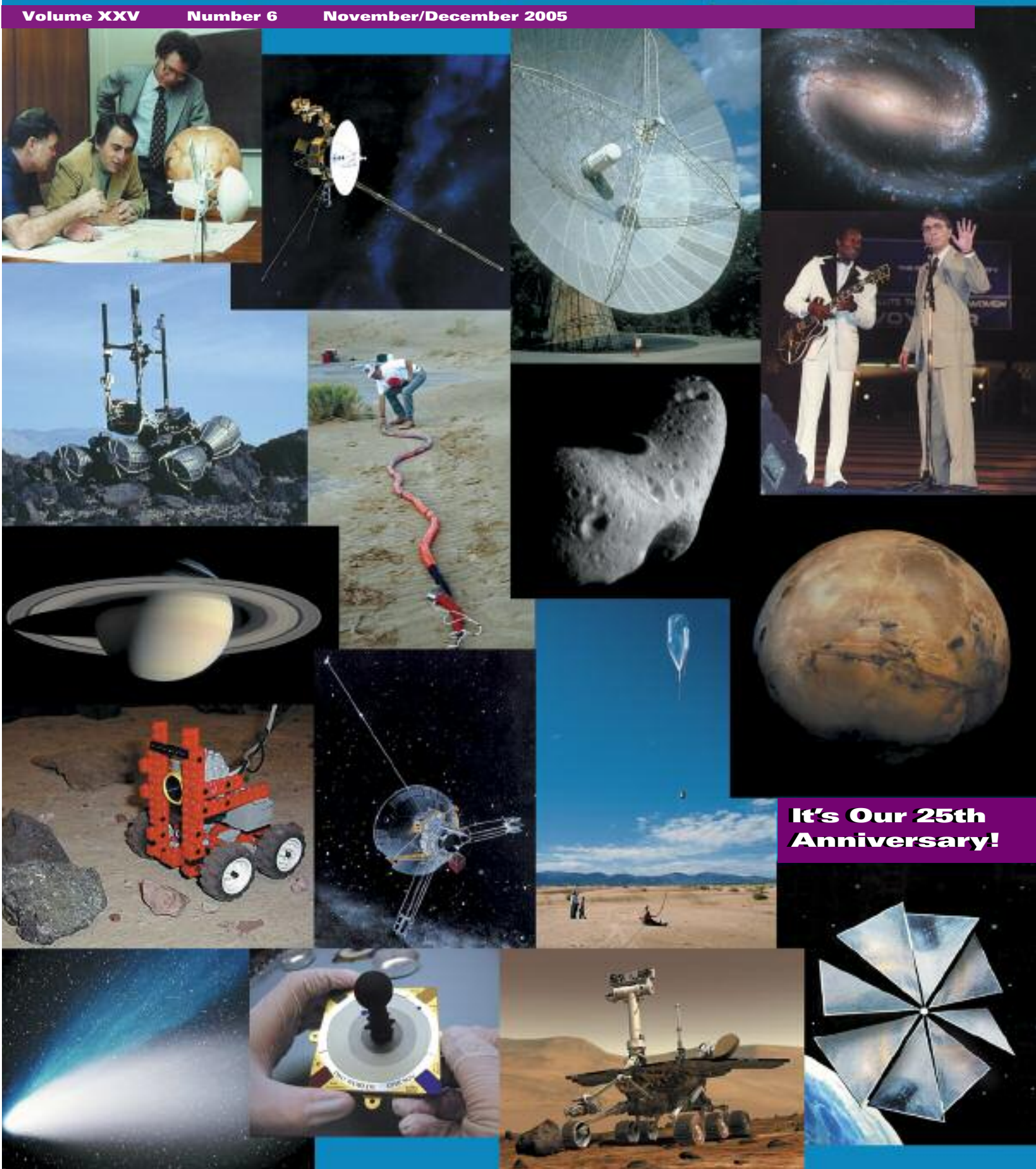
# The PLANETARY REPORT

Volume XXV Number 6 November/December 2005



It's Our 25th Anniversary!

A PUBLICATION OF THE PLANETARY SOCIETY

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## From The Editor

Twenty-five years ago, if you'd told me that in 2005 I'd be working at the same place, doing the same job, I would have said, "No way!" and dismissed you as a maniac or, at least, seriously delusional. So, after a quarter century, here I am, still working at The Planetary Society, introducing this twenty-fifth anniversary issue of *The Planetary Report*.

"Why?" people often ask me, aghast that anyone could have stayed in one job so long. There are many ways I answer, some more smart-alecky than others, but all the reasons distill down to one: The Planetary Society does things. We took as our motto, "We make it happen," and every day, the staff, directors, advisers, and—most important—our members work to fulfill the organization's mission: to explore other worlds and seek other life.

With honesty, perseverance, creativity, and just plain guts, the people of The Planetary Society work to change the world so that our robotic surrogates will explore the ocean that roils beneath Europa's icy crust. We will see human explorers leave footprints in the sands of Mars, and we will probe other star systems seeking to know if we truly are alone in this universe.

Very few jobs offer that kind of challenge and satisfaction. I'll keep this one for a little while longer.

—*Charlene M. Anderson*

**On the Cover:**

In 1980, Bruce Murray, Carl Sagan, and Louis Friedman formed The Planetary Society. This collection of photos represents some of the many facets of our history, of the future we hope for, and of the mission we strive for—to explore other worlds and to seek other life. Photos: The Planetary Society, NASA, Cornell University, and Maas Digital

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The Planetary Society has a mission like that of no other organization: creating ways for the public to have active roles in space exploration. We develop innovative technologies, like the first solar sail spacecraft; we fund astronomers hunting for hazardous asteroids and planets orbiting other stars; we support radio and optical searches for extraterrestrial life; and we influence decision makers, ensuring the future of space exploration. Here we look back at our history, both to feel good about our accomplishments and to ready ourselves for the next 25 years.

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We at The Planetary Society believe that our next age of exploration will be a vital and adventurous time, with our members involved in making great discoveries and acquiring new knowledge about our solar system and beyond. As we look toward our future, we are committed to continue leading by example—through private ventures, public-private partnerships, and space advocacy—to find more ways for the public to participate directly in humanity's evolution into a multiplanet species.

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# Members' **Dialogue**

## The Asteroid Threat

I want to commend the Society for publishing "We Must Decide to Do It" by Rusty Schweickart (see the July/August 2005 issue of *The Planetary Report*) and for your work with the B612 Foundation. There really isn't anything we are doing in space that is more important than this. If we miss something big coming this way, all of the other scientific activities won't matter at all.

Hopefully we can get NASA to increase its priority in the area of planetary defense. There doesn't seem to be any other agency taking ownership of the issue.

Please keep up your support for B612 and keep us informed of their progress.

—BILL PRESCOTT,
*Orange, California*

I'd like to respond to Mike Martinez' letter in the September/October issue. Mike, when you say that it's up to The Planetary Society, other related groups, and scientists to press NASA [to deflect asteroid 2004MN4], you're forgetting the biggest players in this job—all of us. It's up to everybody to get involved, and to try to get our neighbors, family members, and friends involved in stressing to NASA, and all the other space agencies around the world, the importance of keeping a watchful eye on these dangerous space neighbors of ours—the asteroids.

—PABLO CAFISO,
*Dundas, Ontario, Canada*

## Don't Dump the Shuttle

The space shuttle has been both a great success and a failure. From the standpoint of providing a low-cost, reliable, safe means to Earth orbit, it has fallen far short of expectations. Yes, the shuttle is inherently dangerous, but space travel will remain dangerous until such vehicles no longer depend on highly volatile fuels and pyrotechnics to accomplish their missions.

What the shuttle has successfully accomplished is providing an operational flexibility never before experienced. Orbital capabilities and the ability to use runways for landings are monumental achievements.

Space is infinite, but our resources to explore it are limited. There is nothing inherent in the shuttle's design that cannot be fixed or evolved. For continuous progress, a throwaway approach for space vehicles will not work. The shuttle is not retarding progress but is part of it.

Let's build and refine an infrastructure within the confines of existing technology: fly to orbit and back, transport to the Moon from the space station, establish Moon colonies, and then off to Mars.

—GEORGE MANCUSO,
*San Diego, California*

## *Voyager* Operations

The data that continue to be received by the *Voyager* spacecraft are unique in our studies of the universe, and it would be a historical tragedy if we simply turned them off as they leave the solar system. I've been watching the annual plea to keep *Voyager* operations alive for at least the last five years, and I have often wondered why a group of scientists couldn't simply take on the chore of receiving and recording the data for future analysis. John Cserep's letter in the September/October 2005 issue shows that I'm not the only person who has considered such action.

If this were done by a private group dedicated to recording the data for future scientific investigations, I don't understand why it would cost several million dollars per year. Why does this task take more than a couple of people in a data receiving station spread out over 4 to 10 shifts per week ? The labor and the data storage should be the major costs, or am I missing something? Why not solicit a volunteer task force to do this job? I suspect NASA might even be receptive to contributing the DSN operations costs as a cooperative venture with such a volunteer organization.

Such an activity would require novel partnerships with NASA, JPL, and the DSN network. I'm sure the volunteers could be found to reduce the data collection operations to almost zero. The government facilities might be induced to cooperate in the interest of saving the current costs of *Voyager* operations, and The Planetary Society, or similar organizations, can raise the remaining funds required to make this operation successful.

—HARVEY WILLENBERG,
*Huntsville, Alabama*

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Please send your letters to
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The Planetary Society
65 North Catalina Avenue
Pasadena, CA 91106-2301
or e-mail:
*tps.des@planetary.org*

# We Make It Happen!

by Bruce Betts

## 25 Years in Planetary Science

Since the founding of The Planetary Society, the human species has reached out, nearly completing its reconnaissance of the solar system, while at the same time starting to focus on certain regions of the solar system, searching for deeper understanding. We have found answers, and we've ended up with many more questions.

When The Planetary Society was formed, the planetary exploration program was nearly dead. This, in fact, was one of the main reasons Carl Sagan, Bruce Murray, and Lou Friedman formed The Planetary Society. *Voyagers 1* and *2* were headed to the outer solar system, but beyond that, the future of planetary exploration looked dim. (Ironically, today we are fighting to keep *Voyager* funded as it encounters the edge of our solar system.) *Voyager* turned out to be incredibly successful, and during the 1980s, NASA's planetary program started to turn around. Today, we are in the midst of a grand international era of planetary exploration, with five working spacecraft at Mars and one more on the way, a mission headed to Venus, a mission to Pluto launching in January, another mission returning to Mercury, and many other missions on their way or in the works.

## A Changing View of Our Solar System?

In the last 25 years, we explored the Uranian and Neptunian systems for the first time, and we didn't find what we expected. We explored comets for the first time, and we didn't find what we expected. We explored asteroids for the first time, and, well . . . you get the picture. Comets have variety and aren't all just dirty snowballs. Asteroids have variety as well, including, we think, some with rubble-pile structures and some with their own moons. We have discovered myriad near-Earth objects through programs like The Planetary Society's Shoemaker NEO grants.

We've found that all the giant planets, not just Saturn, have ring systems. Their numerous satellites make each of them like a miniature solar system. The *Galileo* and *Cassini* orbiters have provided great detail about the Jovian and Saturnian systems. We plunged a probe into Jupiter and descended into Titan's mysterious atmosphere.

We have explored Mars and seen a planet that gets more

# What's **Up?**

## In the Sky

Mars, glowing orange, continues to be bright in November but fades quickly as its distance grows from Earth. You can find it in the eastern sky in the early evening. Venus is the brightest starlike object in the sky and is seen in the west after sunset, getting lower as the weeks go on. Saturn is up in the midevening in the east. Bright Jupiter returns to the predawn sky in the east, and Mercury can be seen in mid-December low in the east just before dawn. The Geminid meteor shower peaks December 14, but the full Moon will interfere with observations. The Quatrantids peak January 4, 2006 but need a dark sky to be seen well. Both will have increased meteor activity for a few days before and after the peak. Look for rapid streaks of light crossing the sky, up to about 60 per hour.

## Random Space Fact

As the *Stardust* spacecraft flew through the coma of comet Wild 2, it was hit by up to 1 million particles per second. *Stardust* is scheduled to drop collected comet samples into the Utah desert on January 15, 2006.

## Trivia Contest

Our July/August contest winner is Paul Oakley of Hertfordshire, United Kingdom. Congratulations!

*The Question was:* STS-3 was the only space shuttle landing at a site other than Kennedy Space Center or Edwards Air Force Base. Where did it land?

*The Answer:* On March 30, 1982, STS-3 landed at White Sands, New Mexico.

Try to win a free year's Planetary Society membership and a Planetary Radio T-shirt by answering this question:

***What was the first spacecraft to return images from the surface of another planet?***

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E-mail your answer to *planetaryreport@planetary.org* or mail your answer to *The Planetary Report*, 65 North Catalina Avenue, Pasadena, CA 91106. Make sure you include the answer and your name, mailing address, and e-mail address (if you have one).

Submissions must be received by February 1, 2006. The winner will be chosen by a random drawing from among all the correct entries received.

For a weekly dose of "What's Up?" complete with humor, a weekly trivia contest, and a range of significant space and science fiction guests, listen to Planetary Radio at *planetary.org/radio.*

complicated the more we study it. In addition, we have gone from a post-*Viking* view that is negative on the possibility of life on Mars, to having a whole new field of astrobiology that ponders the possibilities of past life on the Red Planet. Astrobiology has been energized by Earth studies over the last 25 years as we've discovered how tough life is on Earth. The existence of Earth's "extremophiles" has led astrobiologists to drool over Jupiter's moon Europa and what we now think is a subsurface liquid water ocean. (The Planetary Society is right now pushing hard for a mission to this fascinating world.)

In only the last 10 years, the number of known planets has increased by a factor of more than 15, with more than 150 new worlds discovered orbiting other stars. The field of extrasolar planet studies—one the Society has long supported—has revolutionized our understanding of how solar systems form and what the norm is.

As I look at the exploration of the last 25 years, a few common themes arise in my mind.

- There is more complexity and diversity than we ever dreamed. Almost without exception, all worlds we explore—planets, moons, asteroids, or comets—are more complex than we imagined, and each has its own story.
- There is far more "recent" activity in our solar system than we expected 25 years ago, for example, Io's and Triton's active volcanism; recent geologic time (tens of millions of years) Martian volcanism and, perhaps, liquid water; resurfacing of all of Venus roughly 500 million years ago; and Titan's probable recurring methane rain and lakes, with associated erosion.
- Even as a scientist, I can't resist the aesthetic importance of these missions: the beauty and splendor of the universe never ceases. The more we explore, the more spectacular the vistas we uncover.

The Planetary Society has played an invaluable role in increasing the vibrancy of the planetary exploration program. Our membership allows us to be the voice for the interested public, a voice not easily ignored in the halls of national capitols or the halls of space agencies. There is much left to do, but as we reflect, let us be proud of how far we as humans, and we as The Planetary Society, have come. Let us continue toexplore and inspire—both as The Planetary Society and as a species.

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*Bruce Betts is director of projects at The Planetary Society.*

25th Anniversary

# Only the Beginning: The First 25 Years of The

For all of human history, the planets were wandering lights in the night sky. They stirred our ancestors, provoked their curiosity, and encouraged mathematics and more accurate record keeping. The work of Johannes Kepler and Isaac Newton in the understanding of planetary motion led to the development of modern physics and, in a very real sense, opened up the modern age of science and technology. In the last 18 years every one of those wandering lights has been visited by space vehicles from Earth. We humans have landed exquisite robot spacecraft on Mars and Venus and have orbited both planets. We have flown by Mercury, Jupiter, and Saturn. We discovered the broiling surface of Venus, the windswept valleys of Mars, the sulfur rivers of Io, the great polychrome storm systems of Jupiter. We have discovered new moons, new ring systems, puzzling markings, enigmatic pyramids, and have searched for life. Never again will the planets be mere wandering points of light. Because of the effort of the last two decades they will forever after be worlds crying out for exploration and discovery.

—Carl Sagan,
*Omni* magazine, September 1980

This was the situation in 1980, a time when the United States—the nation that had so boldly placed men on the Moon—was on the verge of pulling back from planetary exploration and confining human spaceflight to low Earth orbit. Carl Sagan, Bruce Murray, and Louis D. Friedman resolved to not let that happen.

***Planetary Society headquarters in Pasadena, California.***
*All photos by The Planetary Society, unless otherwise noted.*

They chose to act by forming a nonprofit membership organization to demonstrate unequivocally that a large, vocal, and active constituency existed for space exploration. Concurrently in *Omni* magazine and on the *The Tonight Show with Johnny Carson*, Carl Sagan announced the formation of The Planetary Society. Immediately, people flocked to join the new group, understanding that by coming together in a single cause, they would be able to foment change.

Within months, our membership expanded to include members around our planet, and the scope of The Planetary Society grew as well. It is said that the unstated purpose of a nonprofit organization is to change the world. In many ways, we've given it our best effort. In these pages, we have space to cover only a few highlights from our first 25 years. We know there's so much more to do; with the help of our members, in the next 25 years, we'll be even more effective.

## Politics *and* Advocacy

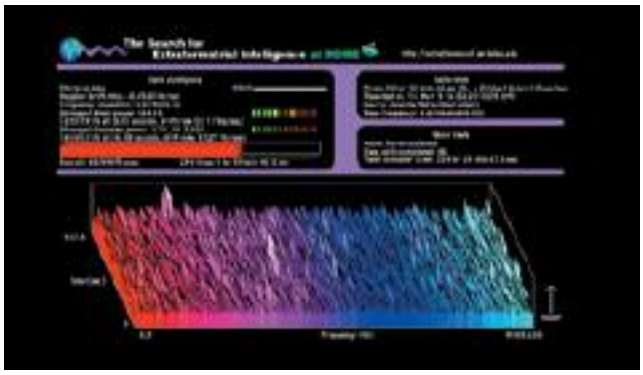
The Planetary Society was formed to demonstrate—simply by its existence—that the public strongly supported planetary exploration and the search for extraterrestrial life. We succeeded immediately in that goal, becoming the fastest-growing membership organization of the 1980s.

It quickly became clear that we were going to have to do more than just exist. In 1981, our first full year as an organization, Senator William Proxmire targeted NASA's SETI program for elimination. Society President Carl Sagan visited the senator and, with his considerable persuasive powers, convinced Proxmire to spare SETI. (NASA's program later fell to other budget axes, but the search continues in projects sponsored by The Planetary Society and the SETI Institute.)

In 1987, Mars became a primary focus for Planetary Society advocacy with the Mars Declaration, published in the *Washington Post*, in which we called on the spacefaring nations to join together

# Planetary Society

BY CHARLENE M. ANDERSON



*The original SETI@home screensaver.*

**New Horizons** ***at Pluto—a mission fought for long and hard by Planetary Society members.***

*Illustration: Johns Hopkins University, Applied Physics Laboratory*

*The 1991 Mars Rover test in Death Valley, California.*

***Eleanor Helin of the Jet Propulsion Laboratory scans the night sky for the Asteroid Project (which was supported by The Planetary Society).***

***Above: Southern Hemisphere SETI radio telescope dishes at the Argentine Institute of Radio Astronomy, south of Buenos Aires.***

***Left: The SETI dish at Harvard's Oak Ridge Observatory.***

*Photo: Paul Horowitz*

to send humans to explore the Red Planet. With an article in *Parade* magazine, Carl Sagan took our message to millions, and The Planetary Society established itself as a leading proponent of human spaceflight beyond Earth orbit.

To restart the flagging robotic efforts to explore Mars, in 1984 we brought together in Graz, Austria the leading scientists and engineers from the antagonistic superpowers—the United States and the Soviet Union—to find ways to merge their talents and capabilities into a coordinated endeavor to get us back to Mars. The Graz meeting planted a seed that grew into the International Mars Exploration Working Group, which today is helping propel the renaissance in robotic missions.

To add a dose of excitement and mobility to Mars missions, in 1990 we began to promote the use of robotic rovers as planetary explorers. We invited the public to watch the Russian rover tested in Death Valley, we showed off rovers' capabilities to tens of thousands in front of the Smithsonian Institution, and we paraded assorted rovers across the beach at Santa Monica, California. NASA noticed our efforts, and in 1997, *Mars Pathfinder* carried the rover *Sojourner* to the planet's surface.

When the *New Horizons* spacecraft lifts off next January, we will celebrate the culmination of our Pluto Campaign. In 1994, we began agitating to get a mission on the books, and eventually NASA initiated work. Then, in 2000, that work was ordered stopped. The Planetary Society swung into action and pressured NASA to get serious. Over

*Comet Hyakutake, imaged by Shoemaker NEO Grant winner Herman Mikuz on March 28, 1996.*

*The Mars Microphone.*
*Photo: © Robin Weiner, Associated Press*




*Photos 1–6: The 1990 Mars Balloon tests in Death Valley.*
*Photos: Charlene M. Anderson*



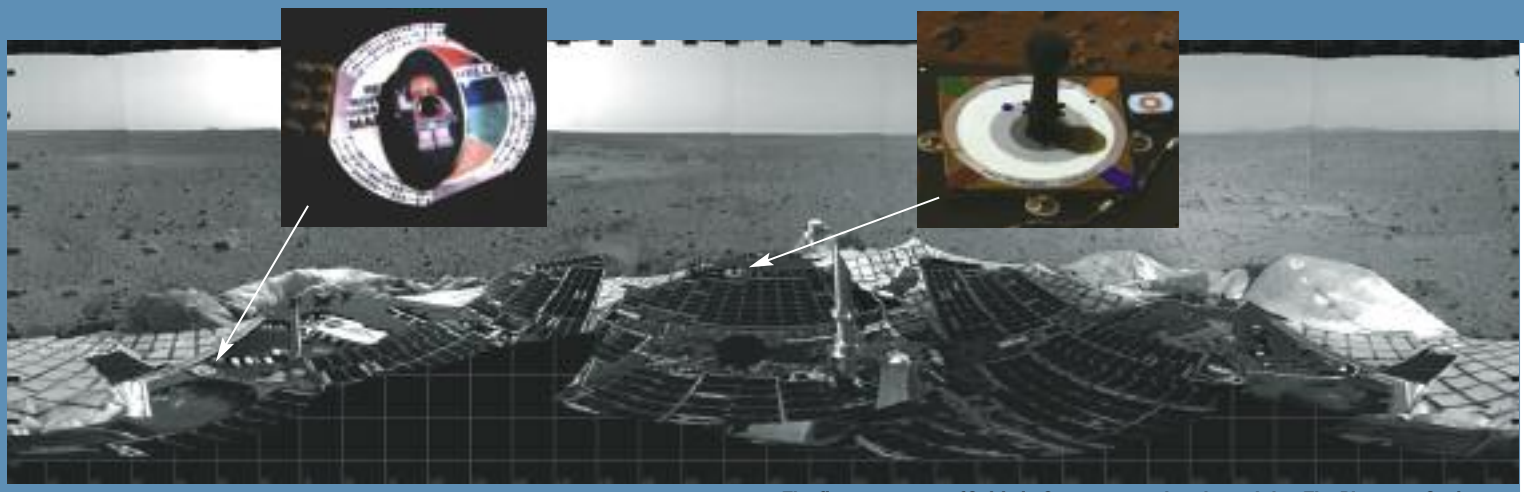

the next few years, we had to rise up again and again to keep a Pluto mission alive, earning in 2001 an Aerospace Laurel Award from *Aviation Week & Space Technology* for our campaign.

There is no doubt that without The Planetary Society, Earth's efforts to explore other worlds would not have reached as far into our solar system as they have today.

## Programs *and* Projects

At its founding in 1980, The Planetary Society was not designed to support its own projects in space exploration and the search for extraterrestrial life. But within our first year, we found ourselves called upon to step in where federal agencies had failed and fund SETI scientists to do their work. That set a precedent, and in 1982, we funded three research projects that grew into full-fledged Society programs on SETI (Paul Horowitz's Suitcase SETI), near-Earth objects (Eleanor Helin's asteroid discovery project), and extrasolar planets (George Gatewood's telescope at the Allegheny Observatory). We've never looked back.

Our SETI program has encompassed searches in radio and optical wavelengths from the Northern and Southern hemispheres of our planet. SETI@home,



*The first panorama of* Spirit *in Gusev crater also showed that The Planetary Society had landed on Mars. The inset at left shows the DVD that holds our members' names. At right is a close-up of the MarsDial.* Panorama: JPL/NASA, insets: JPL/NASA/Cornell University

## Members in Space

If you've been a member of The Planetary Society for several years, chances are that you have flown in space—or at least your name has. The practice of flying people's names with spacecraft began at least as early as the mid-1960s with the US *Ranger* mission to the Moon. At that time, the names of people who worked on the mission—and sometimes those of their families, including dogs—were attached to some part of the apparatus.

In the 1990s, The Planetary Society expanded the practice to include members of the public. We began by launching our members' names on the Russian *Mars '96* spacecraft that, unfortunately, ended up at the bottom of the Pacific Ocean.

But in 1997, to our surprise, *Mars Pathfinder* carried our members' names to the Red Planet. We didn't know until the spacecraft landed that the project team had affixed the names to the spacecraft; at Planetfest '97, they startled us by announcing it to the assembled thousands. Then Tony Spear, the *Pathfinder* project manager, further surprised us by announcing that the landed spacecraft would henceforth be known as the Carl Sagan Memorial Station on Mars.

*Planetary Society members' names smashed into comet Tempel 1 via* Deep Impact*'s copper projectile.* Image: JPL/NASA

Our members' signatures are orbiting Saturn with *Cassini*, while their digitized names are on the Martian surface on the *Spirit* and *Opportunity* landers and traveling back to Earth on *Stardust*. Their names crashed into comet Tempel 1 on the probe delivered by *Deep Impact* and, of course, splashed into the Barents Sea with our solar sail spacecraft, *Cosmos 1*.

Is this a worthwhile benefit of membership in The Planetary Society? Our longtime members tell us it is. In fact, some say that occasions of learning that their names have landed on and orbited other worlds have been among the proudest moments of their lives. We promise to keep doing it. —*CMA*

which binds together personal computers into the largest distributed computing experiment on Earth, is our best-known SETI project, but our efforts are many and varied. We've even funded an experiment in interspecies communication, with dolphins as the model.

Just before the Society was founded, a research group led by Luis Alvarez published a theory that an asteroid impact wiped out the dinosaurs 65 million years ago. Even after that paper sparked the realization that an object from space could wipe out civilization, asteroids attracted little research support. Seeing this as folly, The Planetary Society stepped in and supported groundbreaking projects to find and track potentially dangerous objects. We continue this work today through the Gene Shoemaker NEO Grants to amateurs and professional astronomers in developing nations.

Mars came late to our program roster; our efforts started only in 1985 with support to the Mars Underground, a group of university students agitating to make the human exploration of the Red Planet an international priority. In 1987, we started on hardware with an in situ propellant production experiment to test ways of producing fuel from Martian resources. The Mars Balloon project led to the development and testing of a flight component for a French experiment set to fly on a Russian mission. In 1996, we started work on our Mars Microphone, which reached Mars in 1999—unfortunately, the *Mars Polar Lander* carrying it crashed. But the Mars Microphone will fly again.

The search for extrasolar planets has reached the mass media only in the last decade, but The Planetary Society has supported ESP projects since 1982, funding Bruce Campbell's pioneering search for planets around other


***Through* The Planetary Report, *space scientists, engineers, and policy-makers talk directly to our members.***

stars using the spectroscopic method that has since found more planets than any other means. In the current decade, we've undertaken a "transit" search that will soon go live from Kitt Peak in Arizona.

What new, exciting space research will catch our attention next? Stay with us to find out.

## Publications *and* Information

When we began to create our flagship publication, *The Planetary Report*, we decided it would distinguish itself by providing a direct conduit between space professionals and Society members. By writing directly to members, scientists would report on their own discoveries, engineers would lay out their spacecraft designs, and policymakers would explain their decisions.

Turning sometimes arcane and technical manuscripts into readable articles can be an editing challenge, but we've worked hard at it, aided by a meticulous review process anchored for 25 years by Jim Burke, who's continued to fill this role even after his retirement from the technical staff at the Jet Propulsion Laboratory. With design and illustration guided by our designer for 25 years, Barbara Smith, we deliberately chose to avoid looking academic and official. As with the words, we strive to be accurate but approachable and entertaining.

Have we succeeded in what we set out to do? It looks like it. As with all serious organizations, from time to time The Planetary Society hires professional firms to survey the membership and assess how well we are doing. Although this can be a scary process, the editorial staff has come to look forward to seeing what the survey firms say about us—comments like "publications and the information they provide are clearly at the heart of the member relationship" and "It is extremely rare and impressive for an organization's publications to be considered the number-one benefit of being a member."

Through our website, *planetary.org*, and e-mail newsletters, we have the ability to communicate nearly instantaneously with members around the world. We try to apply the same standards to those media as well as our weekly radio program, Planetary Radio, as we do to our bimonthly *Planetary Report.*

We have just redesigned *planetary.org* to make it easier to use and to make it a more effective tool in disseminating the results of planetary exploration. If you haven't already, please visit the site and let us know what you think.

## Planetfests *and* More

We've thrown the biggest parties on Earth for our wandering spacecraft: Planetfest '81 for *Voyager 2* at Saturn, Planetfest '89 for *Voyager 2* at Neptune, Planetfest '97 for *Pathfinder* on Mars, Planetfest '99 for the ill-fated *Mars Polar Lander*, and Wild About Mars for the *Spirit* rover. Thousands of people from


***The* Independence Day*–inspired poster for Planetfest '97.***

***Left: Chuck Berry played "Johnny B. Goode" (which rode to space on the* Voyager *record) at the Society's Planetfest '89* Voyager *Wrap party.***

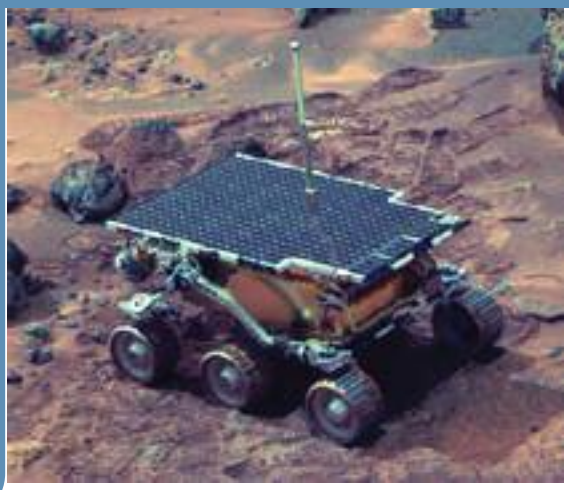
***Right: The crowd at Wild About Mars reacts to* Spirit*'s first signal from Mars.***

## The Naming of Spacecraft

**Planetary Society members have left their mark on space exploration in other ways, including the naming of spacecraft. To involve the public in space, we have held contests to name robotic explorers, beginning with the *Magellan* mission to map Venus with radar. The *Sojourner* rover, carried to Mars by *Pathfinder*, was named in a Society contest for the 19th-century abolitionist Sojourner Truth.**

***Spirit* and *Opportunity* are the two latest members of this naming tradition, given their sobriquets in a contest run by the Society with the LEGO Company as an extension of our Red Rover Goes to Mars partnership.**

**So, what will we name next? Stay tuned. . . .**



*The* Mars Pathfinder *rover* Sojourner *was named by Valerie Ambroise in a Planetary Society naming contest.* Image: JPL/NASA

around the world have come to Pasadena, California to celebrate these missions and to "be there" when history happens.

From lectures in small-town libraries to hanging a solar sail blade in Rockefeller Center in New York, we are constantly finding new ways to involve people. For example, the 1992 Rover Expo on the Mall in Washington, DC showcased robotic technologies for investigating other planets and helped convince politicians that the public would support little robotic rovers. A few years later, *Sojourner*, named in a Planetary Society contest, landed on Mars.

Even when we're having fun, we're working toward advancing our goals.

## Education *and* Scholarships

Planetary exploration is, by its very nature, a risky, ambitious, time-devouring process that demands a belief that it is worthwhile to commit today's time, energy, and resources to an endeavor that will bear fruit only in distant years. If you support planetary exploration, you must believe in the future. In that sense, it is much like the education of young people. Thus, it is natural that The Planetary Society dedicates itself to preparing the next generation of space explorers.

We have found many ways to do it, beginning with a nationwide essay contest connected to Planetfest '81. In 1992, with the H. Dudley Wright International "Together to Mars" Contest, we brought 27 students from 16 nations, from Ukraine to Malaysia, to attend the World Space Congress, held that year in Washington, DC Art contests, experiment-design contests, asteroid-naming contests—we've got the contest concept down, and our contests have been an effective way to get both kids and adults excited and involved in planetary projects.

Following the success of our Mars Rover Test Project in the early 1990s, we decided to capture the appeal of mobile planetary robots in an educational project called Red Rover, Red Rover. In partnership with the LEGO Company, we designed the project to involve students around the world in simulated Mars exploration. That simulation became real in Red Rover Goes to Mars, when students became actual Mars Exploration Rover team members, processing images of the MarsDials (another Planetary Society project) on *Spirit* and *Opportunity*.

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*Charlene Anderson is associate director of The Planetary Society and has been editor of* The Planetary Report *since its first issue in 1980.*

Spirit *and* Opportunity *were named through the Society's "Name the Rovers" contest by winner Sofi Collis.* Photo: JPL/NASA

*A Red Rover Mars Station gets a lot of play at Wild About Mars.*


*Red Rover Goes to Mars Student Astronauts give a press conference.*

# Our Next Age of Exploration

by Louis D. Friedman and Neil deGrasse Tyson

*A spacecraft skims the clouds above the atmosphere of an alien planet in* Reaching Out. *It is impossible to know now whether a scene like this, set in the far distant future, will ever become reality. However, if it does, the work we've done—and will do—in our next age of exploration will have provided the groundwork for such scenarios.*
*Illustration: Gary Tonge*

Exploration, like evolution, is a steady process punctuated by great episodes of frenetic activity and transforming change. The next age of exploration surely will build upon the accomplishments of the present age. But will it be marked by some great episode—a great moment of discovery or a grand adventure? Finding some little bug in a bit of Martian soil? Detecting an oxygen-rich atmosphere on an extrasolar planet? Launching an international human mission to Mars? Or the big one—receiving a signal from an extraterrestrial civilization? Any of these could provide the impetus for an unprecedented new era in exploration.

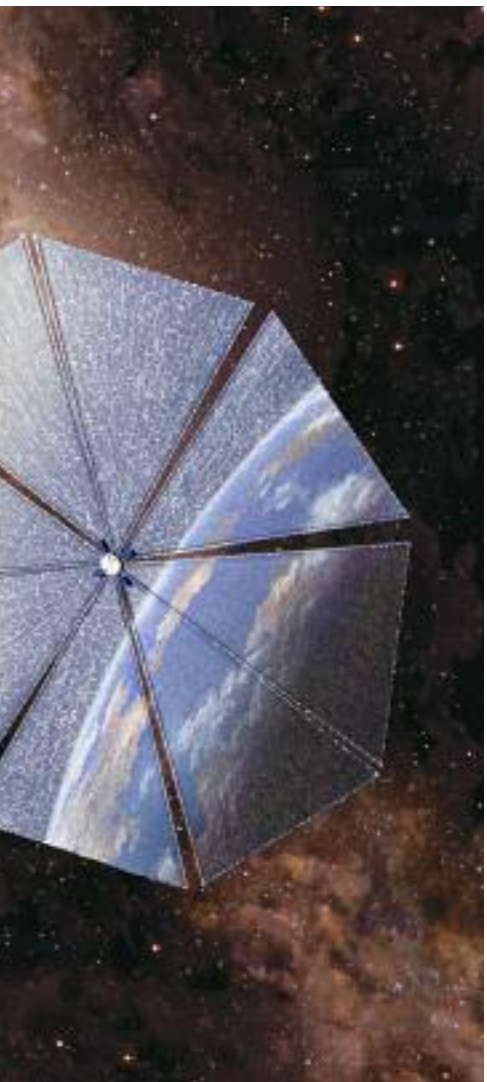
But we cannot rely on something unknown to move us forward. It could be that, 25 years from now, our exploration will remain limited to robots poking the surfaces of the Moon and Mars and flying around more distant worlds. Human explorers still may have ventured no farther than the Moon, and Earth may remain the only planet known to support life.

Whether or not the next 25 years see some great discovery in space, The Planetary Society will be driven by the same impulse that started us: to explore new worlds and seek other life. By 2030, our 50th anniversary, we might actually find extraterrestrial life and extend human presence into the solar system, or those objectives may remain only hopes for a more distant future.

Either way, we believe that our next age of exploration will be a vital, exciting, adventurous time, with Planetary Society members involved in the adventure of making great discoveries and acquiring new knowledge about our solar system neighborhood—and about ourselves.

Exploration, whether of new lands, uncharted seas, or the vastness of space, is only secondarily about what is to be discovered. Fundamentally, it is about humanity as an evolving species and our discovery of what we are capable of becoming.

Our hope for the next age of exploration is that it will involve a focus on the best and most creative aspects of



***Left: When the solar sail orbits Earth, the reflection of its home planet may be visible in its shimmering Mylar blades. The Planetary Society is determined to try again to make this happen.*** *Illustration: Rick Sternbach for The Planetary Society*

human achievement. We believe space exploration can do that if we solve issues created by two interfaces: between humans and robots and between humans and humans.

The first will determine whether we can be satisfied with sending robot emissaries to other worlds, from which they will beam back information to our increasingly capable gadgets, which will process information and enable us to feel as if we are there ourselves. Information-processing technology is advancing so quickly that we may be able to explore the solar system virtually from our homes, without giant rockets to launch heavy life support systems that humans require to survive on other worlds.

Even if we could program robots to equal us in exploratory performance (and we are decades, if not centuries, away from that), will we be satisfied? After all, most sports fans are happy just to watch a game, feeling no need to be involved personally, playing the sport themselves. But would we be satisfied if there were no living, breathing players, no humans such as Muhammad Ali, Venus Williams, or David Beckham, but only computer-driven fantasy sports? We feel that our species possesses an innate drive to explore, to actually set our feet on unknown territory, to travel to other worlds. In a century or two, this view may become outmoded, but for now, we remain human chauvinists and cheer on our fellows, and we hope to see them walk on other worlds. Perhaps we will watch a new space race: human desire to explore versus satisfaction with robots.

The second interface lies among humans themselves. From a cosmic perspective, we send representatives of planet Earth to explore other worlds. As we reach into space, we people of Earth organize ourselves into distinct

*In 1993, the* Marsokhod *was tested alongside the Jet Propulsion Laboratory's (JPL)* Rocky 4, *an early test model of* Sojourner, *the* Mars Pathfinder *spacecraft that would land on the Red Planet in 1997. Pictured from left to right are Ed McNevin, JPL; Louis Friedman, and Henry Stone, JPL.* Photo: JPL/NASA

*In late 1991, Slava Linkin of Russia's Space Research Institute and Louis Friedman demonstrated the* Marsokhod *to then-administrator of NASA Dan Goldin.*
Photo: The Planetary Society

*Working with the Russians, The Planetary Society advanced the technology of Mars rovers. An engineering model of the* Marsokhod *(which would later launch on Russia's doomed* Mars '96 *mission) traverses the bleak terrain of the Kamchatka peninsula.* Photo: The Planetary Society

nations, drawing on national budgets, to achieve national objectives. As space ventures become more complex and expensive, cooperation among nations becomes more attractive—perhaps even enabling. The US Space Station Freedom, proposed by President Reagan in 1984, went nowhere until it became the International Space Station. It probably would not have been built, and it could not have been maintained, had it not become an international project. This may well be true of ambitious robotic missions as well, such as returning a sample of Martian soil or rock to Earth. And human missions to Mars could be nearly impossible for one nation to accomplish alone.

Thus, The Planetary Society of the next quarter century must grow internationally. We are already an international organization, as we proved in putting together our international team to try the first solar sail. We are officially recognized as a nongovernmental organiza-

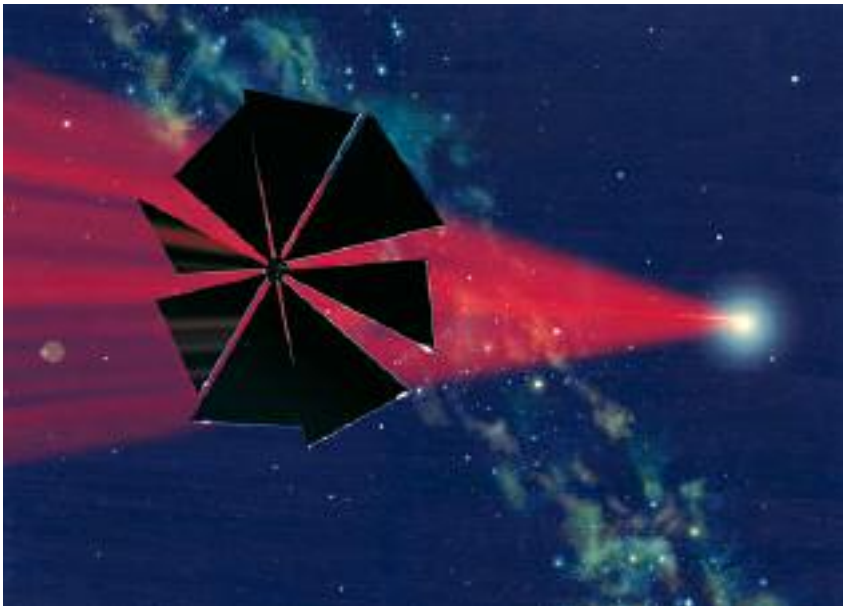
***In* View of Home*, a future explorer stands atop a huge rock on another world to look back at the planet that sent him (or her) there.*** *Painting: Frank Hettick*

tion (NGO) by the United Nations. Around the world, we play a significant role in making things happen in space. Working with the Russians and the French, we created a prototype Mars Balloon. With Russians and Americans, we advanced the technology of Mars rovers. But the attempt to conduct our own mission, working with Russian space capability, was our most audacious move yet.

Our creation of private space initiatives is fueled not by antigovernment rhetoric but by belief in the creativity and synergy of public-private cooperation. Just as international cooperation can bring greater resources to space ventures, so can public-private cooperation. Our solar sail project is designed to lead to bigger ventures in the solar system, perhaps interplanetary shuttles and, someday, to interstellar flight. There is no way that such expensive and demanding undertakings can be anything but government ventures.

The Planetary Society is determined to try again to fly the solar sail. We are determined to undertake new ventures and have some audacious ideas for our next age of exploration. We hope to pursue them with funding from private sponsors and, as we always do, with participation from citizens worldwide. We will fly other missions; we will even piggyback on others' spacecraft, as we did with the Mars Microphone. Just maybe, we will help trigger one of those great episodes of exploration.

The punctuations in the process of evolution are caused by mutations—from influences we don't entirely understand, perhaps some combination of competition, isolation, habitat change, or human interference. They may sometimes be entirely random. The great episodes in exploration also may be driven by a confluence of



***As solar sail technology advances, we may one day be able to push these delicate spacecraft outside the solar system with a beam of laser energy.*** *Illustration: Michael Carroll for The Planetary Society*

random events, but we know they can be influenced by human action. Those influences may be negative, such as conflict and conquest, or as when the Ming Dynasty, beset by a change of government focusing on domestic internal rivalries, recalled and burned the exploring fleet of Admiral Zheng He. Or they can be positive, such as President Thomas Jefferson sending Lewis and Clark to the American Northwest, seeking both to explore and to establish a presence in a new and largely unknown territory. These episodes also can be driven by random discoveries, such as those of spices in Southeast Asia, gold in California, or water on Europa. We can take advantage of such random discoveries only when foresighted political decisions support exploration and the pursuit of knowledge.

The Planetary Society exists to influence political decisions and to apply foresight to ensure that the outcomes of these decisions support space exploration. In our next age of exploration, The Planetary Society will lead by example: through private ventures, such as the solar sail; through public-private partnerships, such as the Mars Microphone; and through promoting grand and ambitious adventures, such as human missions to Mars. We will find more ways for members of the public to participate directly in humanity's evolution into a multiplanet species—as we inspire the people of Earth to explore other worlds and seek other life.

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*Louis D. Friedman is executive director of The Planetary Society and Neil deGrasse Tyson is chairman of the Society's Board of Directors.*

# Bill Nye Looks at Our Past and Our Future

When I saw my first picture from Mars in 1976, during a college astronomy course, I remember not being completely overwhelmed. Carl Sagan, our professor for this lecture, brought in remarkable images all the time. It seemed quite natural that we had sent a couple of spacecraft to a distant world, and here were some pictures to prove it. I was not astonished . . . that is, until Sagan pointed out that this was a picture of a real place. If you were properly equipped, you could go there and explore it. As your afternoon wore on, you could stop for lunch, just as you would here on Earth. (The length of a sol on Mars is quite close to the length of a day on Earth.) It was so very much like our own world, yet so different. I was fascinated.

I'd always loved airplanes, rocket ships, and exploring. I'd imagined myself as an astronaut many times and taken countless imaginary journeys to fantastic worlds. During each flight of imagination, I knew it was make-believe. But here was the most wonderful kind of exploration. It was real. Mars was actually being explored, and this is what it really looked like. Now, I was astonished. We might be part of something bigger, something universal. So, it would be a worthy thing to know our place in the universe, especially our place among the nearby planetary worlds.

I had the same feeling 14 years earlier, when my parents took us out into the street on a warm July night to observe the first Telstar satellite. It was as bright as a star, maybe a little brighter. It was different from a star, however; it was moving quickly across the sky. I was thrilled; I wanted to cheer. But all the grown-ups were hushed. They knew the world had changed; humans could fling things above the atmosphere into space. We could become wonderful space explorers, or we could become space warriors, using this technology to shoot weapons at those thought to be our enemies.

The vision of The Planetary Society was articulated to me during those all-too-brief astronomy lectures. By exploring space—especially the planets—we could elevate humankind, taking our place alongside other spacefaring species that might inhabit the cosmos. By means of science, we might discover life elsewhere. Or, we might find that we are completely, utterly alone. No matter what the outcome, planetary exploration is a noble activity, a worthy undertaking for us—more important than many other human pursuits. I got the message: if one wanted to be part of the future, join The Planetary Society. So in 1980, I did.

Since Carl Sagan, Bruce Murray, and Lou Friedman founded The Planetary Society, humankind has had a new and essential perspective of our Earth as a planetary world. The prediction that one day many nations would work together to explore space has come true in a limited but nevertheless real and important sense.

**Remember the Dream** ***captures that special feeling experienced by kids growing up in the early days of the Space Age.***

***Illustration: Frank Hettick***

Since the founding of the Society, our knowledge of planets has grown enormously. We've gotten close looks at the remarkable details of our planetary neighbors. It's routine now to study climates on these other worlds and compare them with that of our own—a notion not obvious to my parents or their parents. Just consider this idea: in the last 25 years, we have learned the fate of the ancient dinosaurs. They were killed directly or indirectly by the impact of meteoritic material from space. That planetary insight alone is astonishing. Without that impact 65 million years ago, we wouldn't be here.

Through all this, The Planetary Society has been on what rocket fin designers call the leading edge. The Society advocated mobility in Mars exploration, steady telemetry of fantastically distant spacecraft to gain fundamental knowledge of our solar system, and, recently, the building of humankind's first solar sail spacecraft. So, I ask myself often, who will make the next discoveries? Who will design the next spacecraft? Who will inspire our next space explorers? What will we learn about our past, our future, and our fate through the exploration of nearby worlds and the search for life elsewhere? No one knows, of course. But, I'm sure I want to be part of it. I hope you do, too.

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*Bill Nye is vice president of The Planetary Society.*

# World Watch

**by Louis D. Friedman**

Twenty-five years ago, I wrote my first column about space politics for *The Planetary Report* and called it "Washington Watch." We quickly learned that the politics and policies governing space exploration were not local to NASA Headquarters and the US Congress and administration, but instead were global, and that the public that supported us was spread around the world. Hence, we soon changed the name of this column.

The reality that space exploration is an endeavor of planet Earth and not of any one nation was certainly brought home to us this month.

While the space shuttle is grounded, American astronauts can't reach space unless they fly on Russian rockets. In November, the Iran Non-Proliferation Act (see World Watch in the July/August 2005 issue of *The Planetary Report*) was amended, making it possible for astronauts to fly to and from the International Space Station using Russian Soyuz spacecraft and launch vehicles.

While the US struggles to regain its human spaceflight capability, other nations are moving forward with their own programs. Europe and Japan have been stung by the possibility that the modules they built for the International Space Station may never fly because they are grounded by the problems in the shuttle program. Europe is contemplating working with the Russians to build a new orbital transfer vehicle and not waiting for the US to build its new Crew Exploration Vehicle. Meanwhile, China has completed its second human space mission, this time sending two *taikonauts* to Earth orbit and triggering speculation among space aficionados that another geopolitical space race may be brewing.

The robotic scene has also broadened worldwide. Japan's *Hayabusa* mission is currently in the midst of a fantastic and audacious asteroid sample return mission. The spacecraft hovered a few kilometers from the asteroid for almost a month before it reached out and touched the surface. As we go to press, we eagerly await details about the mission.

Europe's *Venus Express* is on its way, using a Russian rocket operated by a French-Russian private company. This orbiter was developed as a quick, low-cost successor to the enormously successful *Mars Express*, which is still working in Martian orbit.

And at Mars, US robots remain busy, with two orbiters and two rovers still cruising the surface. The *New Horizons* mission to Pluto and the Kuiper belt is ready for its January launch from Cape Canaveral. The *Cassini* orbiter continues to reveal more and more about Saturn, its tremendously intriguing moons, and its spectacular rings. Late last year, *Cassini* released the European *Huygens* probe to conduct its hugely successful mission on the surface of Titan, and scientists will be analyzing *Huygens* discoveries for years.

It's no wonder this column had to become a "World Watch." As we look toward the next 25 years of space exploration, we do so with an increased appreciation that, while Earthly politics may be local, space exploration is an endeavor that involves the entire world.

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*Louis D. Friedman is executive director of The Planetary Society.*

# Society News

### Our Next Age of Exploration

The Society's 25th Anniversary Gala Awards Dinner, held on November 12, was a huge success. Members, friends, and sponsors from around the world joined us to celebrate our anniversary and to honor Ray Bradbury and James Cameron.

Thanks to our generous sponsors: Northrop Grumman Corporation, SpaceX, The Jet Propulsion Laboratory, Raytheon, The Aerospace Corporation, The Boeing Company, Dan Geraci, Joseph Ryan, International Launch Services, Edison International, Swales Aerospace, and Paramount Home Video.

Special thanks to the M. R. & Evelyn Hudson Foundation; Florian Noller of Spaceflori; our Gala Awards Dinner Chair, Ann Druyan; and our Dinner Organizing Committee: Buzz Aldrin; Jacques Blamont, Roger Bonnet, Arthur C. Clarke, Charles Elachi, Garry E. Hunt, Louis M. Kwong, David Levy, Gordon Moore, G. Madavan Nair, Robert Picardo, Sally Ride, Dava Sobel, Edward Stone, and Henry Tanner.

Thank you, as well, to our members and supporters throughout the world—especially our Charter members, our New Millennium Committee, and our Discovery Team members who are too many in number to list by name in this small space.

Please visit *planetary.org* to learn more about how you can support The Planetary Society in our next age of exploration.

*—Andrea Carroll,*
*Director of Development*

### Society Adds to Board of Directors

The Planetary Society has added to our Board of Directors three prominent scientists: James Bell, Heidi Hammel, and George Yancopoulos.

Jim Bell, a professor of astronomy at Cornell University, may be best known to Society members for his leadership of the Mars Exploration Rover imaging team. Jim served as our science team liaison for The Planetary Society Red Rover Goes to Mars students and the sundial experiment on the Mars Exploration Rovers.

Heidi Hammel is a research scientist at the Space Science Institute. She gained international fame as leader of the Hubble Space Telescope team imaging the impact of comet Shoemaker-Levy 9 at Jupiter. Outer planets are her principal area of research, although she has also specialized in public education.

George Yancopoulos received his MD and PhD degrees in 1987 from Columbia University's College of Physicians & Surgeons. Following widely recognized work in the field of molecular immunology at Columbia University, he left academia in 1989 to serve as a founding scientist for Regeneron Pharmaceuticals, where he is now the chief scientific officer and President of Regeneron Laboratories.

*—Louis D. Friedman,*
*Executive Director*

# Questions and Answers

***We have marveled at* Cassini*'s ability to take pictures of Titan's surface by penetrating its hazy atmosphere. Can the same technique be used to image the surface of Venus, or is its atmosphere so different and/or thick that it cannot be penetrated from orbit?***
**—Dimitris Kiminas**
**Athens, Greece**

Even though Venus possesses a thick, cloudy atmosphere, 100 times more massive than Earth's, the surface indeed can be seen in certain infrared "colors." About 20 years ago, astronomer David Allen, using the Anglo-Australian Observatory's telescope, found that there are spectral "windows" through which heat radiation from Venus' hot lower atmosphere escapes. Allen made this discovery just prior to the *Galileo* spacecraft's 1990 flyby of Venus, so we programmed *Galileo*'s Near Infrared Mapping Spectrometer (NIMS) to map Venus in these windows.

Our images were spectacular, and we found spectral windows that would allow us to sense even down to the surface (see figure below). We used these planetary data to infer some absorption properties of the $CO_2$ molecule. (Usually it's the other way around—laboratory data are used to interpret planetary observations.)

Since then, Venus' surface has been observed by ground-based telescopes and briefly by *Cassini* during its Venus flyby. The European Space Agency's *Venus Express* mission has a Visible and Infrared Thermal Emission Imaging Spectrometer (VIRTIS) that will systematically map Venus' clouds and surface. Along with numerous atmospheric studies, these spectral images will be used to search for active volcanism and investigate surface composition.
—ROBERT W. CARLSON,
*Jet Propulsion Laboratory*

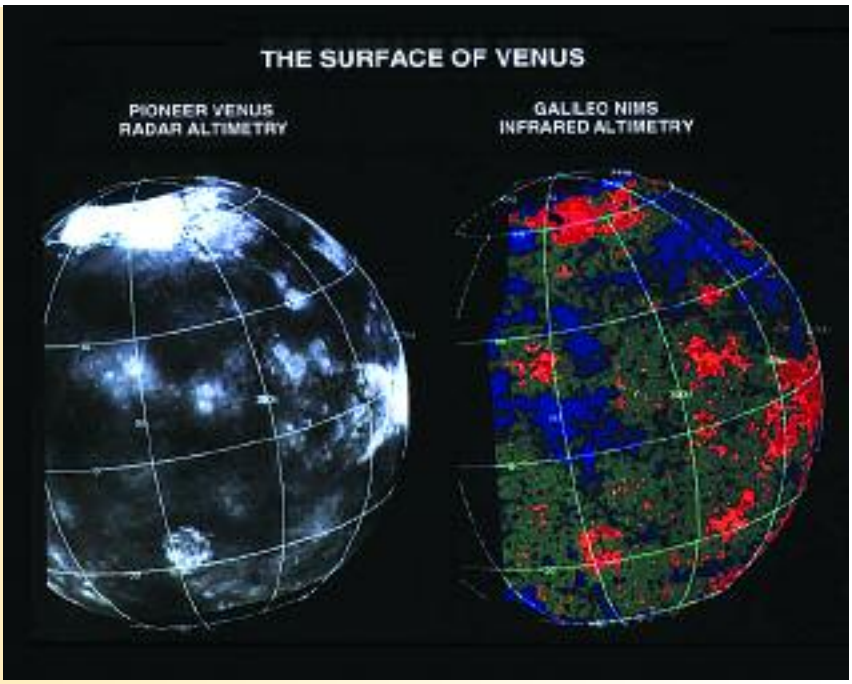
***Do scientists assign compass points to objects beyond our solar system, such as stars and galaxies? If so, how are these points determined?***
**—Miriam Smith**
**Santa Monica, California**

Assigning compass directions, even within the solar system, is complicated and not without some controversy. The need for such directions beyond the solar system follows an extension of the rules adopted for use closer to home.

Within the solar system, the International Astronomical Union (IAU) defines the north pole of a planet, satellite, asteroid, or other body as the rotation pole from which the object's axis extends into any part of the sky north of the celestial equator. The celestial equator is defined as an extension of Earth's equator into the sky. Essentially, the northern celestial hemisphere as seen from Earth defines north for the cosmos.

This leads to some oddities: Venus has a north pole, but the planet rotates "backward" compared with Earth and many other planets. Uranus also rotates backward by this definition, but it is tipped over so far that it almost seems like it is rolling around its orbit, and an observer visiting there would find things rather disorienting.

Some scientists argue that the north pole of a planet should be defined by the "right hand rule" (a convention widely used by physicists for many phenomena) and not by Earth.




***The infrared-derived topography (right) returned by* Galileo*'s Near Infrared Mapping Spectrometer is compared with radar altimetry at left. The highest regions are shown in the infrared map as red, and they include Venus' highest mountain, Maxwell Montes, which is almost 11 kilometers (or nearly 7 miles) high, in the far north and the 4-kilometer- (2.5-mile-) high Aphrodite Terra on the right limb.* Galileo*'s observations lasted only a few hours and provided just a glimpse of our sister planet; however,* Venus Express *will produce higher spatial and spectral maps such as this on a daily basis for more than a year.***
*Image: JPL/NASA*

To demonstrate this rule, curl the fingers of your right hand and point your thumb up. This orientation conveniently matches Earth's rotation (your curled fingers) and the north pole (your thumb). By the IAU's definition, Venus follows a left hand rule to keep north in the direction of your right thumb. Using the right hand rule places Venus' north pole in Earth's southern celestial hemisphere, but it would permit the Sun to rise in Venus' east and to set in Venus' west.

A source of confusion was added with the onset of the Space Age and lunar exploration. Until the 1960s, astronomers would refer to directions in the sky as the direction to the horizon on that side of the object. This led to confusion regarding the directions for east and west. As Earth rotates, any object larger than a star has "preceding" and "following" parts. An evening crescent Moon has its crescent preceding and its Earthlit portion following—these are astronomical west and astronomical east, respectively, and more commonly for Northern Hemisphere observers, right and left, respectively. ("Leading" equals west, which equals right; "following" equals east, which equals left.)

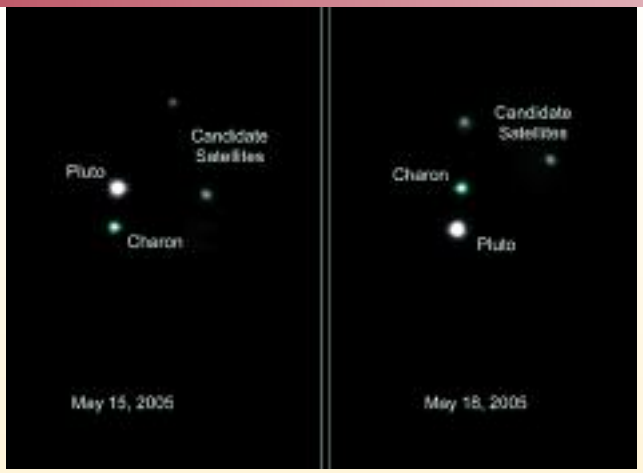
But for humans thinking about walking or driving around on the Moon and other planets, and also used to looking at maps, east is on the right and west is on the left. To avoid confusion, the astronomical view was dropped for the Moon and common usage was adopted for mapmaking.

When research on stars and galaxies needs to specify what is north and what is south, the orientation of the spin axis or the line perpendicular to the plane of the orbit is used to define north based on Earth's celestial equator.

A close example is the North Ecliptic Pole, which is defined as the direction perpendicular to the plane of Earth's orbit. It is located in the constellation Draco (the dragon), fairly high in the northern sky at dusk in midsummer (for Earth's Northern Hemisphere). The Milky Way's North Galactic Pole is situated in the constellation Coma Berenices (in Berenices' hair) which is high overhead at dusk in May.

—STEPHEN J. EDBERG,
*Jet Propulsion Laboratory*

# Factinos




***These Hubble Space Telescope images show Pluto, Charon, and the planet's two new candidate moons. Between the 15th and 18th of May 2005, Charon and the putative moons all appeared to rotate counterclockwise around Pluto.***

***Image: NASA, ESA, H. Weaver, A. Stern, and the HST Pluto Companion Search Team***

Scientists using the Hubble Space Telescope (HST) have discovered that Pluto may have an additional two moons, giving the ninth planet a total of three satellites.

On May 15 and 18, 2005, S. Alan Stern of the Southwest Research Institute and Harold F. Weaver of Johns Hopkins University found the new moons while studying Pluto in preparation for the *New Horizons* mission. The pair, temporarily called S/2005 P1 and S/2005 P2 (or simply P1 and P2), are 64,500 and 49,500 kilometers (40,000 and 30,700 miles) away from Pluto, respectively, and they appear to orbit in the same plane as Pluto's largest moon, Charon (see image above). They are about 150 and 100 kilometers (93 and 62 miles) across and have orbital periods of 38 and 25.5 days.

According to Stern, the little moons are not captured bodies—they most likely formed in the same collision that formed Charon.

For more details on this story, see *http://planetary.org/news/2005/1103_Hubble_Observations_Add_Two_New_Moons.html*

—from *SkyandTelescope.com*

NASA's Spitzer Space Telescope has spotted the very beginnings of what might become planets around brown dwarfs, or "failed stars."

The telescope's infrared eyes have, for the first time, detected clumps of microscopic dust grains and tiny crystals orbiting five brown dwarfs. Scientists believe these clumps and crystals collide and lump together to eventually make planets. Similar materials are seen in planet-forming regions around stars and in comets, the remnants of our own solar system's formation.

"We are learning that the first stages of planet formation are more robust than previously believed," said Daniel Apai, a scientist at the University of Arizona and member of the NASA Astrobiology Institute's Life and Planets Astrobiology Center. "Spitzer has given us the possibility to study how planets are built in widely different environments."

Apai and his team collected detailed information on the minerals that make up the dust disks of six young brown dwarfs located 520 light-years away, in the Chamaeleon constellation. The scientists discovered that five of the six disks contain relatively large grains and many small crystals of olivine, a green mineral found on Earth.

"We are seeing processed particles that are linking up and growing in size," said Ilaria Pascucci, also of the University of Arizona. "This is exciting because we weren't sure if the disks of such cool objects would behave the same way that stellar disks do."

—from the California Institute of Technology

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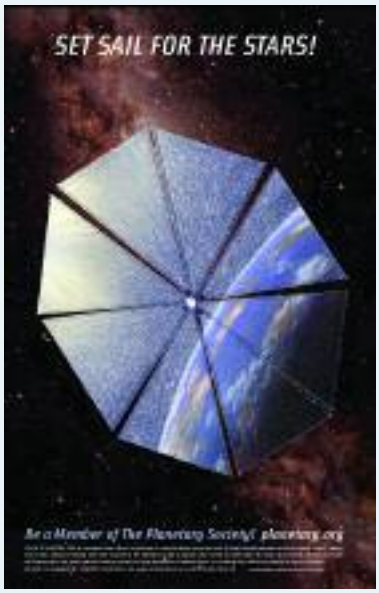



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*The Trustees of the Heinlein Prize Trust are pleased to announce the first prize winner of the Heinlein Student contest for China, co-sponsored by the Chinese Society of Aeronautics, is:*

## Mr. Hu Lingzin of the Nanjing University of Aeronautics and Astronautics, for his proposal for a "Generalist" electrodynamic space tether system.

From the right to the left of the photo: **Mr. Hu Lingzin,** first prize winner; **Mr. Yang Junhua,** Secretary-general of Chinese Society of Astronautics; **Prof. Li Furong,** Consultant, CSA; **Mrs. Guan Aiping,** Local Organizing Committee; **Prof. Wang Zhijing,** Evaluation Committee; and **Mr. Yu Ming,** winner of the Heinlein Excellence Prize.

Next year the Heinlein Prize Trust and the Chinese Society of Astronautics hope to invite student teams from all of Asia to propose commercial space projects for the Heinlein Student Contest.

For more information on the Heinlein Prize, please visit: www.heinleinprize.com
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