THE PLANETARY SOCIETY

# THE PLANETARY REPORT

SEPTEMBER EQUINOX 2012

VOLUME 32, NUMBER 3

*www.planetary.org*

## SUPER ROBOT

***CURIOSITY*** **OPENS A NEW ERA OF MARS EXPLORATION**

50 YEARS OUT IN THE SOLAR SYSTEM ✻ *CURIOSITY*'S FIRST DAYS ON MARS ✻ OPTICAL SETI

**EMILY STEWART LAKDAWALLA**
*blogs at* planetary.org/blog.

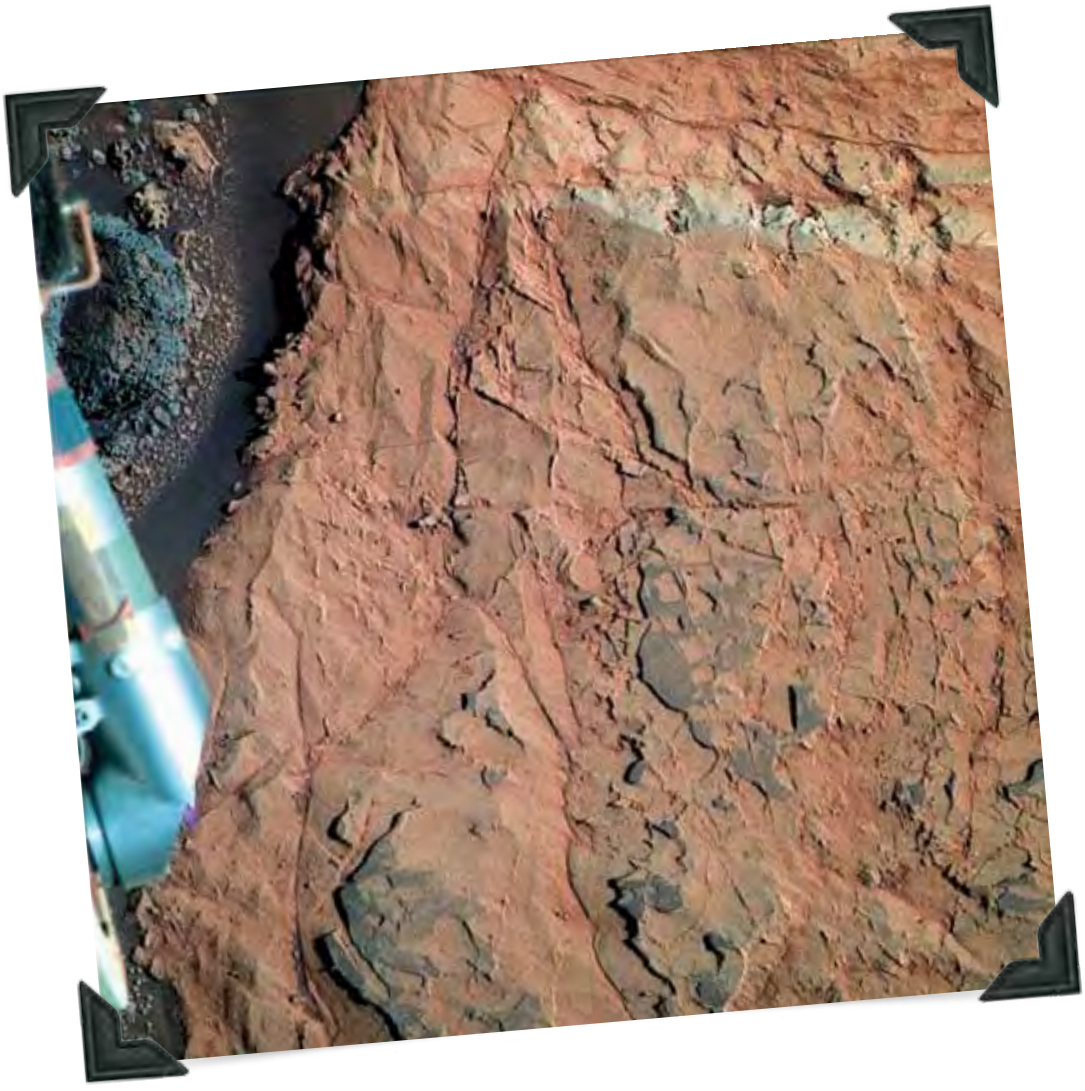

Photo: NASA/JPL/Cornell University/Karle Schlieff

# Catching More Opportunities

## Rover Finds New Rocks to Explore

**WITH THE COMING OF ITS FIFTH** Martian spring, *Opportunity* has been roving again, down the interior edge of the rim of Endeavour crater. At a site now named Matijevic Hill, *Opportunity* has discovered rocks unlike any previously seen during the mission. This outcrop, dubbed Whitewater Lake, contains myriad cracks and strange rock textures that speak of different, ancient Martian environments and the tremendous shock of the impact that created Endeavour crater. *Opportunity* likely will spend months exploring these new rocks.

*–Emily Stewart Lakdawalla*

**SEE MORE AMATEUR-PROCESSED SPACE IMAGES** PLANETARY.ORG/AMATEUR

**SEE MORE EVERY DAY!** PLANETARY.ORG/BLOGS



**ON THE COVER:** Named for that special characteristic that fuels humanity's desire to reach beyond its grasp, *Curiosity* captured this photo of itself on Mars with its Navigation Camera on August 28, 2012. Delivered to the Red Planet by a crazily complex landing procedure, the most advanced spacecraft laboratory in history is busy looking for evidence of past (or present) life on Mars—proving once again that space exploration brings out the best in us. *Image: NASA/JPL-Caltech*

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*The Planetary Report* (ISSN 0736-3680) is published quarterly at the editorial offices of The Planetary Society, 85 South Grand Avenue, Pasadena, CA 91105-1602, 626-793-5100. It is available to members of The Planetary Society. Annual dues in the United States are $37 (U.S. dollars); in Canada, $40 (Canadian dollars). Dues in other countries are $57 (U.S. dollars). Printed in USA. Third-class postage at Pasadena, California, and at an additional mailing office. Canada Post Agreement Number 87424.

**BILL NYE** *is chief executive officer of The Planetary Society.*



# We're on Mars

## ...but We Came from the Moon

**ONCE THE MARS SCIENCE LABORATORY** *Curiosity* rover landed on Mars, it took 14 minutes at the speed of light to send a signal to Earth. We all held our breath as we awaited confirmation of a successful entry into the Martian atmosphere, a successful supersonic parachute deployment, and successful attitude thruster firings.

Then came the moment. The results became clear; we received the signals telling the world that the wild rocket-powered sky crane had lowered its plutonium-powered rover payload, cut its cables, and flown away. Our spacecraft was on Mars! I hope you were among the Planetary Society Members and supporters around the world sharing the extraordinary night of August 5. Whether you were with the 3,200 people in Pasadena, where we filled a huge ballroom and the Pasadena Civic Center auditorium, or with the 6,000 or more people joining us electronically from 60 sites around the globe–this globe, the Earth–we shared something big, a giant step in humankind's search for water and life on another world.

If you weren't there, I urge you to check out the webcast at HTTP://BIT.LY/TPS120902.

Within five minutes of the landing, more than 4 billion kilometers (about 2.5 billion miles) away, we all saw the first images clearly showing *Curiosity*'s shadow. The crowd went wild. With each passing day, the images coming to us from *Curiosity*'s cameras continue to amaze and intrigue us. In the coming months, we can expect a steady stream of discoveries. Some will be astonishing.

The successful landing on Mars is wonderful news. This summer, though, has come with the deaths of two remarkable people: two astronauts who, each in his or her own way, changed the world. Sally Ride was the first woman from the United States to fly in space. Her professionalism and charm, and the visionary foundation she created to engage girls and young women in math and science, reverberate throughout the science education community today. She worked hard to achieve her goals in what started out as a man's world. Her success and contribution to the space program made it acceptable for girls and women coming after her also to pull themselves up, here on Earth or in the weightlessness of space.

Neil Armstrong also died this summer. He was a hero of the 20th century like no other. He got the assignment to land a completely novel rocket machine on Earth's Moon because he was the perfect man for the job: he could really fly, he had excellent judgment about the capabilities of his ship, and, above all, he had a remarkable ability to keep his wits about him in extraordinarily dangerous situations.

Neil learned to land on the Moon by flying a test machine called the Lunar Landing Research Vehicle. It looked like a metal insect or a complicated umbrella with no fabric–and had barely enough means to control it. In 1968, the thing went out of control. He ejected just high enough above the ground for his parachute to open and keep him from being killed. The story goes that afterward, he just packed up his chute and his gear, went up to his desk, and filled out the proper paperwork. Another day at the office.

Armstrong landed the Lunar Excursion Module on the Moon on July 20, 1969, memorably stating, "One small step for a man, one giant leap for mankind." Like many people my age, I was on my knees with my face as close to our General Electric black-and-white television as my parents would allow. He changed the world, and, of course, he certainly changed me. I went on to become a professional engineer and now am CEO of

The Planetary Society with a deep love of science and especially engineering, using science to solve problems and make things.

We all owe Neil Armstrong a debt. Just think how the world would be different if he had crashed on the Moon, or not managed to return from its surface, or if he and his crew had missed Earth on their way back. None of us would think of our place in the cosmos–our place in space–the same way. He raised the expectations–the hopes and dreams–of every human on Earth. Thanks to him, we all believe that humans can achieve great things, that we can learn about our place among the stars, that we can all reach up and out, that we can fly and change the world. It turns out, Neil, that yours was a pretty big step after all. Thank you, sir.

It's not an especially large step in thought to conclude that without Neil Armstrong and Sally Ride, or other astronauts every bit as competent, and without the tens of thousands of scientists, engineers, craftspeople, and staffers involved in that first lunar landing, and without the shuttle missions, the *Curiosity* rover never would have been funded and made it to Mars.

You and I are living in extraordinary times. We are on the verge of making discoveries that may very well prove that there was–or even is–life on Mars. At The Planetary Society, we don't want anyone to lose sight of this enormously important big idea. We must continue humankind's quest for knowledge beyond Earth. For this, we continue our political advocacy, especially here in the United States. We advocate for space exploration with the White House, with Congress, and now with the lesser-known, but essential, Office of Management and Budget and Office of Science and Technology Policy. We have to nudge the powers that be and remind them of the extraordinary value of planetary science missions.

I want to remind everyone that we are excited indeed about two upcoming smaller-scale missions to Mars: *MAVEN* (Mars Atmosphere & Volatile EvolutioN) and *InSIght* (Interior Exploration Investigation using Seismic Investigations, Geodesy and Heat Transport). These two spacecraft and their teams are going to do great work, but they are not of the scale of a flagship mission. Furthermore, *InSight* was selected over a mission to an asteroid and a remarkable mission to float a boat on the methane lake or sea of Saturn's moon Titan. It's heartbreaking. Two more great missions, each at a reasonable cost, but we cannot do them. *MAVEN* and *InSight* are going to do some important science, but they are constrained by their budgets to be less ambitious than *Curiosity*. We want the world's premier space agency to carry our proxies, our instruments and cameras, to other worlds in big ways to make the next big discoveries. It's your continued support that makes this kind of thoughtful, targeted advocacy possible.

Meanwhile, I participated in a conversation with astronauts about the International Space Station (ISS) from a studio in Britain. We showcased students who proposed experiments to be put in orbit and were selected to have their ideas fly! Not bad. With this, I hope to engage The Planetary Society and you in the human space program in a new way. Thanks for your continued support. The more people join with us, the more we can change the world.

Bill Nye

**ABOVE** *This past summer, Sally Ride, the first woman from the United States to go into space, and Neil Armstrong, the first human being to set foot on the Moon, both died. We thank them for their pioneering, world-changing work.*

**BELOW** *Bill Nye talks with students whose experiments were chosen to fly on the International Space Station. To watch the YouTube SpaceLab special of Bill and the students speaking with astronaut Sunita Williams on board the ISS, go to* HTTP://BIT.LY/TPS121093.

Sally Ride and Neil Armstrong photos: NASA; Bill Nye photo: YouTube.

**BRUCE BETTS** *is director of projects for The Planetary Society.*

# *Curiosity*'s First Days on Mars

**AWESOME! GENERALLY, THIS IS AN** overused word, but it truly applies to the landing of the Mars Science Laboratory mission's *Curiosity* rover on Mars on August 5, 2012 at 10:32 p.m. Pacific time. Many thousands of us experienced the tension, followed by joy, at The Planetary Society's Planetfest in Pasadena and at satellite Planetfests around the world, where we gathered to wait for—and celebrate—the landing. The visually stunning but seemingly crazy sky crane landing system worked flawlessly, setting a one-ton rover down on the Red Planet to begin years of scientific discovery with the most advanced robotically landed science payload ever assembled.

The mission, as of the time of this writing, has been essentially flawless. *Curiosity* landed two kilometers (about one mile) from the center of its landing ellipse in the 154-kilometer (96-mile) Gale crater. Immediately after touching down, it communicated its successful landing to Earth through an overflight of the *Mars Odyssey* spacecraft. Not only that, but it was able, in those first minutes, to return images from the hazard cameras (Hazcams) that sit low on the front and rear of the rover. The Hazcams are meant to be used to examine driving hazards near the rover, but at the beginning of the mission, they were the only cameras immediately available for use. Although the images were low-resolution thumbnails taken through dusty lens covers, they nevertheless communicated the glory of a new landing site.

Additional images and engineering data began to flow back over the first days, as more and more communication relays with Mars orbiters took place. In addition to the Hazcam images, photos began coming back from the descent imager, MARDI, which took pictures as *Curiosity* descended through the lower atmosphere. Images were taken from the time before the heat shield dropped away until the time of landing, nailing the location of the landing site and making for an amazing movie.

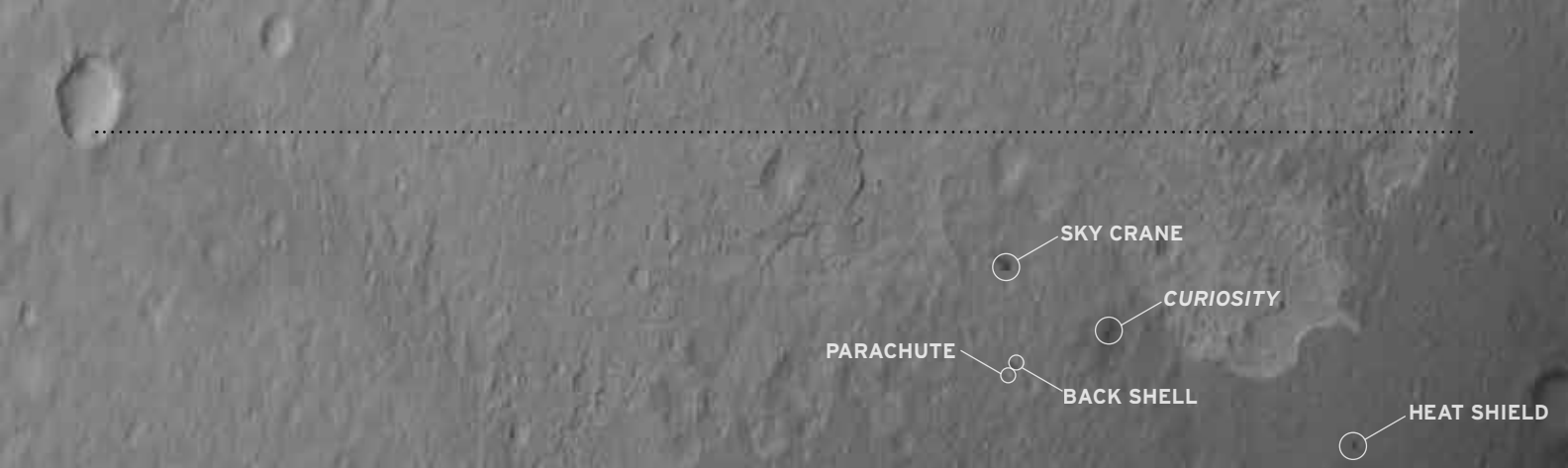
Patience is the mantra for *Curiosity*'s managers and engineers. Checkouts of systems proceeded at a methodical and planned pace. The mast was deployed on sol 2 (a sol is a Martian day, about 24 hours and 40 minutes long). This exposed the higher resolution stereo navigation cameras (Navcams) and the even higher resolution and color Mastcam science cameras, all of which are at the height of a tall human (6 feet, 9 inches). Every day during the first couple of weeks of the mission brought better images, each more stunning than the last. Because of the challenge of returning data from Mars to Earth, images typically are returned first as subsampled thumbnails. Then, when a data link is available, the full-resolution images are returned. The sequence of camera use from Hazcams to Navcams to Mastcams has made it feel like we are on a sailing ship of exploration, seeing the new land get crisper and richer with each new view.

Meanwhile, *Mars Reconnaissance Orbiter* was obtaining its own set of amazing images, from the lander on its parachute to the landing and impact sites of the rover, back shell, heat shield, descent stage, and ballast weights. Around each is a dark region where the bright dust has been blown away or where darker material has been ejected onto the surface.

As planned, a few sols after landing, the rover's software was upgraded, removing the no-longer-needed landing sequence software and improving the capabilities of the surface operations software. At the time of this writing, instruments are still undergoing checkout, high-resolution data are coming back gradually, and the exact traverse plan for the rover is being planned. *Curiosity* will set off toward Mt. Sharp (named for Caltech field geologist Bob Sharp, and formerly named Aeolis Mons). Gale crater was chosen as a landing site because it offered the opportunity to explore Mt. Sharp. Geologists love exposures of rock layers. Not only does Mt. Sharp contain layers, but its layers contain minerals like clays and sulfates that are associated with deposition in liquid water. Scientists probably won't be able to resist the temptation to study some rock outcrops on the way to Mt. Sharp.

Engineers and managers have done the hardest parts of their jobs with stunning success. Now, the scientists will be digging in, figuratively and literally. *Curiosity*'s diverse science payload consists of 10 instruments with 15 times the mass of the science payloads on the Mars Exploration Rovers *Spirit* or *Opportunity*. Obligatory pun: it is time to let our *Curiosity* wander.

Dust cloud image: NASA/JPL-Caltech; Mt. Sharp image: NASA/JPL-Caltech; HiRise image: NASA/JPL-Caltech/University of Arizona





Curiosity *appears to have captured the dust cloud thrown up by the impact of the descent stage (sky crane) in this Hazcam image (left), taken very shortly after landing. Note that the cloud feature does not appear in the image taken 45 minutes later (right). The image has spots because the clear lens covers were still on and became covered in dirt during the landing.*

*This early Hazcam image from* Curiosity *shows part of its ultimate destination, Mt. Sharp, as well as the shadow of the rover.*

*The 4.5-meter (15-foot) heat shield as it falls away from Mars Science Laboratory during descent. This image was one of many hundreds captured during the descent by the MARDI descent imager.*

*See more* Curiosity *photos at*
**PLANETARY.ORG/BLOGS**

# PLANETFEST




**THIS PAGE, CLOCKWISE FROM TOP LEFT** *A full-size SpaceX* Dragon *Crew Transportation Model gleams outside the convention center; a young explorer waves from the cockpit of a full-scale model of XCOR Aerospace's* Lynx *suborbital vehicle; NASA Administrator Charles Bolden joined JPL Director Charles Elachi to talk about leadership in space exploration; Bill Nye fires up the crowd at Saturday night's Celebrate* Curiosity *party;* Curiosity*–the inflatable version, that is!* **FACING PAGE FROM LEFT** *Author David Brin asks, "Why the sudden activity in space?"; Volunteer Geovanni Somoza demonstrates how to use ordinary ingredients to create an icy "comet nucleus"; JPL staff displayed a rover wheel just like those on* Curiosity*; well-known space artists displayed originals and prints for sale.*

Photos: SpaceX *Dragon*: Albert Garcia, NZ Graphics; Celebrate *Curiosity* party: payvlie; all others: Cheri Kinley.

**DONNA STEVENS** *is senior editor of* The Planetary Report.

**THOSE OF YOU WHO'VE BEEN** Members for years know that The Planetary Society has a long history of throwing a multiday party called Planetfest to celebrate an important landing or flyby at another world. We want everyone who attends to have thousands of fellow space exploration enthusiasts—kindred spirits—with whom to share the excitement. To that end, Planetfest 2012 did not disappoint. The successful landing of the Mars Science Laboratory (MSL) *Curiosity* rover on the Red Planet was the perfect and thrilling finish to a weekend celebration of the passion, beauty, and joy of exploring space.

Held at Pasadena's newly remodeled convention center, Planetfest 2012 featured a nonstop lineup of A-list speakers from all walks of the space exploration community, such as science, engineering, outreach, history, and the arts. Adding to the fun were surprise visits by NASA Administrator Charles Bolden, astronaut and NASA Associate Administrator for the Science Mission Directorate John Grunsfeld, *Cosmos* writer Ann Druyan, and TV producer Seth MacFarlane, who will be bringing us a new *Cosmos* series, currently in production.

A variety of engaging exhibits also kept festivalgoers entertained. JPL displayed a life-size inflatable model of *Curiosity*; there was a touchable Mars meteorite; well-known space artists displayed their work and painted on site; and solar system formation processes were illuminated and Sun and Marsdials explained, to name a few. Our most audacious exhibits, however, were two full-size spacecraft donated by our sponsors, SpaceX and XCOR. The SpaceX *Dragon* Crew Transportation Module, too big to get into the building, greeted attendees and created an exciting spectacle on the sidewalk outside. Indoors, guests were able to sit in the pilot's seat of XCOR's *Lynx* suborbital vehicle.

On Saturday, our Celebrate *Curiosity* after-hours party blazed late into the night at Pasadena's Paseo Colorado across the street from the convention center.

A live DJ and lightning speakers provided audible stimulation, while "Astronaut" mojitos, free LED necklaces, spacey costumes, and lively conversation provided the rest.

On Sunday we had more than 45 other Planetfest-themed events worldwide, including major happenings in Toronto and Atlanta. We Skype-chatted with the Toronto group as well as a very festive bunch in Melbourne, Australia. Our live Internet feed (when it worked) shared Planetfest with additional thousands of folks on both days.

Of course, the grand finale—the main reason we all were there—was the complex, risky landing of *Curiosity* on Mars late Sunday night. Thousands packed the main ballroom and waited in silence as the time inched closer to MSL's entry, descent, and landing. On the big screen, we witnessed the almost palpable tension of mission controllers at JPL. The silence was not long-lived, and after the now-famous "seven minutes of terror," cheers from the crowd erupted after each successful operation: parachute deployment, heat shield separation, powered flight, and skycrane function. When JPL announced that *Curiosity* had touched down, the jubilation that ensued no doubt burned itself into the memories of everyone in the room.

Planetfest 2012 was a success because of the hard

work of every employee at The Planetary Society. We're not a large group, and to produce an event of this magnitude required long days (and nights) of organization and planning. We wouldn't have been able to pull it off, however, without the help of our dozens of wonderful volunteers, who worked tirelessly to help make Planetfest a success. We cannot thank them enough for their dedication.

Most of Planetfest 2012 is already available for streaming at the Planetfest Livestream Event page, HTTP://BIT.LY/TPS121090, and we have posted individual talks on our YouTube channel at HTTP://BIT.LY/TPS121091. Finally, you can browse through hundreds of photos on The Planetary Society's Photostream at HTTP://BIT.LY/TPS121092.

We had a lot of fun putting Planetfest 2012 together, and we had even more fun watching our guests have a great time. Thanks, everyone!

## Thank you, Planetfest Sponsors!

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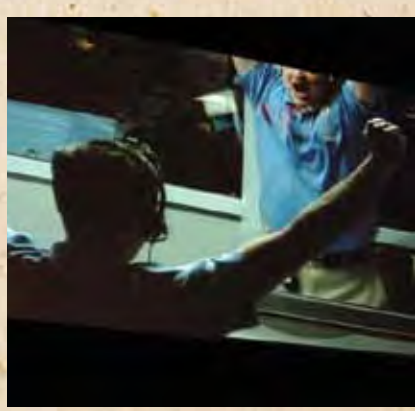
**Thank you to *Planetary Society Members* worldwide, and to our *Charter Members*, our *New Millennium Committee* Members, our *Discovery Team* Members, and our *Legacy Society* Members!**



**CLOCKWISE FROM ABOVE** *Seth MacFarlane and Ann Druyan announced the coming of a new* Cosmos *series; our big-screen window to JPL's mission control showed a quiet, tension-filled room in the moments before landing; once* Curiosity *let Earth know it was safe on Mars, mission control exploded with joy; across town in our ballroom, the scene was the same. This is why we produce Planetfests!*

**BRUCE BETTS** *is director of projects for The Planetary Society.*

# Major Upgrade

## New SETI Electronics, Asteroid Detection, and a Naming Contest

### SHOEMAKER NEO GRANT ENABLES DISCOVERY OF FEBRUARY 2013 CLOSE FLYBY ASTEROID

A Planetary Society Shoemaker Near-Earth Objects Grant enabled the discovery of the 50-meter asteroid 2012 DA14, which will pass Earth at about the distance of geostationary communications satellites on February 15, 2013 at 19:25 UT. The asteroid is similar in size to the object that caused the Tunguska air burst in 1908 over Siberia that leveled 2,000 square kilometers (770 square miles) of forest. There is no danger of impact from the 2013 asteroid pass of 2012 DA14.

The discovery was made by astronomers at La Sagra Observatory in southern Spain. Jaime Nomen and his colleagues there were awarded a Shoemaker NEO Grant to upgrade one of their telescopes with a new camera with faster readout times, precisely with the goal of detecting objects like 2012 DA14—fast-moving objects that pass close to Earth and require rapid imaging for discovery and orbit tracking. 2012 DA14 easily could have avoided detection without the specialized system. The upgraded telescope at La Sagra has far outperformed the observatory's other telescopes in terms of discovery, with about 10 near-Earth object discoveries and a recent comet discovery.

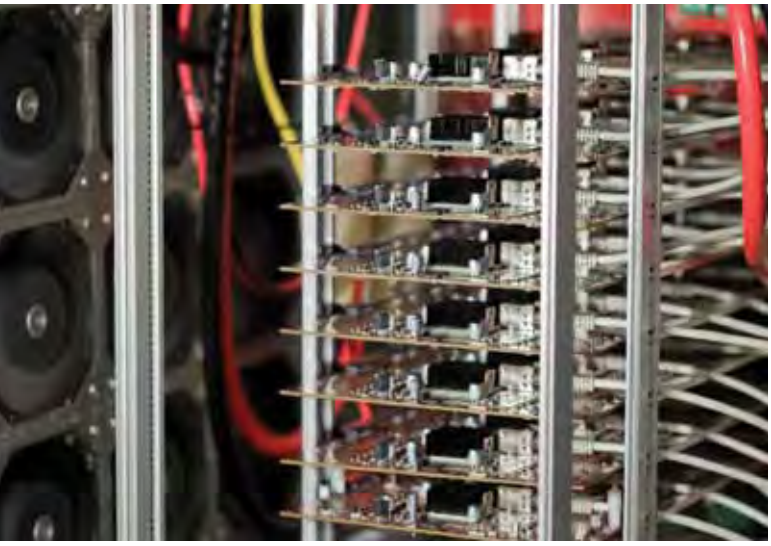
Current estimates are that 2012 DA14 will not be visible with the naked eye but might be seen with binoculars or a small telescope. It will be moving across the sky at about one Moon diameter per minute. Knowing that the close approach is coming will enable telescopic and radar studies of the characteristics of the asteroid and the ability to refine knowledge of the orbit so as to better determine future close approaches and possible impacts. The 2012 DA14 flyby in 2013 also will serve as a test and warm-up for a similar flyby in 2029 of the larger, 270-meter asteroid Apophis, co-discovered by Shoemaker NEO Grant winner Roy Tucker. For more information, including an animation of the Discovery images of 2012 DA14, visit HTTP://BIT.LY/TPS121098.

### OPTICAL SETI GETS A MAJOR UPGRADE

The Planetary Society Optical SETI Telescope in Harvard, Massachusetts just received a major upgrade of its electronics. The telescope, which has been operating the only all-sky optical SETI survey since its opening in 2006, is run by Harvard University Professor Paul Horowitz and his team. The telescope scans the sky every clear night with a 183-centimeter (72-inch) primary mirror, looking for laser pulses as short as 1 billionth of a second that could be transmitted by distant extraterrestrials. When observing, it has been able to process 1 terabit (trillion bits) of data every second—as much data

**ABOVE** *Grad student Curtis Mead designed the new 12-layer boards that will even more quickly discriminate between Cherenkov radiation and potential laser pulses in the Optical SETI Telescope.*

Planetary Society Members have helped make the Shoemaker Grant and Optical SETI projects possible. *Thanks!*



**ABOVE** *An array of new OSETI electronics boards on the lab's test bench.*

**RIGHT** *OSETI team members prepare to hoist a set of incredibly advanced electronics boards into the Planetary Society OSETI Telescope building. From left: Al Sliski, Curtis Mead, Balthasar Müller, Aaron Sliski.*


as in all the books in print worldwide.

One cause of false triggers of the system has been Cherenkov radiation, light given off when charged cosmic particles plunge through Earth's atmosphere faster than the speed that light travels in the atmosphere. What was needed was a new, even more amazing set of back-end electronics that could not only sift data quickly but also store more data than previously possible. As a result, the streaks of light from Cherenkov radiation or other sources can be sorted out from the points of light that might emanate from an alien signal. Enter graduate student Curtis Mead's impressive designs for electronics boards.

Those boards, made possible by Planetary Society members, have now been fabricated, thoroughly tested in the lab, and recently installed on the telescope. But wait—it gets better. The Harvard team also upgraded the photomultiplier tube detectors with new models that are more sensitive and that extend out into the infrared (to 950 nanometers wavelength). Because we don't know the wavelength at which ET might transmit, observing at a wider range of wavelengths will improve our chances. ET, we're watching.

See the July/August 2010 issue of *The Planetary Report* for more details on the Planetary Society Optical SETI Telescope and on the electronics upgrades, which were no more than hoped-for plans at the time. Check out my recent blog about the upgrade at HTTP://BIT.LY/TPS121099.

## NAME AN ASTEROID!

This fall, The Planetary Society is running a contest for students to suggest a name for the near-Earth asteroid from which NASA's OSIRIS-REx (Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer) mission will return samples. The mission is looking for a name that is a little easier to chew on than (101955) 1999 RQ36. The naming contest for the near-Earth asteroid is a partnership of The Planetary Society, MIT's Lincoln Laboratory (the discoverers of 1999 RQ36), and the University of Arizona. Dante Lauretta of the University of Arizona is the mission's principal investigator. Look for details and official rules on our website, HTTP://PLANETARY.ORG/NAME, and help spread the word to students under the age of 18.

OSETI photos: Paul Horowitz; "Name that Asteroid" illustration: NASA/Goddard/University of Arizona

**PAUL SCHENK** *is a senior staff scientist at Houston's Lunar and Planetary Institute.*

**LEFT** *It has been half a century since the launch of* Mariner 2*, the first robotic explorer to successfully visit another world and return data to Earth. The spacecraft measured the temperatures of Venus' clouds and surface, as well as the nature of fields and particles near the planet and in interplanetary space.*

# Why We Explore

## Celebrating 50 Years in the Solar System

### THE SUMMER OF 1962

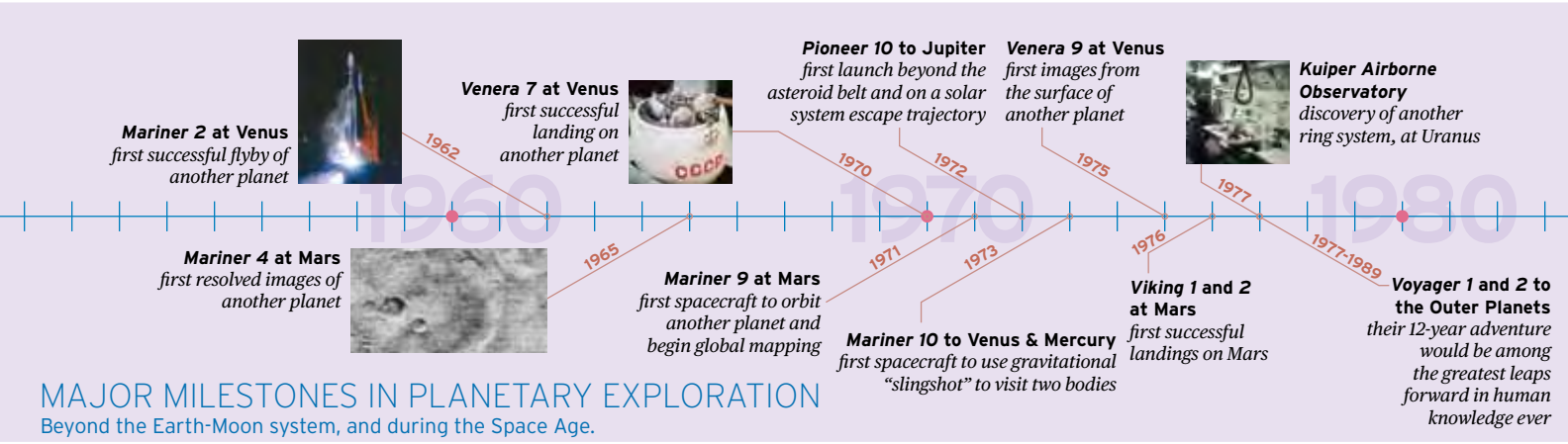
The engineers were nervous, and not without reason, having tried only a month earlier, without success, what they would attempt today. Indeed, July 22 had been the kind of day that gave engineers unpleasant dreams too often in 1962. An Atlas-Agena booster bearing a robotic dragonfly code-named *Mariner 1* had veered dangerously off course and was destroyed. Now they were set to try again, sending its prudently constructed twin, *Mariner 2*, on an unprecedented deep-space cruise to the planet Venus. If they were successful, they would have won a major scientific and Cold War prize, the first successful rendezvous with another planet.

Despite occasional disorientation and a solar panel failure during its four-month cruise, *Mariner 2* passed within 35,000 kilometers (22,000 miles) of Venus' opaque cloud tops on December 14, 1962. *Mariner 2* accomplished several things that day. Its instruments confirmed the worst suspicions about our twin-like nearest neighbor, a blisteringly hot, dry place smothered under a dense, crushing atmosphere. Equally important for the scientific revolution that followed, a remotely controlled machine had been sent to another planet and successfully returned data. The solar system was now open to examination.

This autumn, we celebrate the 50th anniversary of these events, yet the mission of *Mariner 2* did not grip the headlines as did other early major milestones in space. Despite occasional drama during the cruise, the vehicle lacked an occupant (John Glenn had orbited Earth only a few months before) and, most problematic, returned no pictures!

**BELOW** *In 1965, too eager to wait for the official processed image from* Mariner 4 *at Mars, Jet Propulsion Laboratory staffers got creative. Here, a "real-time data translator" converts digital image data into numbers on strips of paper, which he then hand-colors, like a paint-by-numbers picture.*

Images: NASA/JPL-Caltech




## MAJOR MILESTONES IN PLANETARY EXPLORATION

Beyond the Earth-Moon system, and during the Space Age.

**BELOW** *Before spacecraft visited Venus, our notions of the planet's hot surface, under its thick atmosphere, leaned toward visions of sandy deserts or steamy, oily swamps—possibly full of monstrous creatures.* Mariner 2 *showed conclusively that there was no water on Venus and that the temperatures there were much higher than scientists believed possible.*


It was thought that Venus was bland, as the dramatic cloud structures visible in the ultraviolet wavelength were not well known. Also, Centaur was not ready, and Agena boosters could not loft much payload, camera included.

Much more would be revealed about Venus and the other planets over the next decades, and today we have spacecraft on their way to or orbiting every major planet (except Uranus and Neptune) and three dwarf planets. That is an astonishing leap for only 50 years, and this year's anniversary provides a welcome opportunity to look back and ask "What have we learned for all our travels?" Before we can answer that, we need to recall where we stood in the summer of 1962.

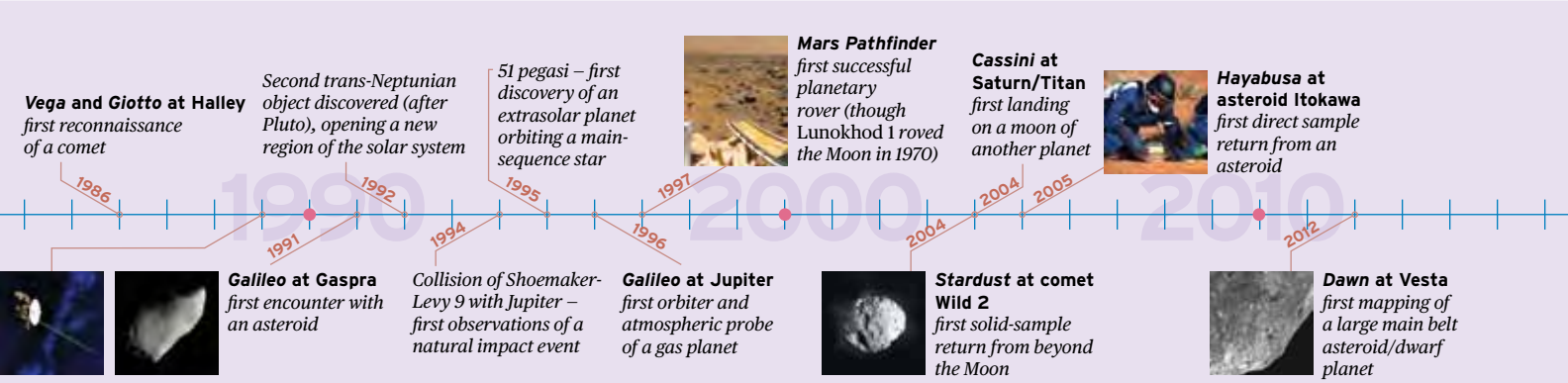
Venus was an obvious, if highly frustrating, first target, easiest to reach but virtually unknown to us. Its dense clouds so obscured the surface that the rotation rate had been a mystery for centuries. Its surface was thought, alternatively, to be a steamy swamp or a wind-swept desert. Then there was Mars! The science impetus for planetary exploration was obvious, not least because the solar system was "wild," untamed territory, yet *Mariner 2* was still a child of the space race.

The International Geophysical Year of 1957–1958 and the race to launch an Earth-orbiting satellite finally opened space to in situ exploration, fulfilling age-old dreams. But in 1962, both U.S. President John F. Kennedy and the Soviet Union's Premier Nikita Khrushchev were eager for their nations to lead in space. The competition spanned all reaches of space, with "bonus points" awarded to the nation reaching a given target first.

The Soviets had numerous early successes at the Moon, but in deep space they were having troubles: at least one launch each to both Venus and Mars in 1961 failed. U.S. plans for a *Mariner* mission to Venus were accelerated partly in response to these events. Mars was far more intriguing (we could see the surface) given its apparent resemblances to Earth, but it would have to wait until 1965 for a close-up. White polar caps and seasonally changing dusky marking invited overly imaginative speculations, fueling a nascent science fiction movement.

*Since 1991,* **PAUL SCHENK** *has been a senior staff scientist at Houston's Lunar and Planetary Institute, where he works on the topography and impact histories of the icy satellites and Vesta. He is also a participating scientist on* Dawn *and* Cassini *and an amateur deep-sea diver. Some of Paul's work can be found on YouTube channel galsat400, as well as on his blog* stereomoons.blogspot.com, *where an expanded discussion of the* Mariner 2 *anniversary and its implications is posted.*

Comic: Planet Comics, 1940




A basic lesson from our half century of progress is that true understanding requires comprehensive mapping and investigation at all scales and wavelengths. The vast lava channels on Mercury missed by *Mariner 10* and the parade of surprises at Saturn described below are excellent examples, but the classic example is Mars. *Mariner 4* returned 22 modest images (at eight bits per second) of what seemed a disappointingly Moon-like surface. *Mariner 6* and *7* in 1969 were but a tease, having looked at mostly less interesting places.

It was not until *Mariner 9* became the first human-made object to orbit another planet in 1971 that the towering volcanoes, canyons, and dry valleys of Mars finally were revealed. Since then, we have had successes as well as failures, each new mapping mission yielding unguessed vistas and surprises. Mars is now the best-documented and most-understood place in the universe other than Earth.

## MORE COMPLEXITY THAN WE IMAGINED

The Planetary Age has given us much more than a long catalog of stunning discoveries and milestones (see the accompanying graphic); it also has revealed fundamental truths about how planets and solar systems evolve and the forces acting on them, most of which were not guessed at 50 years ago. Nine planets in serene orbit, a rabble of rocky asteroids, and occasional stray comets–that about sums up the solar system as known in 1962.

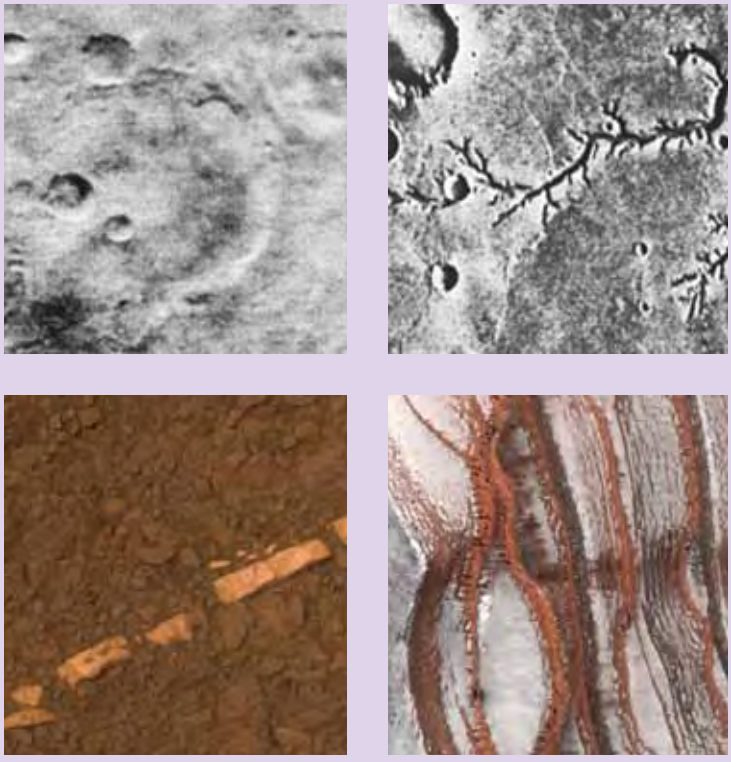
Over the decades, new layers of complexity have been slowly unraveled. Case in point: in 1992, after more than five years of searching, astronomers found the first object beyond Neptune, after Pluto. This object, prosaically designated 1992 QB1 (and, oddly enough, still unnamed), was the first of 1,000 known (and likely more than 10,000) such objects, confirming the existence of a vast zone of small objects beyond Neptune (trans-Neptunian objects, or TNOs). Surmised by astronomers Frederick C. Leonard, Kenneth Edgeworth, and Gerard Kuiper, this zone, commonly called the Kuiper belt, may consist of remnants of the birth of the solar system. Pluto itself has confounded us with at least five moons, all possibly the result of some giant collision suffered at birth. We know all this even though *New Horizons* hasn't gotten there, with its arrival scheduled for 2015.

The giant planets, so often thought of as

**ABOVE** *The commonality of ocean worlds is a key revelation in the search for habitable environments and the origins of life. This perspective rendering from* Galileo *shows Tyre, an impact scar on Europa that is roughly 120 kilometers (75 miles) wide. The reddish and orange tints may be sulfates or salts within the surface ice and might be related to ocean chemistry. Only a new mission to this water-soaked world will unravel its deep secrets.*

Image: Paul Schenk

## INCREASING RESOLUTION



**ABOVE** *Our understanding of planets seemingly increases a thousand-fold every time we look closer. Clockwise from top left: a* Mariner 4 *photo of apparently bland cratered terrain; a* Mariner 9 *view of Nirgil Vallis, one of many sinuous dry channels showing abundant ancient fluvial activity; a* Mars Reconnaissance Orbiter *image of fine-scale layers a few meters thick in polar terrain; and a close-up from* Opportunity *showing a thick vein of gypsum (about two centimeters, or one inch, wide), likely formed from groundwater.*

miniature solar systems, are living up to that billing. As an example, Saturn, like the other gas giants, is the center of a vast system of rings, charged particles, and dozens of moons of all sizes, all interacting in ways both subtle and gross. *Voyager* revealed much, but only when we returned with *Cassini* (and *Galileo*) did we begin to understand how bizarrely complex these planetary systems can be. The rings continue to astound as new dynamic phenomena and morphologies are witnessed. Small embedded satellites turn the ring particles into spinning and twisting knots, and vertical ripples marking the edges of some rings are just a few of the sights we've seen. With all the large exoplanets being discovered, ring systems may be not only common but expected.

Saturn's icy moons also provide many surprises. Those smooth, tiny Trojan moons defy explanation. Small, icy Enceladus is partially molten and erupting water vapor. Methane and ethane rain from the clouds of Titan, and Olympic yachting might take place someday on its polar lakes. Indeed, a new storm system has developed over Titan's south pole, and it may start raining there. One of the biggest shockers is that satellites can have rings too. Blue splotches (or "pearls") along Rhea's equator and the giant ridge of Iapetus both look to be formed from now-lost ring systems around those satellites.

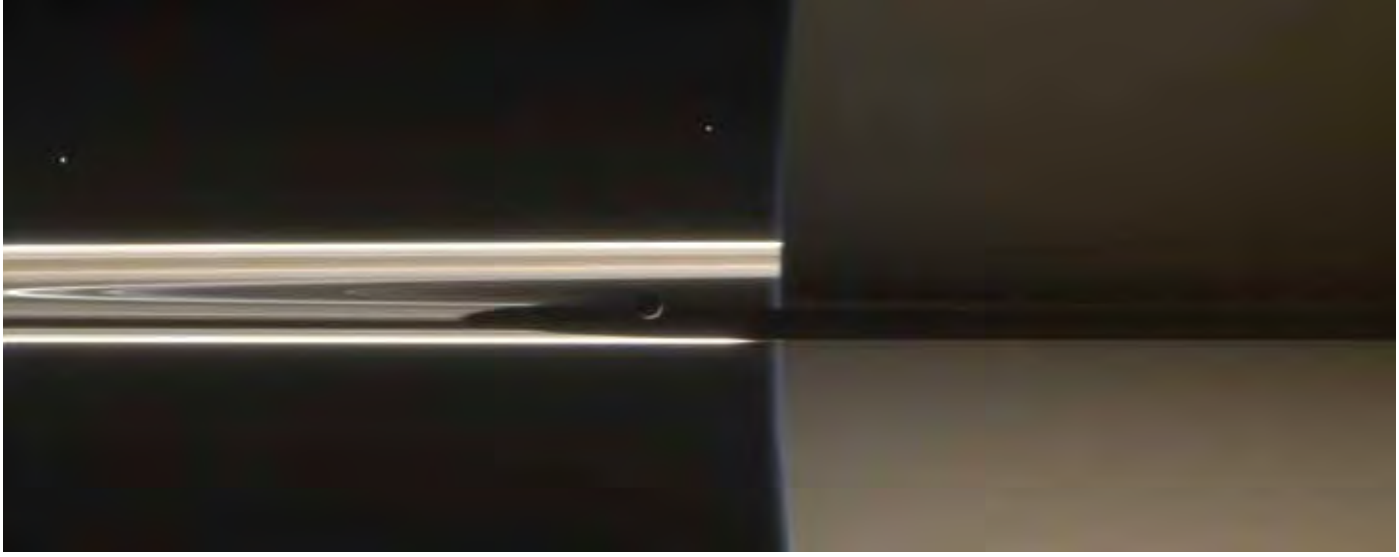
### OCEAN WORLDS EVERYWHERE

Planets also are peculiar on the inside. As stunning as Mars is, it took *Voyager* to reveal the solar system to us. The outer solar system was a vast uncharted "continent" when the two *Voyagers* were launched in 1977. The ring systems of Jupiter, Uranus, and Neptune had not yet been discovered, and the icy satellites were little more than smudges on photographic plates. The most dreamy-eyed space artists had no clue as to the complexity of these worlds, no two alike–Io's volcanoes; Europe's young, fractured surface; and Ganymede's global resurfacing and magnetic field were among the surprises.

We were shocked by the troughs and mushy ice flows of Miranda, Ariel, and especially Triton, a bitterly cold world that may well be active today. *Galileo* and *Cassini* have since returned to Jupiter and Saturn to probe these moons up close and examine their inner workings. It turns out that many of these worlds have liquid water oceans hidden beneath their icy exteriors.

Why all this diversity? Gravity and location really do matter. The power of tidal heating on a planetary scale was not understood until 1979, when theory and observation collided over hadean Io. Tides would not be so important except for the proximity of

Images: NASA/JPL



**ABOVE** *Our astonishment continues as we discover new dynamic phenomena and morphologies of the "miniature solar systems" that are the giant planets.* Cassini *captured this portrait of Mimas silhouetted against Saturn's rings in June 2006. The planet is lit by reflected and scattered ringlight. In the background, two stars glimmer above the rings.*

Image: NASA/JPL/SSI/color composite by Gordan Ugarkovic

these moons to each other and the intense gravitational potential of the giant planets. It is the heat from tidal forces that keeps the larger icy worlds' oceans liquid.

In the search for the origins of life and places that it could be nurtured, the commonality of ocean worlds is a key revelation. Europa stands apart for its rocky ocean floor, which can interact chemically with the water, one of the reasons it remains one of the highest priorities for exploration.

### A DYNAMIC SOLAR SYSTEM

It turns out that all planets and satellites are rather mobile. In 1962, we imagined that the planets are essentially in the same orbits in which they formed billions of years ago. As computing power has increased, so has our ability to glimpse into the past. Although we cannot explicitly model the exact history of the solar system, we can look at evolutionary trends. In the most advanced of these, the so-called Nice models (named after the city in southern France in which this work first bore fruit), the planets go through gravitationally driven outward migrations. These lead to intense periods of instability and reordering lasting tens of millions of years, wherein the outer planets exchange places and asteroids and comets are flung wildly about, wreaking havoc in the inner solar system through intense impact bombardment. The large basins on the Moon might be a record of such a catastrophic event.

Although the Nice model successfully explains many peculiarities of the solar system, such as orbital inclinations and eccentricities, it is not yet fully validated. As models improve, they will move us closer to the truth. They already emphatically demonstrate that planets are indeed mobile, with severe consequences.

Satellites can be mobile too! A new model under evaluation suggests that all those icy satellites of the giant planets may migrate as well. If that is true, satellite systems may form several times, only to be eaten by their parent planets. Those we see today may be only the last set of survivors. By this mechanism, the glorious rings of Saturn may be the crushed remains of one of those moons, which strayed just close enough to be destroyed. The solar system may have been quite rowdy in its younger days.

### THE IMPACT OF THINGS

In 1962, impact cratering as a natural force was regarded as speculative. This violent process was at last recognized for its catastrophic potential to build and shape planets, spearheaded by Gene Shoemaker's work on Earth, the *Apollo* samples, and images of cratered Mars and Mercury. Indeed, planetary-scale impact events early in planetary history are likely to have formed our own Moon, reshaping Earth in the process. Impact events continue to reshape the planets long after formation. Large impact events have a high likelihood and high potential to alter a planet's biosphere and force evolutionary changes.

There are other triggers for biological change, including massive volcanism, climate change, solar variations, and galactic clouds, but the 200-kilometer (120-mile) impact event in the Yucatán 65 million years ago is the likely trigger for the demise of at least 30 percent of all species on Earth, including all dinosaurs. The much smaller Meteor crater

**RIGHT** *Fifty years after* Mariner 2*'s launch,* Curiosity *is roving Mars, returning images of unprecedented detail. The patch of ground shown here is about 86 centimeters (34 inches) wide, and the large pebble is about 8 centimeters (3 inches) in diameter.* Curiosity*'s Mars Hand Lens Imager (MAHLI) snapped this picture on September 8, 2012.*

in Arizona formed only 50,000 years ago. In 1994, in the first major impact event to be witnessed by humankind (on the Internet, no less), Comet Shoemaker-Levy 9 struck Jupiter, followed by similar impact events two decades later.

### WHY DO WE EXPLORE?

The stunning geologic diversity of planets seen in our own solar system is but a harbinger of what we may find out in the galaxy. We are finding extrasolar planetary systems on a monthly basis, and these are proving to be even more bizarre, including some planets so close to their parent stars that they are probably melting. The dynamic and geologic forces behind all this diversity fold into the overarching question of whether the development of life-forms (and ultimately us) is common in the universe. Recent discoveries at Mars, at Europa, and elsewhere suggest that dynamic habitable environments are not uncommon. Whether life-forms have ever existed there remains to be determined. The vast library of data returned shows that the solar system is a visual feast of wonders, but it is also clear that none of these worlds is habitable to humans today. We had better take care of our own planet.

Naming the new rover *Curiosity* reflects the insatiable characteristic that elevates humankind, the curiosity to go beyond existence and explore. It is also part of our species' drive to place ourselves in some sort of context in the universe. *Curiosity*'s landing also reminds us that NASA's planetary program gets more good press than that of most other government agencies combined. The large crowds that gathered at Times Square and elsewhere to watch the live feed of the descent and landing on August 5 were unprecedented for robotic flight. National pride is an obvious factor, but so is simply "geeking out" over the technical wizardry. In difficult times, sometimes a bit of magic can uplift an entire nation, at least for a little while.

The energetic worldwide reaction to the Mars landing also speaks to broad support for space generally and NASA in particular. With few exceptions, the planetary program has been consistently successful for five decades. That success doesn't stop at Mars, as the current fleet of spacecraft spread across the planets testifies. Not only spacecraft have been involved; major leaps in adaptive telescope optics, computer modeling, and the contributions of amateur observers (detecting comets and monitoring asteroids, planetary clouds, Jupiter impacts, Mars changes, and so on) also add fundamentally to our rapidly evolving comprehension of the solar system.

Today we can marvel at a universe working its wonders through the power of natural laws. These successes, begun 50 years ago this summer, are indeed something to support and to celebrate.

Image: NASA/JPL-Caltech/Malin Space Science Systems

## SOCIETY TRAVEL

**Bill Nye invites you to "Adventure with The Planetary Society. We'll take you on spectacular journeys!"**

### Visit Arecibo and the Lesser Antilles

January 30–February 9, 2013

Travel with us to the Arecibo Observatory in San Juan, Puerto Rico. There you'll meet scientists who perform the deep-space observations vital to finding extraterrestrial life, understanding quasars, and revealing the mysteries of the Big Bang. From there, you'll fly to Barbados; board the 227-foot, five-mast *Royal Clipper;* and sail to the Lesser Antilles, where you can explore the islands, go snorkeling, watch whales, and more!

### Witness Alaska's Aurora Borealis

March 7–13, 2013

Join us for the greatest light show on Earth! Enjoy the breathtaking beauty of Alaska. Watch marine animals and local wildlife, then ride the train from Anchorage to Fairbanks, passing stunning 20,320-foot Denali (Mt. McKinley) en route. Visit the Ice Festival in Fairbanks and learn about the aurora from special guests at the Geophysical Institute. See the lights dance across the night sky with Alaskan astronomy enthusiasts at Creamer's Field and Mt. Aurora.

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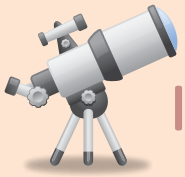
## WHAT'S UP? *by Bruce Betts*



### IN THE SKY

In late October, reddish **Mars** is near the reddish star **Antares** low in the west after sunset. Bright **Jupiter** rises in the east in the late evening early in the fall and in the early evening late in the fall. Look for the **Moon** very close to it on November 28 and December 25. Extremely bright **Venus** dominates the predawn east. **Saturn** rises below it in November, getting closer until they are only 1 degree apart on November 27. **Mercury** is low in the predawn east in late November and early December. On November 13, a total solar eclipse is visible in northern Australia and the South Pacific. A **partial eclipse** will be visible in eastern Australia and New Zealand and throughout the South Pacific. The **Geminids meteor shower**, on average the best of the year, peaks on December 13–14. Expect 60 meteors per hour from a dark location, and viewing will be excellent due to a New Moon.

### RANDOM SPACE FACT

Approximate analogies for Mars rover sizes: *Sojourner* = a microwave oven (with wheels); *Spirit* and *Opportunity* = golf carts; and *Curiosity* = a small car.

### TRIVIA CONTEST

Our December Solstice 2011 contest winner is Ilyssa Evans of Tracy, California. Congratulations! **THE QUESTION WAS**: What star is commonly known as the dog star? **THE ANSWER**: Sirius, the brightest star in the night sky, located in the constellation Canis Major, meaning Greater Dog in Latin.

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

***What is the name of the suspension arrangement used with the six-wheel setup on all rovers that have gone to Mars?***

E-mail your answer to *planetaryreport@planetary.org* or mail your answer to *The Planetary Report*, 85 South Grand Avenue, Pasadena, CA 91105. Make sure you include the answer and your name, mailing address, and e-mail address (if you have one). By entering this contest, you are authorizing *The Planetary Report* to publish your name and hometown. Submissions must be received by December 1, 2012. 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.*

**CASEY DRIER** *is technology and outreach strategist for The Planetary Society.*

# The Battle Continues

## Society Members Fight to Restore Science Funding for NASA

**THE PLANETARY SOCIETY'S YEAR-LONG CAMPAIGN** to reverse proposed cuts to the U.S. planetary science program continues unabated. Thanks to our committed Members, we've generated tens of thousands of messages to congressional representatives, budget staffers, and the president. You also gave us the financial ability to travel to Washington, D.C., meet face to face with decision makers, and unleash our lobbyist on Capitol Hill.

The work is not done, however, and we continue to need your full support to succeed in fully rolling back these proposed cuts.

### WHAT IS SEQUESTRATION? AND WHAT DOES IT MEAN FOR SPACE?

You may remember the political standoff on the U.S. debt ceiling last year. The ultimate compromise for increasing the United States' debt limit was to pair it with $1.2 trillion in cuts over the next decade. The law created a "supercommittee" of legislators in both houses to create special legislation to achieve this reduction. To ensure this would happen, the law contained an incentive: an automatic across-the-board cut to all discretionary spending programs (programs not mandated by law) and Medicare set to occur on January 2, 2013 unless the cost savings had been achieved. This automatic cut is known as the *sequester*.

The sequester was never supposed to take effect, but it will unless these cost savings are somehow achieved by a deeply divided Congress sometime in the next few months. In preparation for this, the Office of Management and Budget (OMB) released its initial report breaking down the cuts for each agency. NASA (like most agencies) gets hit hard, losing about 8.2% of its budget, or about $1.4 billion.

Here's a quick recap of our situation. In February, the administration released its proposed budget for 2013. In it, the planetary science division within NASA was singled out to receive an unusually large cut ($309 million, about one fifth of its budget), effectively preventing the agency from pursuing the highest-priority missions to Mars and Europa.

The Planetary Society leaped into action, organizing a Save Our Science (SOS) campaign to restore funding for planetary sciences. In May, Bill Nye led a contingent of Planetary Society representatives to Washington, D.C. to meet with key staffers and members of Congress. You received mail from us asking you to sign physical petitions to Congress and to sign our online petition. As of September, our Members have sent more than 2,000 physical petitions and 17,000 e-mails to Congress asking for funding to be restored.

As the presidential race has heated up, however, Congress has become more and more distracted. To add an element of confusion to our budgetary efforts, Congress is likely to pass a continuing resolution to the 2012 budget, putting off any decisions about the future of planetary science funding until March 2013, six months into next year's budget cycle.

With the election still ahead, The Planetary Society has helped to organize a letter-writing campaign focused on staffers at the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP). In cooperation with the American Geophysical Union (AGU) and the American Astronomical Society (AAS) Division of Planetary Sciences (DPS), we recently finished a one-week e-mail drive asking the administration to restore funding in its 2014 budget, which is being refined as I write this. We had a great response, with The Planetary Society alone generating more than 18,000 e-mails from 3,200 respondents. E-mails from the DPS and AGU will add to this total.

In October, Bill Nye once again will be in Washington, D.C., where he will meet with representatives from Congress, NASA, and the administration. He also will hand-deliver the thousands of petitions signed by our Members.

It's a difficult political climate, and the looming sequestration (across-the-board cuts to all federal agencies) is set to occur on January 2, 2013. We need you, our Members, to keep the pressure on your representatives in Congress and in the administration. Tell them to preserve the modest budget NASA requires to continue searching for signs of life on Mars and elsewhere in our solar system.

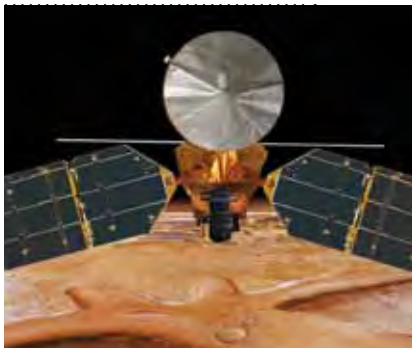
The Planetary Society will keep you posted on the latest news and action items as this situation continues. Follow along at HTTP://PLANETARY.ORG/SOS.

**Q I've heard of spacecraft that remain over the body they orbit over a certain time of day, for example, 2:00 p.m. on Mars. I believe *Mars Global Surveyor* and *Mars Odyssey* had this type of orbit. How is this achieved?** – *Nickolai Cowell, New Brunswick, New Jersey*

A Sun-synchronous planetary orbits are near-polar orbits; that is, they have a high inclination–the spacecraft orbits while the planet rotates below. Such an orbit is a type of "walking" orbit, which uses precession of the orbit (slow rotation of the spacecraft's orbital plane) to keep the craft's ground-track in a desirable state, such as flying over the approximate local time of 2:00 p.m. on the planet being orbited. This type of orbit offers advantages to scientists who are making remote-sensing observations of the planet's surface and looking for such things as a desired shadow length in images. There's a section on walking orbits in my Basics of Space Flight tutorial at HTTP://BIT.LY/TPS121101.

When possible, a Sun-synchronous orbit takes advantage of a planet's nonspherical shape and mass distribution (and, possibly, other gravitational influences) to keep the spacecraft's orbit plane precessing by the correct amount. This usually is an imperfect arrangement, so a minimal number of rocket firings occasionally are necessary to force the precession to continue as needed.

*–DAVE DOODY, Jet Propulsion Laboratory*



**ABOVE** Mars Reconnaissance Orbiter *has a walking, Sun-synchronous orbit that enables mission controllers to time the spacecraft's orbit so that it looks down at the Red Planet at about 3:00 p.m. local time every day.*



# Water Marks

**A STREAM OF WATER ONCE** ran vigorously across the area on Mars where *Curiosity* is driving. The evidence–*Curiosity*'s images of rocks containing ancient streambed gravels–is the first of its kind.

Scientists are studying the rover's images of stones cemented into a layer of conglomerate rock. The sizes and shapes of stones offer clues to the speed and distance of an ancient stream's flow.

"From the size of gravels it carried, we can interpret the water was moving about three feet per second, with a depth somewhere between ankle and hip deep," says *Curiosity* science co-investigator William Dietrich of the University of California, Berkeley. "Plenty of papers have been written about channels on Mars with many different hypotheses about the flows in them. This is the first time we're actually seeing water-transported gravel on Mars. This is a transition from speculation about the size of streambed material to direct observation of it."


The mission team arrived at their discovery using the telephoto function of *Curiosity*'s mast camera to observe two outcrops, called "Hottah" and "Link." Those observations followed on earlier hints from another outcrop, which was exposed by thruster exhaust as *Curiosity* touched down on the planet's surface. "Hottah looks like someone jackhammered up a slab of city sidewalk, but it's really a tilted block of an ancient streambed," says Mars Science Laboratory Project Scientist John Grotzinger of Caltech.

*–from NASA*

*For more information on these findings, go to* HTTP://BIT.LY/TPS121094


**ABOVE** *The site where* Curiosity *discovered evidence of ancient flowing water lies between the north rim of Gale crater and the base of Mt. Sharp, a mountain inside the crater. This close-up view of the outcrop Hottah shows a rounded gravel clast (circled), indicative of running water.*

MRO Illustration: NASA/JPL; image: NASA/JPL-Caltech/Malin Space Science Systems

# An Amazing New Wall Calendar





You'll need a lot of space to hang up this new, large-format calendar! Published in cooperation with The Planetary Society, *The Year In Space 2013 Wall Calendar* opens to an impressive 16 × 22 inches—more like a poster than a typical calendar.

You'll quickly see that size isn't the only thing that sets this product apart. Unlike most one-picture-per-month wall calendars, *The Year In Space* showcases collages totaling more than 100 stunning images that seem to leap off the page.

Each month features an in-depth exploration of a different topic in planetary exploration, human spaceflight, or deep-space science. The writing is lively and engaging throughout, with background information, fun facts, and biographies of key people—much more than you would normally find in a wall calendar.

The calendar grids feature space history dates, daily Moon phase images, sky events, and holidays. There's even a Monthly Sky Guide to help you find the planets.

Planetary Society Members can purchase *The Year In Space 2013 Wall Calendar* at the discounted price of $12.95 (less on multiple copies) with free U.S. shipping and discounted international shipping.

## Order now—limited quantities! **HTTP://BIT.LY/TPS121102**

**If you've missed *Planetary Radio* lately, here are some recent highlights:**

**Astronaut Tom Jones Discusses Near-Earth Objects**

**Andrew Chaikin & Scott Hubbard at Planetfest**

**The Legacy of Neil Armstrong**

**Author David Brin Talks About *Existence***

**A Conversation With Telescope Inventor John Dobson**

**35 Years Later: Celebrating the *Voyager* Missions**

**Exploring the OSIRIS-REx Mission at the Pacific Astronomy and Telescope Show**

**The Deepest Image of Our Universe, With Garth Illingworth**

**Find these shows and our entire archive of *Planetary Radio* at *planetary.org/radio*!**

I took these photographs when Neil Armstrong and Buzz Aldrin landed on the Moon on July 20, 1969. I was a navigator in the United States Air Force, living at Travis Air Force Base outside Vacaville, California. We had a 17-inch black-and-white television balanced on a small table in the living room of our home. Walter Cronkite told us all how to take the photographs using a Brownie box camera set at 1/60th of a second.

These images are in stark contrast to the crystal-clear images we now receive from Mars. The snowy shadows that represent Armstrong and Aldrin; the thin sticks we can imagine are the legs of *Eagle*, the lunar lander; and the dim images of Armstrong and Aldrin at work in the distance remind me of an ancient past in America's race to the Moon. — *Anthony Mournian, San Diego, California*

I captured this picture of orographic clouds in 1962 at Hope Bay, a British Antarctic Survey Base located on Trinity Peninsula, Graham Land. Antarctica's isolation—greater then than in these days—gave one the impression of being on another planet. I had been an avid reader of science fiction since I was about 12 years old, and this experience heightened my interest. Then, along came Carl Sagan with *Cosmos*! —*Jim Franks, Aviemore, Scotland*

*Planetary Society Members are united in their love of space exploration—which has its origins in Earth's skies. Thank you for sharing your views with us! To see more, go to* MYSKY.PLANETARY.ORG.

**WANT TO SHARE YOUR SPACE IMAGE?** Send us an e-mail with a jpeg (less than 5 MB) attachment of your image to *planetaryreport@planetary.org*. Please use the subject line "MySky" and include a short caption (such as where you took the image and, if appropriate, with what equipment) and credit line for the image. Please include just one MySky image per submission. Also, be sure to include your name, contact information, and membership number (it's on your membership card and on the mailing label of your magazine). We'd also love to receive a picture of you and to learn more about what is most important to you about being a Planetary Society Member. Questions? E-mail *planetaryreport@planetary.org* or call (626) 793-5100, extension 218.

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# Toshiba introduced The Planetary Society to Times Square.

# Will you introduce someone to The Planetary Society?

*NASA's* Curiosity *rover is on Mars! I'll bet that, like me, you are smiling. Smiling when you think of that landing, of those first pictures, smiling with the joy of anticipation, imagining what this remarkable machine will find on its journey at Gale crater.*

*Discovering. Exploring. Understanding. Learning more about who we are, you and me, this star stuff.*

*This is a great time, and* Curiosity *is a great reason, to introduce someone to space. Share a story about Mars. Share this issue of* The Planetary Report. *Share your excitement. Bring a smile to someone's face.*

*Will you introduce someone to The Planetary Society?*

**- ANDREA CARROLL, CHIEF DEVELOPMENT OFFICER**

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