary structure produced by the movement of sediments by water or winds. The cross beds observed in the Opportunity Ledge outcrop had structures deemed distinctive of movement by water—confirming to many of my colleagues that these rocks had formed in a long-gone standing body of water and were, in fact, evaporates. Evaporates are rocks formed by the evaporation of ancient lakes or seas and the resulting concentration of salts and related minerals into sediments and consequently, rocks.

In essence, Opportunity had succeeded in its mission—finding evidence of the sustained action of water at the surface of Mars. Thus, potentially, finding evidence of an environment where life would have had the ingredients, and the time, to come into being and, for a time, prosper.

While the explorations of Opportunity of Eagle Crater had been fruitful, other parts of the Meridiani plains beckoned. Thus after 56 Martian days, or sols, exploring Eagle Crater, Opportunity emerged from the crater, started across the plains to the larger (150 meter in diameter) Endurance Crater which lay 800 meters to the east of Opportunity's landing site.

After 39 sols of roving across the exceedingly flat plains of Meridiani Planum, with several significant science stops along the way, the rover reached the western rim of Endurance Crater (informally named in recognition of Antarctic explorer Ernest Shackleton's ship) and was rewarded with a spectacular vista. While Opportunity had spent nearly 56 sols examining only about a meter's thickness of outcrop, the walls of Endurance crater had more than 10 meters of outcrop.

Opportunity's exploration of Endurance began with a partial circumnavigation of the outer rim of the crater, with two stops for panoramic imaging of the crater interior. At the same time, engineers



Opportunity looks at the Burns Cliff portion of the walls of Endurance crater. The image is a Pancam composite. Note: All the Pancam images use colors that are close to what the human eye sees, with the exception that the red band is centered at a slightly longer wavelength than what we see. Contrast in the images has been stretched to accentuate their colors. Some images are false color to accentuate details.

were performing computer simulations and physical trials with a test bed rover to see if Opportunity could safely descend into the crater (and later drive out) and begin to sample those outcrop layers directly. Eventually, the decision was reached, and a location found, that was deemed safe for the rover to drive in and its sampling of the layering in Endurance began.

A NEW WORLD

Meanwhile, on the other side of the planet, Spirit's long traverse across the plains of Gusev Crater had been successful. Along the way, Spirit had found tantalizing hints of the action of water: rocks with fractures and veins potentially affected by water, rounded pebbles armoring dunes, layered coatings on basaltic rocks. However, no "smoking gun" to compare with the cross-bedded, sulfate-rich rocks found by Opportunity had yet been found by Spirit. Each rock examined by Spirit was found to be variations on a theme of basalt. However, all that was to change when Spirit finally reached the Columbia Hills. Upon reaching the base of the hills, Spirit found a unique set of rocks with an odd "inside out" form of weathering (*Fig. 5*). Analysis of these rocks revealed that it had a generally basaltic composition, but that it also had a mineral common at Meridiani Planum- hematite. These rocks with unique names such as "Pot of Gold" and "Breadbox" have been deemed as very likely being altered by the action of water.

Spirit's journey had been long and hard and while the "promised land" of the Columbia Hills was at hand, Martian winter was approaching and with that change of season, the effects of shorter days and lower sun angles led to the solar powered rover's power situation getting worse and worse. Adding to the difficulties, Spirit's drive had exceeded its tested "warranty" and its right front wheel showed symptoms of overuse. Recent drives have been done backward, using five of the rover's six wheels in order to preserve what is considered a limited number of rotations before the wheel becomes locked in place.

The fact that Spirit has reached the Columbia Hills is actually fortuitous for the energy situation since, by driving up onto north facing slopes of the

hills, Spirit is placed in a more favorable angle for solar charging given Spirit's location in the southern hemisphere. With the improved energy situation Spirit is poised to continue its exploration of the Columbia Hills. That exploration continues to be interesting because as of Sol 190 of the mission, Spirit had finally matched its twin rover by finally finding bedrock! While the exact nature of that bedrock still is in doubt, it is clearly not the same type of dark basalt found out on the plains. The material is softer and lighter in color than the volcanic rocks littering the plains. Further examination of the rocks making up the Columbia Hills should provide more information on the history of water in Gusev Crater.

While Spirit had found nothing but dark rocks until reaching the Columbia Hills, the only in-place rocks found by Opportunity have been variations on a theme of the light-toned rocks first seen in Eagle Crater. However, in situ examination of the layers making up the walls of Endurance Crater have provided important chemical details that should eventually provide a better picture of the history of water at Meridiani Planum. Opportunity has now left Endurance Crater to continue its exploration of the Meridiani plains.

Spirit and Opportunity have far surpassed the expectations that any of us had before they landed nearly one year ago. They have transformed our view of Mars from single views from isolated locations to real, changing landscapes filled with a surprising variety of rocks, soils and skies sometimes peppered with clouds. They have also given us evidence that Mars was once a much different place with salty, probably acidic, seas. Whether life ever formed in those waters is a question that will have to be resolved by future missions, but the Mars Exploration Rovers have given us the spirit to proceed. Now we must seize the opportunity and continue the exploration of our fascinating neighbor in the solar system. 📌

National Space Society member Bill Farrand is a research scientist with the Space Science Institute in Boulder, Colo., and a member of the Mars Exploration Rover science team. Check out Bill's web log on the Mars rover missions at http://gemelli.colorado.edu/~farrand/MER_log.html

FOR THE ARMCHAIR ASTRONAUT

The 2004 Ad Astra

BY TRAVIS K. KIRCHER

It's the holiday season once again, a time when rocketeers, armchair astronomers and space enthusiasts begin to wonder if Grandma's eggnog could be used as a liquid rocket propellant. If Rudolph's very shiny nose is really a genetic mutation caused by a radioactive nickel-iron meteorite that crashed nearby. If a dreidel spinning in zero-gravity ever would stop.

If your friends or family members tend to think of ties as tethers, you may have a bit of a challenge on your hands as you contemplate what to get the space buffs in your life. We're here to help. The editorial staff of *Ad Astra* has scoured the country looking for the perfect gifts that would make any space cadet light up his boosters and head for the nearest shopping mall. Here are our recommendations:

SCOPING OUT 'SCOPES

No gift excites an astronomer more than a shiny new telescope, and this year, there are plenty of scopes on the market that are high on accuracy while still being easy on your pocketbook.

For those just starting out, California-based Celestron offers the Explorascope – a portable 80mm Newtonian reflector mounted on a swivel base. The Explorascope is perfect for viewing craters on the moon and also is adaptable for daytime land viewing. It is lightweight, can be mounted to a camera tripod. Priced less than \$200, the Explorascope is bound to fit nicely on your gift list.

Newcomers also can take advantage of California-based Meade Instruments Corp.'s NG-60 achromatic refractor telescope. With an optical diameter of 60mm, the NG-60 can easily pick up the rings of Saturn and makes for a great "first telescope" for the young astronomer in your family.

Those who are more advanced in the hobby and for whom size matters will spend hours peering out of Meade's Starfinder 16" reflecting telescope. At nearly five feet long, the

optical tube can be mounted to either an Equatorial or a Dobsonian mount. For pricing information, visit www.meade.com and contact the dealer nearest you.

And for the serious – and only for the serious – space geek, Celestron proudly presents the CGE-1400 Schmidt-Cassegrain Telescope for under \$6,000. The 14" scope comes with a database of more than 40,000 heavenly objects and can maintain star alignment over several nights without needing to be realigned. It's also perfect for long-exposure stellar photography.

There is no camera that can record those images better than Meade's Deep Sky Imager. Fresh from the drawing board and powered by Meade's Autostar Suite software, the Deep Sky Imager can be used to photograph nebulae, planets and star clusters. Suggested retail price is \$299.

But there's no point in buying a telescope if you don't know where to point it! That's why the New York-based Imaginova Corp. has created their family of Starry Night astronomy software packages for beginning, intermediate and expert astronomers. Their three most recent releases, the Starry Night Complete Space and Astronomy Pack, the Starry Night Enthusiast Version 5.0 and the Starry Night Pro Version 5.0 range from \$50 to \$150. For more information, call 1-800-252-5417.



AND BEYOND:

Gift Guide

ROCKETS AWAY!

Forget mistletoe. Nothing says, "I love you" more than an actual missile. And while the U.S. Department of Defense may not have any Patriots for sale, the Colorado-based Estes-Cox Corp. has an entire catalog chock-full of model rockets to satisfy anyone who has ever held a match to a fuse.

Take the classic Alpha III rocket. The old saying "don't mess with tradition" immediately comes to mind. The sleek red and black color scheme and the traditional design are a familiar sight to those recently initiated to the hobby of model rocketry. The Alpha III starter set retails for about \$25 and comes with a launching kit consisting of a launch pad, launch controller and ignites.

NASA carefully documents all of its launches.

Why shouldn't you? That's the thinking behind one of Estes Cox's latest offerings: the Oracle rocket. A small camera housed in the rocket's nose cone digitally records the rocket's flight from liftoff to parachute descent. The video can then be transferred to a PC or laptop. The rocket comes complete with USB cable and software. Visit www.coxmodels.com for pricing information.

There are some for who model rocketry is more than a hobby: it's an obsession. Rather than let these pioneers attempt to blast their pet gerbils to the moon, get them the Big Kahuna, manufactured by Rocketman Enterprises Inc. With a height of 19-foot-7 and a diameter more than 11 inches, this 52-pound missile is one of the largest rocket kits available. All launches of this rocket must be approved by the Federal Aviation Administration. Buy it for \$875. Call 1-800-732-4883. Your loved one will thank you, and so will his gerbils.

But rodents aside, anyone willing to mix

flammable propellants, matches and a virtual warhead together without taking adequate safety precautions needs to turn in their rocket launcher and take up something

safer. Like reading. We suggest *The Handbook of Model Rocketry* by G. Harry Stine and Bill Stine and published by John Wiley & Sons. It contains all the essentials on practicing safe and injury-free model rocketry. The paperback edition can be purchased from Amazon.com for \$16.07, plus shipping and handling.

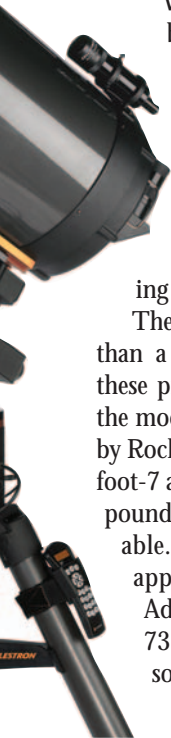
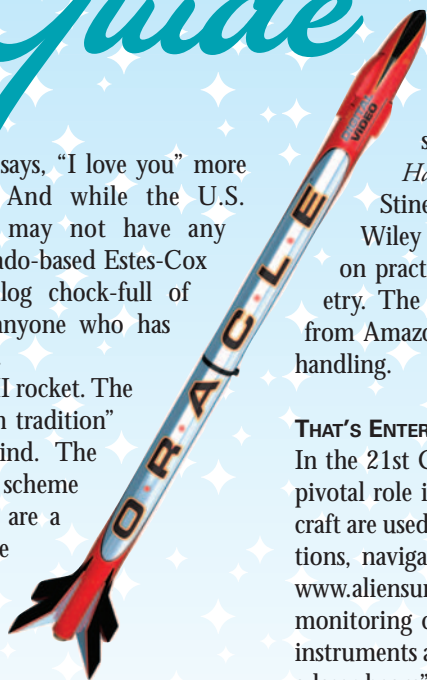
THAT'S ENTERTAINMENT

In the 21st Century, manufactured satellites play a pivotal role in our day-to-day life. Orbiting spacecraft are used for providing long-range communications, navigation and – if you believe the folks at www.aliensurgeon.com — reading a person's mind, monitoring conversations, manipulating electronic instruments and physically assaulting someone with a laser beam". They sure are guys. They sure are.

Those of us whose higher education came from other places besides *The X-Files* have found other ways to take advantage of high-flying technology, such as entertainment.

Take music for instance. Don't you feel sorry for that loved one who still pulls out those eight tracks and listens to the grainy songs on a stereo system held stiffly together by a rubber band and forces of nature man has yet to comprehend? Get them the Skybox, manufactured by the Washington, D.C.-based XM Satellite Radio Inc. The Skybox, retailing for \$199.99, is sure to bring them up to speed. Designed like a boom box, the Skybox consists of an AM/FM radio, a satellite radio, a DVD player and an MP3 player all rolled into one.

Finally,
y o u r



loved one will be able to listen to “Thus Sprach Zarathustra”, the theme song to Stanley Kubrick’s classic *2001: A Space Odyssey* (also available on DVD from Amazon.com for \$16.38 plus shipping and handling), the way it was meant to be heard. For more information, visit www.xmradio.com.

And don’t forget the sports fan in the family! New York-based Sirius Satellite Radio has recently developed the Sportster “plug and play” satellite radio. In addition to providing access to Sirius’ 120 channels of satellite radio, the Sportster has special functions customized to the needs of the typical sports fan — such the game alert function, which prompts the listener when their favorite NFL teams are playing. The game zone feature also lists all of the games that are available and lists scores by league. The receiver retails for \$99.99. Car-docking stations and home-docking stations can be purchased for \$49.99. Visit www.sirius.com to find the dealer nearest you.

No entertainment center could be complete without Dish Network’s High Definition TV System. The standard system, priced at \$999, comes with the basic Dish 811 HD satellite receiver, but customers can choose a system that instead includes the Dish Player-Digital Video Recorder (DVR) 921 for \$1,599. More information can be obtained through www.echostar.com.

There’s nothing more enjoyable to watch than the new DVD release of Lucasfilm’s original *Star Wars* series.

Though widely anticipated, George Lucas’s decision to finally release the classic trilogy on DVD is not without controversy. Some *Star Wars* purists have expressed their displeasure at minor revisions Lucas made to update the films and to make them more streamlined with his recent prequel trilogy. But no matter where your loved one stands on the issue, this boxed set is sure to hold a special place in his or her DVD library. You can purchase the set from Amazon.com for \$41.99, plus shipping and handling.

And while you’re online, don’t forget to pick up the 1998 award winning HBO miniseries “From Earth to the Moon”. In this 4-disk set, executive producer Tom Hanks takes the viewer through the history of the Apollo program and man’s quest to walk on his lunar neighbor. Amazon.com has it for \$86.98, plus shipping and handling.



SPACE ADVENTURES

You can’t really explore space while sitting in front of the boob tube and eating nachos (which, by the way, can be purchased from your local snack machine for 55 cents). True adventurers have to be willing to walk out their door and experience the universe for themselves. And there’s no better destination to head to than U.S. Space Camp in Huntsville, Ala.

Space Camp, Space Academy and their sister program Aviation Challenge are excellent opportunities for folks of all ages to get hands on training for not only space exploration, but also aerospace science and basic engineering. Campers will learn teamwork and problem-solving as they conduct simulated space shuttle missions to the International Space Station. Prices vary, depending on when you register. For more information, call 1-800-63-SPACE.

For a truly star-studded voyage, head to the Space Adventures Ltd. website at www.spaceadventures.com. The Arlington, Va-based company could accurately be described as your travel agent of the stratosphere. It was Space Adventures that organized Dennis Tito’s famous trip to the International Space Station. For those who aren’t able to afford a similar journey, the company offers 30-minute edge-of-space flights in a Russian

MIG-25 for \$18,995 per person, as well as zero gravity simulation flights on the Russian IL-76 for \$6,995 per person. For more information, call 1-

888-85-SPACE.

Closer to home and easier on the wallet, take advantage of zero-gravity parabolic flight through The Zero Gravity Corp., of Dania Beach, Fla. Discounts are available to NSS members. For more information, call 1-888-NO-GRAVITY or visit the company’s website at www.nogravity.com. NSS members also can email members@nss.org or call the Society headquarters at 202-429-1600 and ask to be connected to the Membership Department.

Want more gift ideas? Visit The Space Foundation website at <http://www.spaceconnection.org/index.php> and happy holidays. 🍀

Travis K. Kircher is a freelance journalist based in Louisville, Ky. He can be reached at traviskircher@aol.com.

RECOMMENDED READING

The following reading list has been suggested to enhance your knowledge about the history, theory, and future of space exploration. Many of these books can be found in major bookstores, used bookstores and libraries, or by running a Google, Yahoo, or AltaVista search engine on the author's name or book title.

NEW THIS YEAR

Comm Check...: The Final Flight of Shuttle Columbia

by Michael Cabbage and William Harwood

One would think that the story behind the loss of Columbia has already been told in countless articles published, including many by journalists Michael Cabbage and William Harwood themselves. However, the two do an excellent job putting all the details together in a coherent, even riveting narrative. The book details the events leading up to the accident, including the debate regarding the severity of the foam impact on the orbiter during launch. This debate, revealed through documents, email messages, and interviews with many of the key participants, proves damning: it shows how even very smart people can delude themselves that nothing is wrong when in fact there is a serious problem.

High Calling: The Courageous Life and Faith of Space Shuttle Columbia Commander Rick Husband
by Evelyn Husband with Donna Vanliere

Evelyn Husband writes the biography of her late husband, mission commander Rick Husband. Born and raised in Amarillo, Texas, Husband decided at the age of four that he wanted to be an astronaut: not an uncommon career choice for a boy of that age, particularly given the excitement around that time of the first manned spaceflights. Unlike most others who dreamed of becoming astronauts at that age, though, Husband had the talent and determination to turn that dream into reality.

The Depths of Space: The Pioneer Planetary Probes
by Mark Wolverton

Pity the poor Pioneers. In the annals of exploration of the solar system, many people remember a number of milestone missions: Viking, Voyager, Mars Pathfinder, Galileo, and, more recently, Cassini, Spirit, and Opportunity. More likely to be forgotten, though, are the Pioneer missions. This is an unfortunate oversight: Pioneer 10 was the first mission to Jupiter, Pioneer 11 was the first to make it

to Saturn, while Pioneer 13 is the only American Venus lander mission to date. Those missions, and others in the Pioneer program, have been overshadowed by later missions or otherwise simply forgotten. Mark Wolverton reminds us of these missions' significance.

Leaving Earth: Space Stations, Rival Superpowers, and the Quest for Interplanetary Travel

by Robert Zimmerman

Space stations, believes Robert Zimmerman, are essential proving grounds for the eventual human exploration of the solar system. Space stations allow scientists to find out how people can handle extended periods of weightlessness, as well as how they can — or sometimes can't — get along with fellow crew members in cramped quarters. Stations also offer an opportunity to develop and test key technologies needed for interplanetary journeys, particularly life support systems, as well as test the resourcefulness of crews to carry out repairs in space. While politicians may have been motivated to fund space stations for foreign policy or other political reasons, the various space stations built and flown to date have gone a long ways toward achieving those exploration goals.

New Moon Rising: The Making Of America's New Space Vision and the Remaking Of NASA

by Frank Sietzen Jr. and Keith Cowing

In the months leading up to the publication of *New Moon Rising*, the book had been billed as a behind-the-scenes account of the formation of what has come to be known as the Vision for Space Exploration. The book is that, but it is also a wider review of the recent history of NASA and space policy. The book starts after the 2000 election, with the tortuously extended departure of then-administrator Dan Goldin and the selection of Sean O'Keefe as Goldin's successor. O'Keefe was charged with putting the International Space Station program, and the agency in general, back on track after the station's multi-billion cost overrun came to light. By the time O'Keefe had made headway in that regard, though, came the Columbia accident and investigation, and the soul-searching within NASA and the administration about the future of the agency.

Lost in Space: The Fall of NASA and the Dream of a New Space Age

by Greg Klerkx

The central thesis of *Lost in Space* will be familiar

to many people: NASA, having defeated the Soviet Union in the Cold War race to the moon, has since lost its way, stumbling through the space shuttle and the International Space Station programs without making major progress in the last three decades. Even worse, claims Greg Klerkx is that NASA has tried to disable private space efforts that have encroached on the agency's turf or have otherwise posed a threat to the agency, from effectively scuttling the Industrial Space Facility in the 1980s to actively opposing Dennis Tito's trip to the ISS in 2001. Rather than championing efforts to expand the human presence in space, he argues, NASA has been the grand villain of any private effort to open up space.

Sojourner: An Insider's View of the Mars Pathfinder Mission
by Andrew Mishkin

Based on his notes, program documentation and recollections, Andrew Mishkin, a systems engineer who worked on the Sojourner project at NASA's Jet Propulsion Laboratory, writes a compelling account of the little robot sent to Mars during the successful Mars Pathfinder mission in 1997.

One Giant Leap: Neil Armstrong's Stellar American Journey

by Leon Wagener

Journalist Leon Wagener turns out an edgy, insightful look at Neil Armstrong, the first man to land on the moon, covering Armstrong's all-American boyhood and his dreams of spaceflight, his military service, the foundation of his astronaut career at NASA, the historic mission to the moon and the wave of publicity Armstrong reluctantly faced upon his return.

Light This Candle: The Life & Times of Alan Shepard

by Neal Thompson

Alan B. Shepard earned many titles during his career and life, among them Admiral, first American in space and the first lunar duffer. To his fellow astronauts though, he would become known as the "Icy Commander" in deference to his cordial but stoic, steely-eyed approach to those around him.

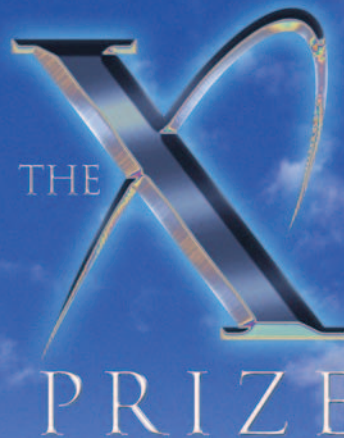
Journalist Neal Thompson delivers a portrait of the complete Shepard, from his childhood in New Hampshire through his pursuit for his Navy wings, to his selection as a Mercury astronaut and his personal quest for the moon to his retirement as a philanthropist.

Moonrush: Improving Life on Earth with the Moon's Resources
by Dennis Wingo

Through the years there have been many arguments made about utilizing the resources of the moon. Many have focused on helium-3, the rare isotope of helium emplaced on the lunar surface by the solar wind. Helium-3, proponents claim, could fuel fusion reactors on Earth, providing bountiful clean energy using only a modest amount of the element. More jaded space advocates, though, tend to guffaw at that claim, noting not only the lack of fusion reactors of any kind on the Earth but that controlled helium-3 fusion would be even more difficult to maintain than fusion reactions that use deuterium or tritium. Dennis Wingo makes a compelling case that other resources available on the moon could solve the impending energy crisis on Earth.

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Use It or Lose It

BY CLIFFORD R. McMURRAY

Ask any athlete the secret to success, and they'll tell you that the only way to stay in shape is to constantly exercise and stretch your muscles. You can't build muscle, then sit back in an easy chair and expect to keep it. Use it or lose it.

Unused muscles are worse than useless: they turn into fat. And so it is with the muscles of political and social influence. It's not enough that NSS can point to significant victories in the past. What counts is what we're doing today to promote our vision of a space-faring civilization. The race goes on, and we haven't won yet. A look at the events in Washington in the past few months makes this very clear.

The Moon-Mars Blitz, held in Washington in July, was an historic event. This year, with President Bush having put forward a plan to return astronauts to the moon and send them on to Mars, space activist groups realized that we need to get together, stop fighting amongst ourselves over details, and speak with a common voice in favor of breaking humanity out of low-Earth orbit.

Since the NSS Washington Legislative Conference already was scheduled, more than two dozen other space activist organizations joined with NSS to come to Washington and speak to Congress together. The result was the largest collection of volunteer space lobbyists in history. Seventy-six private citizens came to Washington for three days to tell their senators and congressional representatives why space is important. We visited more than 200 Congressional offices. We told our elected officials and their staffs that this was a historic opportunity to break NASA out of the rut it has been stuck in for nearly three decades. We told them that investment in space technology is one of the few areas of federal spending that generates a positive economic return. We told them that it was important to provide a higher vision of possibility to our young people. We told them we wanted the chance to see a robust space economy that would allow private citizens a chance to pay for a ticket to space for themselves.

We told them all that and more. Then we came home, and two weeks later we all read that the Senate Appropriations Subcommittee that deals with NASA had not only nixed the small increase requested by the administration, they had slashed funding by more than \$1 billion, to below the current year's budget. Adding insult to injury, our dear senators did this on July 20, the 35th anniversary of Neil Armstrong's first steps on the moon.


I tell you this not to move you to despair, but to arouse you to constructive anger. We need bigger political muscles. That means more people who are willing to speak up for our cause, in letters to newspapers and magazines, and in phone calls and letters to their elected representatives. And those activists need a support system that lets them know just when critical votes are coming up in Congress, so they can apply their muscle at the right time.

NSS used to have a Phone Tree organization that could be quickly tapped to spread the word when action was needed. In its day, the Phone Tree accomplished a lot. But in recent years, that muscle has atrophied through lack of use. Now it's time to build new muscle, in the form of a new Political Action Network.

The NSS Political Action Network is a tool for space activists in the Internet Age. Unlike the old Phone Tree alert system, volunteers won't have to waste a lot of time on the phone with details about what's happening. Instead, they'll just call their friends to alert them to news posted on the NSS website about upcoming critical votes in Congress, etc. These phone calls will be backed up by e-mail alerts. The result will be that NSS members who want to make Washington hear their voices can be sure that they're talking when their elected representatives are most likely to be paying attention.

If the action of the Senate Appropriations Subcommittee is unacceptable to you, please tell your

senators so — and be sure to tell them why. Then, I invite you to take the next step to effective political action and join the NSS Political Action Network. You can sign up at the NSS website home page, www.nss.org. Our registration form allows you to choose the level of your involvement — you can be as active as you want to be. If you decide to join the PAN, you have my pledge that we won't bombard you with dozens of calls-to-arm each year. We'll only ask for your help when we think it can make a real difference.

Getting the future we want will be a long political battle, a fight that requires us to build some muscles that haven't been used much lately. Let's start getting back in shape! 

SEDS-USA JOINS FORCES WITH MIT

By JOSHUA NEUBERT,
SEDS-USA CHAIRMAN

SEDS and the MIT Mars Society joined forces for a new event this fall: SpaceVision2004, which combines the SEDS national conference with MIT's Marsweek.

The event marked the official return of the SEDS-USA national conference from an eight-year hiatus. The national conference was an annual gathering of students to organize the future activities of SEDS throughout the 1980s and '90s. In the past, this had been organized in conjunction with the International Space Development Conference hosted by the NSS.

SpaceVision2004 was scheduled for Nov. 11 through 14 with the goal of bringing students and professionals together in an atmosphere that fosters communication and networking across generations of space enthusiasts. The combined resources and efforts of the organizing groups created a great opportunity for space enthusiasts of all ages to share their ideas. SEDS focuses primarily upon university students, but students and professionals of all ages were encouraged to attend to create the perfect community and atmosphere for this conference.

The majority of space conferences are dominated by the "Apollo generation," with a speckling of young faces in the audience. SpaceVision2004 aimed to change that, not by diminishing the number of professionals in attendance, but by reaching out to all the students

who have the same drive and desire for space exploration and to demonstrate that now is the time to join forces and make a difference.

To do this, SpaceVision2004 hosted not only a number of great speakers, but also demonstrations, workshops and other activities for students to get more involved in the future of SEDS and space exploration. Primary presentations included: Communicating the Vision; Commercialization of Space; and Governmental Space Programs.


Scheduled speakers included Craig Steidle who is the NASA associate administrator for Exploration Systems; Peter Diamandis who founded SEDS as well as the X Prize Foundation and a number of other companies; Lori Garver, a former NSS executive director who served as an advisor to John Kerry's presidential campaign; NASA astronaut Jeff Hoffman, who was a mission specialist on the first Hubble Space Telescope servicing mission; and many more excellent individuals.

Other activities that were part SpaceVision2004 included student project presentations, a space career fair, an evening social event, a dinner banquet, a forum for space advocacy groups, a space elevator climber demonstration and several SEDS meetings.

A number of space advocacy organizations, including the NSS, sponsored the conference by providing speakers, financial support, publicity and other services.

The conference career fair was an excellent opportunity for both companies and students. Companies and organizations were able to meet and recruit from a highly talented and enthusiastic group of students from all across the country. In turn, students visited representatives from a broad array of companies specifically interested in aerospace research and exploration.

SpaceVision2004 marks the beginning of what will be a recurring event throughout the years. Each year SEDS will be hosting its national conference at another university around the nation, and each year new activities will become a part of the conference. We all look forward to the future and with any luck this event will spark a great new journey for many young students and space enthusiasts.

For more information about the conference email Vision2004-info@mit.edu or click on the SpaceVision2004 link at the SEDS website (<http://www.seds.org>). 

NSS announces new scholarship for *International Space University*

NSS is pleased to announce a new scholarship for the International Space University, in cooperation with SEDS and the Space Generation Foundation.

The scholarship will cover \$12,000 of fees for either the Summer Session program or the Masters program. It offers a tremendous opportunity for a promising young professional or student to benefit from the interdisciplinary and international education that ISU offers.

What is ISU?

The International Space University (ISU), located in Strasbourg, France, develops future space leaders by providing graduate level educational programs to students and space professionals in an international, intercultural and interdisciplinary environment. ISU offers its students a unique and comprehensive education covering all aspects of space programs and enterprises — space science, space engineering, systems engineering, space policy and law, business and management, and space's role in society.

International graduate students and young space professionals in both the Masters programs and the Summer Session Program complete an intensive interdisciplinary curriculum and become part of integrated international teams to solve complex space related problems and complete a major team project in a truly intercultural environment. Created in 1988, ISU alumni now number just under 2,200 from 86 countries.

How to apply?

Download the application form from the NSS website, www.nss.org. Applicants will need to make a separate application to ISU. Deadline: December 31, 2004

Questions?

Call the NSS office at (202) 429-1600 or email us at scholarship@nss.org



ISU is an incredible global family. Thanks to my NSS scholarship, not only did I have the opportunity to spend a summer in Germany placing my space interests in a more interdisciplinary context, but I got to tackle those challenges with 90 other classmates from 30 different countries, building terrific friendships and memories along the way. What really amazes me, though, is that the experience has only gotten better. Every time I turn around in my career, I am meeting more alumni in the ISU family—colleagues who share a slightly larger view of what space can be. Thank you NSS for providing me with such a stellar experience and an amazing network!

Erika Wagner, MIT

LANCE BASS JOINS NSS BOARD

His plans to fly in space aboard a Russian Soyuz rocket faltered, but aspiring space tourist Lance Bass, lead singer of 'NSync, has been doing his part to open up the final frontier.

In addition to participating in several World Space Week events, including a competition named "Lance's Lab" that challenges students to design modules for the space station, Bass has joined the National Space Society's Board of Governors.

Serving in an advisory and public outreach capacity, this honorary group includes astronauts and prominent individuals who have made a lasting, positive impact on human space exploration, including actor Tom Hanks, journalist Hugh Downs and futurist Sir Arthur C. Clarke, among many others.

"It's fitting that we recognize Lance's contributions to space education with this honor during World Space Week," said George Whitesides, NSS executive director. "Lance's unique partnership with Spaceweek International Association brought an energetic, credible new voice to the space industry and a renewed level of interest in space among young people. His work continues to draw attention to the limitless opportunities space offers children around the world."

Special World Space Week instructional materials are available to schools at no charge, featuring space-related math and science

activities for teachers. Materials are available in several languages with activities for all grade levels and require little or no teacher preparation. By participating in World Space Week, teachers can excite students about learning and even receive cash grants. For details, to download educational materials or learn more about Lance's Lab, visit: www.spaceweek.org/education.

BRINGING DOWN THE COST OF SPACE TOURISM

By G.B. LEATHERWOOD

In a recent article in *Space Future Journal*, director of Spaceport Associates Derek Weber quotes the 2002 Futron/Zogby demand study as saying: "...when prices to orbit are reduced to \$1 million, then there would be 250 per year public space travelers in orbit, and of course the figure would soon get into the thousands once prices drop much below \$1 million."

But NSS member and entrepreneur Joe Latrell sees it differently.

"We are still playing in the sandbox in the space exploration business," said Latrell, founder and chief executive officer of Beyond-Earth Enterprises (www.beyond-earth.com). In an interview with David Livingston, host of "The Space Show," Latrell insists that B-EE is a commercial space development company, with emphasis on "commercial."

"We are consumer-driven," said Latrell, who plans to unveil soon "a

commercial product the general public can easily afford. We will listen to our customers, find out what they want and redesign our product within 10 days."

The product? Initially it will be some item the customer wants to travel into space. Latrell describes it this way: "You send us your request for 'MissionOne,'" and \$149. We send you the kit, which contains an envelope for your item and instructions of what can go in and what can't, and a tracking card with your number on it," he said,

"On launch day, we put your packet in the nose cone with the others making the journey with you. You can watch the launch and recovery on our web site in real time and experience the thrill of space-flight yourself. When the trip is over, we return your item with a certificate verifying that it went into space," Latrell said.

Well, you don't get to go personally, but then the cost is certainly within reach of anyone wanting to commemorate a birthday, an anniversary, or just about anything else — and for far less than the \$1 million or so estimated as a "reasonable" cost of a tourist flight in the future. The future, that is, after years of development of vehicles, destinations, and spaceports and billions of dollars, Euros, or whatever other currency is involved. Joe Latrell and Beyond-Earth Enterprises want to give ordinary people the opportunity to experience the thrill of space travel at a price they can afford.



Lance Bass is the newest luminary to join the NSS Board of Governors.

In his interview on "The Space Show," Latrell challenged the optimism of the space tourism advocates. In referring to the interest in the X Prize, he said, "Once you have built the X Prize vehicle, what are you going to do with it? There is no space tourism business at the present."

On one hand, Latrell is correct — there is no space tourism business at the present. And why not? Because there is only one vehicle operating, the Russian Soyuz, capable of carrying only one extra person to one destination, the International Space Station, leaving from and returning to one spaceport, located deep inside Russia. It costs a reported \$20 million for this trip; each prospective tourist is tested, screened, probed and prodded, and subjected to months of preparation just like professional government astronauts and cosmonauts. Not exactly a "family friendly" vacation trip. And even when the U.S. space shuttle resumes service (assuming it will sometime in 2005) only the chosen few will reach orbit.

But no market at all? No, that's not quite right either, and Latrell would agree. After all, that's why Beyond-Earth Enterprises exists. "Mission One" is just the first step, the first paying product to pave the way to a much, much larger business that promises ever increasing demand and profits for those brave enough to invest.

And what is Latrell doing to make this happen? In April, the B-EE

crew launched an unusual rocket from the Pawnee National Grassland in northern Colorado. Assisted by members of the Northern Colorado Rocketry Association, the rocket, dubbed and registered "Launch Craft Mission One (LC-M001) roared from the launch tower, climbed to an altitude of 6,000 feet, tipped over at apogee, and returned to the launch site. Unfortunately the nose cone separation system was damaged on liftoff and failed to allow deployment of the parachute that would have guaranteed a soft landing. Part of the rocket crumpled as it was designed to do, but the payload container, protected by a blast shield between it and the motor/fuel compartment, survived, as did the rocket motor itself and the rear fin assembly.

"Unfortunately, a couple of the bears didn't survive the crash," Latrell said, with a chuckle, "but the children's contest drawings, coins, and the rest of the package came through fine." Bears? Part of the payload was 25 toy teddy bears, two of which, as he said, "didn't survive." Not a bad result for the first launch of a rocket built by amateurs in a converted warehouse using "off the shelf" parts.

That is what made this rocket unique. There were no government funds involved, no teams of highly paid rocket scientists and engineers. All elements were designed and built by a dedicated team all of whom have other full-time jobs. The objective of this entire project is to

MEETING MARBURGER



NSS intern Brian Olds meets Dr. John Marburger, director of the White House Office of Science & Technology Policy at a workshop introducing NASA's Centennial Challenge program.

NASA/Renee Bouchard

prove that private industry is fully capable of designing, building, launching, and documenting space flight safely, reliably, and above all, inexpensively.

Let's not forget that oft-stated bugaboo of space flight: government regulations and the myriad of alphabet-soup agencies scrutinizing every aspect of any new and untried enterprise. How did the B-EE company deal with all the restrictions and regulations? Latrell says, "It's a lot easier than you think. For example, the folks at AST (the Federal Aviation Administration Associate Administrator for Space Transportation) are very supportive and want to encourage efforts such as ours." "Dealing with the government agencies is easy," he said, "you just ask them what they want and give it to them. I'm more interested in launching rockets than dealing with suits."

The next step in development of this commercial space enterprise, called "The Road to Space," already

is under way. The B-EE team analyzed what happened to the nose cone separation system, which is also unique in that it is a completely mechanical system employing no chemicals or pyrotechnics to deploy the parachute. Immediately after the launch, the team was already designing the remedy and planning for the next launch that took place at Oklahoma's newly christened Capps Space Science Center in Frederick.

The vehicle launched on this second flight was one-third scale, but still built by the same dedicated crew in the same warehouse in Colorado Springs, Colo., using the same sources of fund — money from their own pockets. Although still not a complete success (a small miscalculation in the amount of propellant needed to jettison the payload container) the vehicle, dubbed "LC-2" reached its intended altitude and returned to the launch site well within the launch parameters.

Oklahoma State Senator Gilmer Capps pressed the red "GO" button and expressed admiration for the team's efforts. The city of Frederick gave B-EE high marks for their determination, acknowledging that here was a group actually doing something to get us into space.

For its support, NSS may receive a contribution from every "Mission One" Space Kit sold to the public and taking that ride into space. NSS members will receive a discount for their own kits, which will soon be purchased from B-EE through the NSS Space Store. This is a commer-

cial venture guaranteed to not only satisfy the desires of NSS members to go into space, but to benefit other NSS programs needing funds.

For complete information about Beyond-Earth Enterprises, visit its web site at www.beyondearth.com. Space Kits will soon be available at the NSS Space Store — watch for it under "New Items."

WANTED: SPACE BOOKS

United Societies in Space, in cooperation with Colorado's Douglas County Libraries, are creating the Buzz Aldrin Space Library Collection with volumes to focus on outer space development and human habitation.

"We are pleased to expand this important part of the library with substantial community and private sector support," said Douglas County Library director Jamie LaRue.

The Buzz Aldrin Reading Room is scheduled to open in the county's Philip S. Miller Library, located in Castle Rock, in July.

United Societies in Space, headed by Declan O'Donnell, has committed to fund capital acquisitions and promote the collection in partnership with Apollo 11 astronaut Buzz Aldrin and his wife Lois.

Project heads want to acquire another 2,000 titles before the end of the year to round out an already impressive collection of space books. Donors contributing \$50 or more will be honored by having their names placed on the inside cover of the book. Artwork,

memorabilia, and relevant volumes are accepted as donations at fair value.

For more information, contact O'Donnell at 800 632-2828 or by email at djopc@qwest.net.

POLL: WE LOVE SPACE

NASA and the U.S. space program enjoy broad support and interest from the American public, according to the results of a new Gallup survey coordinated by the Space Foundation and sponsored by the Coalition for Space Exploration, a group that includes the National Space Society.

More than two-thirds, 68 percent, of the American public say they support a new plan for space exploration that would include a stepping-stone approach to return the space shuttle to flight, complete assembly of the space station, build a replacement for the shuttle, go back to the moon and then on to Mars and beyond.

With funding for such a program expected not to exceed 1 percent of the federal budget, 42 percent of adults surveyed say they support the program and 26 percent strongly support it. Of note is that a majority of Republicans, 79 percent, and Democrats — 60 percent — support such an exploration plan.

When it comes to NASA's budget, almost two-thirds, 63 percent, of American adults surveyed think NASA's budget should remain at present or increased levels. NASA's current share of the total federal budget is .7 percent, or about \$55 per year for

the average taxpayer. During the height of Project Apollo, NASA's share of the budget was about 4 percent.

"These poll results are extremely important and historically significant as the nation considers its future direction in space," said Jeff Carr, communications director for United Space Alliance, which is a founding member of the Coalition.

"Those of us in the space community have always believed the public supports the space program and wants to see it fully funded," Carr said. "Thanks to the Gallup organization's expertise, the Coalition now can demonstrate widespread support for the elements of the Vision for Space Exploration."

The complete Gallup survey report and supporting data can be read on the Coalition website www.space-coalition.com.

POLITICAL ACTION


The National Space Society was proud to co-host space events at the conventions of both national political parties this summer.

The Democratic National Convention took place in the great city of Boston, where NSS and the Space Foundation organized an event at the city's Museum of Science. Honoring Congressional supporters of space in the Democratic party, the event was headlined by a speech from Representative Bart Gordon, ranking minority member on the House Science Committee. Former NSS executive director Lori Garver, who advised John Kerry on space issues, also spoke.



Later in the summer came the Republican National Convention, where NSS was a supporter for an event honoring House Majority Leader Tom Delay and Representative Dave Weldon for their work for space. The event was a tremendous success, drawing NASA administrator Sean

O'Keefe, former NASA astronaut David Low, and many, many others.

NSS thanks the many sponsors who made these events possible, and will continue to work to bring space issues to the forefront of future political races. 

Astronaut Mary Ellen Weber, far right, members of SEDS and Boston-area NSS chapter members, including board member Bruce Mackenzie, third from left, help prepare gift bags for delegates and guests of the NSS space event, held in conjunction with the Space Foundation and industry sponsors.



NSS supported an event honoring House Majority Leader Tom Delay and Representative Dave Weldon of Florida for their work for space during the Republican National Convention in New York.

Letters



SPREADING THE WORD

I just read the new issue of *Ad Astra* and it is terrific, especially the focus on the president's space policies.

I saw a brief section on what we can do to promote space and that is vital to our effort. I teach a course on the space program to seniors in my high school. It is entering year number four and going strong. I have yet to find another high school in this country that has such a class.

Also, I have spoken before the Long Island Space Society and other chapters, so I am trying to do my part. It is a labor of love.

Joseph F. Russo
Valley Stream, N.Y.

NO TRUE ASTRONAUT

So, the beginning of summer 2004, the 21st of June, we should note as an "historical milestone." Since yesterday, mankind has its first "fully privatized" astronaut.

It is astonishing that the test pilot seems so much older than his sponsor, a Microsoft co-founder (he could be his father.) You would expect it just opposite. (In former times the older had the money and sent the younger to the front.)

So far we seem really been arrived in a new age.

But for me however this good Mike Melvill is no astronaut (not at all in the literal sense.)

The 100-kilometer mark as "space border" is a more or less arbitrary definition. At least it looks there — also for future "space

tourists" — like "space" (the sky is no longer blue, but black.)

But even the ISS may not drop significantly under 300 kilometers, in order not to slow down too much by running into still existing air particles.

So finally the mentioned 100-kilometer mark and approximate triple sonic speed has been reached. "True" astronauts do not do it under 25-fold supersonic speed. Only then has one reached the "First Cosmic Speed," which overcomes at least the Earth's gravity.

But it is probably a first step toward space, at least in the minds of those, who want to finance the grip to the stars — this time without tax funds.

Michael Stennecken
Muenster, German.

SAVING HUBBLE

I concur with Mr. Zubrin that the Hubble should be saved. The reasons are:

The losses of the shuttle program have not resulted from the extra "effort" that it would take to reach Hubble. The Challenger was lost due to launching in the face of extreme weather conditions, while the Columbia was lost due to foam or ice damaging heat shield tiles, also at launch. A good ship (at launch) has never failed. Orbital hazards, to our knowledge, have never materially threatened a shuttle.

The Hubble is the "jewel" of the NASA inventory, at the moment. Together with Apollo, Voyager and the

Mars landers, it has had a great effect on science and national prestige. At this time above all others, when we are assaulted by negative publicity, we must maintain such an "icon."

The Hubble rescue would be, arguably, the most cost-effective venture of the space program. Not only would it save a mission that already has been amortized (thus is "free" except for maintenance and ground control,) but it would allow the economical exploration of a multitude of worthy space objects. Remember the Shoemaker-Levy event at Jupiter; though we were lucky enough to have a spacecraft en route to take some images, it was Hubble that provided the bulk of the photographic record. How many objects remain to be discovered, from nearby planets (extrasolar or Oort cloud) to nascent stars.

James Boshnack

WELCOME ABOARD

Thank you for publishing the Kennedy Space Center Visitor Complex News. The magazine gives me some interesting insights and information that I can share with the college students I take to KSC. Although we do environmental research on farming methods, we still find space topics very central to our interests. KSC also helps provides the ultimate positive representation of our nation for the international visitors that I host.

John C. Capece
LaBelle, Fla.

THANK YOU!

Credit for photographs taken by NSS member Larry Evans were inadvertently omitted from the last issue of *Ad Astra*.

Chapter Projects

By G. B. LEATHERWOOD

“We do not know how to properly build a lunar habitat for even a half-dozen people.”

So says Jesus Raygoza B., president of Sociedad Espacial Mexicana, A.C. Chapter, the current NSS chapter in Mexico.

In his paper, “*The Mex-LunarHab (MLH) Project*,” he describes not only some of the roadblocks, major and minor, to building a true lunar habitat, but also outlines many of the decisions made during the past 30 years that lead to his statement.

“Had the U.S. space program continued at the pace of the mid-1960s (the pace of John F. Kennedy) by now we *might have well been* on the way to *properly* building such habitats,” Raygoza writes.

One of the major roadblocks is the inability to completely and accurately duplicate here on Earth conditions of vacuum, reduced gravity, extreme temperatures, etc., that exist on the moon.

We know, for example, that it will be vital to find ways to con-

struct habitats, extract fuel and water, grow plants, and even dispose of our waste material with only what exists on the moon. Water is extremely heavy and costly to transport off the Earth, and even then it is eventually consumed.

Then there is the issue of humans living together for long periods in even a semblance of harmony. Experiences starting with the earliest habitats in space have demonstrated again and again that as compatible as people can be, private space is critical to mental health. It may be as simple as a curtain that can be drawn across a sleeping cubicle, but it is necessary.

So what is Raygoza and the Mex-LunarHab doing about it? And where does the NSS come in?

Raygoza has enlisted an impressive list of supporters, including NSS leaders Greg Allison and Ronnie LaJoie, Space Nursing Society Executive director Linda Plush, radio host David Livingston of “The Space Show,” and organizations including the Space Frontier Foundation and Steve Durst’s Space Age Publishing Co.

A site, called the Lunar Mexico Habitat Analogue Project, is planned to be installed somewhere near Ciudad Juarez, Chihuahua on an analog site with “likeness” of a geographical and geological conditions for scientific research and working activities as those needed for humans in a harsh environment as the lunar surface.

The project was introduced to

the space-faring community at the 2003 convention of the United Societies in Space (USIS) held in Denver in August 2003.

One of the most challenging aspects of this is that the Habitat Analog is just the beginning — the real objective is the actual habitat on the surface of the moon. In design now is the lunar habitat, which will be a vertical cylindrical shaped spacecraft-habitat standing 9.5 meters, or 31 feet, tall and 7.2 meters, or 24 feet, in diameter. The top level will be a conical structure with a smaller diameter than the rest of the vehicle. It contains four seats for a pilot, a co-pilot and crew and will be able to be used as both a command module and a rescue module. In case of accident on the base, the cone-shaped aerodynamic command-rescue module will be separated from the rest of the habitat and launched.

The level below the command-rescue module will be the sleeping compartment, resting and exercise areas, a toilet and a bathroom. In the third and lowest level will be the infirmary and telemedicine compartment; laboratories for physical sciences, geology, and biology, a chamber for extravehicular activities, containing two airlocks for decontamination and dust-off, and another one for air decompression. An auxiliary element of this spaceship-habitat is a pressurized all-terrain vehicle.

The vertical design allows for more usable space than a horizontal

design such as now used by the International Space Station, with more headroom. But the habitat is still only part of the total concept.

A major part of the project is to generate interest in Mexican space activities within Mexico — in the short term to encourage the establishment of a national space. In the long-term, organizers want to establish an international space agency. All ambitious undertakings, but indicative of the energy and imagination present in every NSS chapter.

For more information about the project, its progress and needs, and complete background visit the Mex-LunarHab web site at <http://www.angelfire.com/space/users/mexlunar.html> or read a synopsis at <http://www.prl.ernet.in/~ILCG/abs/21.html>. Raygoza can be contacted at jrb_space@latinmail.com. 📧

G. B. Leatherwood, NSS Director of Projects Chapter, wants to know what your chapter has been doing to promote space. You can contact him by email at gbrel@bellsouth.net or projdir@nss.org, by phone at (352) 686-2366 or by mail at 7213 Davenport Lane, Spring Hill, FL 34606-6348.

NSS Chapters and Projects

Learn what is going on at local chapters of the National Space Society and get the latest updates on our website:

www.nss.org/chapters.

Please send any changes to NSS headquarters at nsshq@nss.org. And remember to update us on your projects by contacting Mr. Gail Leatherwood, our Chapters Projects Director, by email at proj-dir@nss.org or gblrel@bellsouth.net, by phone at (352) 686-2366, or by mail at 7213 Davenport Lane, Spring Hill, Fla., 34606. In every issue of the magazine, we will highlight your interesting and inspiring endeavors. Ad Astra!

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NSS Western Spaceport Chapter

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Online: <http://hometown.aol.com/wspaceport/Welcome.html>
Publications: Western Space Report, monthly

Orange County Space Society Chapter

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Online: OCSpacesociety@hotmail.com
Publications: OC Space, monthly
Projects: Public displays and programs;
Student Space Congress; After School
Academy; Space Camp Southern California.

OASIS Chapter

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Redondo Beach CA 90278
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Email: oasis@oasis-nss.org
Online: www.oasis-nss.org
Publications: The Odyssey, monthly
Projects: Public talks and lectures, Star parties
at Mt. Wilson Observatory; Mars Rover
Simulator; Speakers for space-related
convention panels.

Region 2 Chapters: Northern California, Washington State, Oregon

Oregon L5 Society Chapter

Contact: Bryce Walden
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Oregon City OR 97045-0007
Phone: voice (503) 655-6189;
fax (503) 251-9901
Email: moonbase@comcast.net
Online: www.OregonL5.org
Projects: Professional papers, models, brain-
storming and idea incubator, prototyping, and
industry consulting through our Lunar Base
Research Team and Mars Instrument and
Science Team; cooperative activities with
museums and space advocacy groups; public
information tables and educational activities
including Mars rover, models and moon analog
research site; America Online Space Chat .

Golden Gate Space Frontier Society Chapter

Contact: Ned Dodds, 19 Erin Court, Pleasant
Hill CA 94523-2614
Phone: (925) 933 1721
Email: ned_dodds@yahoo.com
Projects: Volunteers for Challenger Learning
Center at Chabot Space and Science Center,
Oakland.

Chapter: Sacramento L-5 Society

Contact: Robert Compton, 3945 Grey Livery
Way, Antelope CA 95843
Phone: (916) 344-3290
Email: energycube1@cs.com
Online: www.ad6uy.com/sac-l5/index.html
Projects: Prototype water/kerosene rocket;
web site; public shopping center displays.



National Space Society

Chapter: NSS Seattle

Contact: David Stuart, 14618 21st Ave. SW, Seattle WA 98166
 Phone: (206) 324-9096 or (206) 241-6165
 Email: NSSSeattle@aol.com
 Online: <http://chapters.nss.org/wa/seattle>
 Publications: Sojourner, monthly
 Projects: Space Day displays and volunteers; NSS speakers and staffed display table at Norwescon, regional sci-fi convention

**Region 3 Chapters:
 Arizona, Oklahoma, Texas,
 New Mexico**

Region 3 chapters coordinator:
 Claire Stephens McMurray
 1206 Classen Blvd., Norman OK 73071
 Phone: (405) 329-4326
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Tucson L5 Space Society Chapter

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 Online:
www.azstarnet.com/public/nonprofit/tucl5
 Projects: Judge space-related exhibits at regional school science fair; chapter newsletter

Phoenix Chapter of NSS

Contact: Veronica Ann Zabala-Aliberto, Arizona State University, Dept. of Geological Sciences, Planetary Geology Group, Tempe AZ 85287-1404
 Phone: (480) 965-7029
 Email: Veronica.Zabala@asu.edu
 Online: <http://groups.yahoo.com/group/NSSPHOENIXCHAPTER/>
 Publications: National Space Society of Phoenix, bimonthly

Oklahoma Space Alliance NSS Chapter

Contact: Thomas Koszoru, 514 Fenwick Court, Norman OK 73072
 Phone: (405) 366-1977
 Email: t_koszoru@cox.net
 Online: <http://members.aol.com/osanss/science>
 Publications: Outreach, Update, bimonthlies
 Projects: Host for ISDC 2004

Austin Space Frontier Society Chapter

Contact: John Strickland, 12717 Bullick Hollow Road, Austin TX 78726
 Phone: (512) 258-8998 or (512) 465-7968
 Email: jkstrick@io.com
 Projects: Revision of Boy Scouts Merit Badge Handbook on Space Exploration; space issue and briefing paper for senatorial campaign of John Cornyn of Texas; participation and papers at conventions and councils on space-related issues

Clear Lake Area NSS Chapter

Contact: Murray G. Clark, PO Box 890588, Houston TX 77289-0588
 Phone: voice (281) 367-2227;
 fax (713) 488-7903
 Email: clearlakechap@yahoo.com
 Online: www.geocities.com/clearlakechap/

NSS of North Texas Chapter

Contact: Carol Johnson, PO Box 1671, Arlington TX 76004-1671
 Phone: (972) 937-3587
 Email: pres@nssnt.org
 Online: www.nssnt.org
 Publications: The North Texas Spacecraft, monthly
 Projects: Information table and display at The Science Place, Dallas; co-authored Boy Scouts Merit Badge Handbook revision; donated World Space Week posters to schools, libraries and museum

San Antonio Space Society Chapter

Contact: Carol Redfield, 609 Ridge View Drive, San Antonio TX 78253
 Phone: voice (210) 679-7625;
 fax (210) 436-3298
 Email: credfield@stmarytx.edu
 Projects: Support for Radiance Academy West charter school the chapter helped start; support for St. Mary's University activities and Young Astronauts organization at Galm Elementary School; distribute CDs from NSS Education Committee Adopt-a-School packet.

New Mexico Space Society Chapter

Contact: Fred Aiken, PO Box 94133, Albuquerque NM 87199-4133
 Phone: (505) 856-2145
 Email: faaiken@aol.com
 Online:
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**Region 4 Chapters:
 Colorado, Kansas, Missouri,
 Utah**
Heart of America Chapter NSS

Contact: George Howard
 (Region 4 chapters coordinator) PO Box 22537, Kansas City MO 64113-0537
 Phone: (816) 523-7593
 Email: KCNSSH18@aol.com
 Publications: Heart of America NSS News,
 Projects: William Bent Station project, a moon/Mars base simulation

United States Air Force Academy Chapter

Contact: Kyle Vacca, PO Box 2649, US Air Force Academy CO 80841
 Phone: (719) 200-6506
 Email: co4kyle.vacca@usafa.edu
 Projects: Sponsor astronaut visits and presentations to cadets; conduct observatory nights; coordinate and conduct trips to Cheyenne Mountain, Lockheed Martin and other locations

Front Range L5 Society Chapter

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 Email: billfrL5@hotmail.com

Mile High L5 Society Chapter

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Wichita Chapter of NSS

Contact: Dr. Randall Chambers, 2704 Winstead Circle, Wichita KS 67226-1179
 Phone: voice (316) 684-2614;
 fax (316) 684-6748
 Email: RChamb8342@aol.com
 Publications: News Digest Reports

Projects: Educational and training programs at the Kansas Cosmosphere and Space Center; support and participate in Astra Kansas Day proclamation and celebration for governor of Kansas; evaluate and judge presentations at Wichita State College of Engineering and National Institute for Aviation Research's Engineering Open House and Banquet.

Utah Space Association Chapter

Contact: J. David Baxter, 378 I Street, Salt Lake City UT 84103
 Phone: (801) 359-0251
 Email: utahspace@aol.com
 Online: <http://www.utahspace.org>
 Publications: Aurora, quarterly

**Region 5 Chapters:
 Alabama, Florida, Georgia,
 Kentucky, Tennessee**
Huntsville Alabama L5 Society Chapter

Contact: Gregory H. Allison, PMB 168, 1019 Old Monrovia Road, Huntsville AL 35806
 Phone: voice (256) 859-5538;
 fax (256) 461-3232
 Email: HAL5@hiwaay.net
 Online: <http://hiwaay.net/~hal5>
 Projects: Project HALO, including test-firings of large and small hybrid rocket motors; public lectures on space-related subjects

Florida Chapter of the NSS

Contact: Jack Fox, 1618 South Mills Ave., Orlando FL 32806
 Phone: (407) 898-7570
 Email: jjfox1@mac.com
 Online: www.nssflorida.org

NSS Atlanta Chapter

Contact: Bill Gardiner, 1197 Spur 138, Jonesboro GA 30236
 Phone: voice (770) 473-7617;
 fax (770) 477-0515
 Email: analytech_1981@analytech.net
 Online: www.nssatlanta.org
 Projects: What's Up in Space TV program

Kentucky Chapter of NSS

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Email: hreed@vci.net

Middle Tennessee Space Society Chapter

Contact: Chuck Schlemm, 508 Beechgrove Way, Burns TN 37029
Phone: (615) 441-1024
Email: cschlemm@comcast.net
Projects: Space TV, an hour-long weekly program; display at Dickson Renaissance Center; educational presentations to groups of Vanderbilt University Childcare children; display tables at Cumberland Science Museum; monthly presentations during public viewing nights at the Vanderbilt Dyer Observatory

Memphis Space Society Chapter

Contact: Robert Hudson, 3861 Trufant, Memphis TN 38128
Phone: voice (901) 388-1480; fax (901) 566-9107
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Online: <http://chapters.nss.org/tn/memphis/>

Region 6 Chapters: Illinois, Ohio, Wisconsin

Region 6 chapters coordinator:
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Chicago Society for Space Studies Chapter

Contact: Lawrence Boyle, PO Box 1454, North Riverside IL 60546
Phone: voice (708) 788-1336; fax (847) 455-6299
Email: LarryBerwy@aol.com
Online: www.astrodigital.org/csss
Projects: Cartoon History of the Space Program, planetary presentations

Chicago Space Frontier L5 Society Chapter

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Phone: (630) 393-6817
Email: Higgins@fnal.gov
Online: www.astrodigital.org/csfs

Illini Space Development Society Chapter

Contact: Mark Wallace, 314 Talbot Laboratory, 104 S. Wright St., Urbana IL 61801
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Online: www.uiuc.edu/ro/isds

Illinois North Shore NSS Chapter

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Email: jgljgl@aol.com

Cuyahoga Valley Space Society Chapter

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Phone: (216) 749-0017
Email: geocooper@aol.com
Publications: Cuyhoga Valley Space Society, monthly

Lunar Reclamation Society, Inc. Chapter

Contact: Peter Kokh, PO Box 2102, Milwaukee WI 53201-2102
Phone: (414) 342-0705
Email: KokhMMM@aol.com
Online: www.lunar-reclamation.org
Publications: Moon Miners' Manifesto, monthly
Projects: Booth and exhibit at Aviation Career Day, Mitchell Field; "Rockets for Schools" annual rocket launch event

Sheboygan Space Society Chapter

Contact: Wilbert G. Foerster, 728 Center St., Kiel WI 53042-1034
Phone (920) 894-2376
Email: willf@ctei.com
Online: www.tcei.com/sss
Projects: "Rockets for Schools" display

Region 7 Chapters: Maryland, Pennsylvania, Metro-DC

Region 7 chapters coordinator:
Bennett Rutledge
4264 Maplewood Way, Centennial CO 80121
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Email: rutledges@nsschapters.org

Baltimore Metro Chapter of NSS

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Phone: (410) 879-3602
Email: science@balticon.org
Projects: Display table at Andrews AFB air show; science programming at Maryland Regional Science Fiction Convention; judging and prize presentations at prize at Maryland Regional Science Fair; display and space backdrop at outdoor community festival

NSS North Coast Chapter

Contact: Edward C. Longnecker, 160 W. 8th Street, Apt. 3E, Erie PA 16510-1013
Phone: (814) 459-2572
Email: nasaspaced@cs.com
Projects: Astronomy Night, Blastoff Rocket Club

Philadelphia Area Space Alliance Chapter

Contact: Earl Bennett, PO Box 1715, Philadelphia PA 19105
Phone: (215) 633-0878
Email: EarlBennett@erols.com
Online: <http://pasa01.tripod.com>
Projects: Presentations at Super Science Weekend, New Jersey State Museum, Special Awards judging at George Washington Carver Science Fair, exhibit at New Jersey State Museum in conjunction with NASA Traveling Exhibit, presentations at Philcon Science Fiction Convention

DC-L5 Chapter

Contact: Donnie Lowther, PO Box 3955, Merrifield VA 22216-3955
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Email: DC-L5@aroundspace.com
Projects: Around Space, cable TV access program

Region 8 Chapters: New York

Region 8 chapters coordinator:
Elaine Walker
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NSS Boston Chapter

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Suffolk Challengers for Space Chapter

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Email: francoisehardy51@viola.fr and edithpiaf51@hotmail.com
Online: www.geocities.com/francoise-hardy51/challengers.html
Projects: Aid to internet startup space firm, educational lectures on French space program

New Frontier Society of Greater Rochester Chapter

Contact: Carl Ellsbree, 117 Kirklees Road, Pittsford NY 14534
Phone: voice (585) 381-4218;
fax (585) 657-7244
Email: celsb@frontiernet.net
Online: <http://space.rochester.ny.us>
Publications: New Frontier Society of Greater Rochester

Long Island Space Society Chapter

Contact: Susan Raizer, 965 Merrick Ave., Merrick, NY 11566
Phone: (516) 489-1427
Email: Trekker724@aol.com
Online: www.lispace.org
Projects: Promote Space Exploration Act of 2002 and local space development authority; Challenger Center for Space Education

New York Space Society

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Phone: (201) 945-0769

Email: CPankanin@aol.com
Online: www.nsschapters.org/ny/nyc
Publications: Online monthly columns
Projects: Lecture series, monthly astronomy observations, host information table at Earth Day at Grand Central Station

Special Interest Chapters

Space Nursing Society Chapter

Contact: Linda Plush, RN, 3053 Rancho Vista Blvd. No. H377, Palmdale CA 93551
Phone: voice (661) 949-6780;
fax (661) 949-7292
Email: lplushsn@ix.netcom.com
Online: www.spacenursingsociety.com
Publications: Expanding Horizons, quarterly

The Odyssey Foundation Chapter

Contact: Harry K. Coffman, PO Box 18987, Huntsville AL 35804
Phone: (404) 786-5958
Online: www.theodysseyfoundation.org

United Societies in Space Chapter

Contact: Declan J. O'Donnell, 499 Larkspur Drive, Castle Rock CO 80104
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Email: djopc@qwest.net
Online: www.angelfire.com/space/usis
Publications: Space Governance Journal

NSS Space Elevator Cyber Chapter

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Online: <http://NSSchapters.org/nsecc> and <http://www.seattlewebcrafters.com/nsecc/> and <http://groups.yahoo.com/group/nsecc/>

International Chapters

Australia

NSS of Australia Chapter

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Publications: Space Frontier News, quarterly

Central Coast Space Frontier Society Chapter

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Online: www.nssa.com.au/ccsfs
Publications: The View From Earth

Newcastle Space Frontier Society Chapter

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Online: www.nssa.com.au/nsfs
Publications: NSFS Newsletter

Queensland Space Frontier Chapter

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Projects: Donate chapter library materials to schools and libraries

Sydney Space Frontier Society Chapter

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National Space of Australia Education Chapter

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Perth Space Frontier Society Chapter

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Germany

Deutsche Raumfahrtgesellschaft e.V. Chapter

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Online: www.drg-gss.org
Publications: Raumfahrt Concret

Mexico

Sociedad Espacial Mexicana, A.C. Chapter

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Email: semspaceorg@starmedia.com
Publications: XAMAN-EK, quarterly and semiannually

Major NSS Donors

National Space Society appreciates the financial support of all of its members, and would like to recognize the top donors in the last year (donation levels reflect cumulative contributions from May 2004—January 2005).

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MAIL TO: NATIONAL SPACE SOCIETY, 1620 I STREET NW, SUITE 615, WASHINGTON, DC 20006

VISIT US ON THE WEB AT: <http://www.nss.org/> OR CALL US AT: 1-202-429-1600

NSS FIRST TO ZERO-G

BY GEORGE T. WHITESIDES, NSS EXECUTIVE DIRECTOR

On September 17, NSS member Maria Thome took flight high above the Pacific Ocean and floated for the first time in her life.

Maria was onboard 'G-Force One,' a playfully named 727 aircraft modified by Zero Gravity Corp. for a type of maneuver called parabolic flight. This type of flight, in which the plane follows a long looping path up and down and back again, creates a condition of weightlessness inside the airplane for 30 seconds at a time. It's the closest you can get to being in orbit, and boy is it fun!

Maria's flight was chartered by NSS, but she and her flight mates paid their own money and had flown in from around the world to be a part of this experience. I salute each of them for being the first. Maria herself came in from Brazil, where she is an NSS chapter president. Eugene Roddenberry, a filmmaker from Los Angeles and Gene's son, was there too, as was Vanna Bonta, a writer and actress. And there was Jason Hillman, a teacher and NSS member from Texas, generously sent with funds from the Houston chapter, demonstrating weightless principles that he could show to the kids back in his classroom.

The Zero Gravity flight is a sign of things to come for NSS. The world of space is undergoing a revolution, and that revolution will bring a democratization of space experiences. The winning X Prize flights have changed everything. NSS intends to be at the front of that revolution, as we were for this

weightless flight. We are proud that NSS was the first membership organization to charter a zero gravity experience for our members. It's just the beginning.

Over the coming months, there will be more chances for NSS members to fly on weightless flights. We had a great presence at Burt Rutan's incredible X Prize launches, and we'll do the same for NASA's Return-to-Flight space shuttle mission next year. We will be involved in several space-related movies coming down the road. And starting in December, the Society will launch the first Zero-G sweepstakes in which one lucky member will get a chance to ride on the new service. Stay tuned for entry forms coming soon to your mailbox.

Creating a space-faring civilization—our ultimate goal—means bringing the whole human family into space. That road starts with milestones like the flight in Los Angeles. Later, that road will bring kids in space, musicians in space, teachers in space, trash collectors in space. Space is for us all, and the new experiences that are becoming available now open the door us for all of us to take part in space in fundamentally new ways.

These are exciting times, and seeing Maria, Eugene, Vanna and Jason float off the floor of the plane with wide weightless smiles really brought that home for me. I look forward to seeing more members with such smiles soon. 🌟



George T. Whitesides

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If you look back 500 years, few events stand out as truly important. A few pieces of great artwork, religious reforms, perhaps certain battles. Topping the list, though, is a discovery every child can recite, an event that shaped the entire world as we know it today—the voyage of Christopher Columbus and the explorations of a new world.

We are embarking on a similar journey, one that again will reshape the course of humanity. You have an opportunity to help bring it about as part of the lasting legacy we at the National Space Society are building, together with the world space community. Your vision of a future for all humanity, spread beyond these bounds of Earth, can be realized as testament to your courage and ability to imagine the possible.

If this is a legacy you wish to share with us, please consider remembering the National Space Society in your will, or through a planned gift. For more information on making a bequest or gift to NSS, please contact our executive director at (202) 429-1600.

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