

THE PLANETARY REPORT

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GREATEST HITS

THE YEAR IN PICTURES



MAT KAPLAN is the producer and host of Planetary Radio.

Planetary Radio Turns 10



ABOVE Planetary Radio host Mat Kaplan in full bunny suit, visiting Curiosity, the Mars Science Laboratory Rover, shortly before its departure for Mars.

I'M THE LUCKIEST RADIO and podcast host on this pale blue dot. For an entire decade, *Planetary Radio* has brought you the explorers, researchers, and dreamers who are pushing beyond the final frontier. We've enjoyed exciting news and eye-popping images from Emily Lakdawalla. Bruce Betts has told you "What's Up?" in the night sky. We've given away hundreds of stylish T-shirts and enjoyed hundreds of *Random Space Facts*. And we've visited centers of science and innovation where men and women are leading us to the stars.

Just the other day, our CEO, the Science Guy, led me downstairs, where our Society colleagues were waiting with a delicious 10th anniversary cake. Bill Nye has been sharing his passion for space in a weekly segment for nearly five years. His affection for *Planetary Radio* is equaled by the enthusiasm so many of our listeners express. We're all very grateful for him and his work. We're especially grateful to the Kenneth T. and Eileen L. Norris

Foundation for its years of support for the show. Of course, it's our Members who do the most to keep *Planetary Radio* on the air and the Net.

Where does the future hold for our foray into the universe? Largely, more of the same, but we hope to get the show out among you even more, through our *Planetary Radio Live* sessions. These already have included programs recorded in front of audiences at the Aquarium of the Pacific and the National Air and Space Museum, along with many more that were presented near our Pasadena headquarters. We'll also bring you more on-location video that complements and expands on the weekly topic.

It's impossible to pick a favorite episode out of more than 500. I'd love to hear from you about your most memorable shows and guests. Write to me at planetaryradio@planetary.org. You can hear every new program and dive into our archives at PLANETARY.ORG/RADIO. Clear skies. 🌌

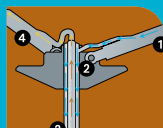
If you've missed *Planetary Radio* lately, here are some recent highlights:



Shoemaker Grants winners Robert Holmes and Gary Hug



The 44th Annual Meeting of the AAS Division of Planetary Sciences



Kris Zacny of Honeybee Robotics discusses PlanetVac



Space shuttle Endeavour opens to the public



A star-studded celebration of Carl Sagan on Sagan Day



Tracking Dawn on its way from Vesta to Ceres, the biggest of the asteroids



Approaching Pluto with New Horizons' principal investigator, Alan Stern



New data from Curiosity with John Grotzinger

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



6 **The Bradbury Imperative**

Andrew Chaikin reflects on why we must explore.

8 **Where We Stand**

Politics and budgets and waiting, with *Casey Dreier*.

9 **COVER STORY**
The Year in Pictures

Emily Lakdawalla shares her favorite images from the past year.

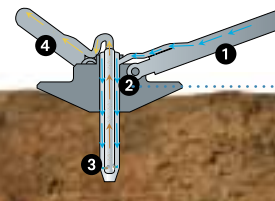
MIDDLE OF THE MAGAZINE

Planetary Society Kids Why is Mars colder than Earth?



16 **Vacuuming Planets and Targeting Asteroids**

Bruce Betts highlights two projects that Members support.



18 **Infinite Visions**

We asked some big questions, and Members answered.

DEPARTMENTS

2 **Planetary Radio** *Mat Kaplan* celebrates a remarkable milestone.



4 **Your Place in Space** *Bill Nye* makes Members' voices heard in Washington and welcomes *Endeavour*.

20 **Snapshots from Space** *Phoenix* gets its laugh on...



21 **What's Up?** Planets and the Geminids.

22 **Volunteer Spotlight** *Geovanni Somoza* calls all volunteers.

23 **MySky** Mars on Earth and a lunar eclipse.



ERRATUM: On page 4 of the September Equinox 2012 issue, the distance between Earth and Mars was stated incorrectly. The distance between Earth and Mars at the time *Curiosity* landed was approximately 248 million kilometers (about 154 million miles).

ON THE COVER: On June 5 and 6, 2012, people all over the world watched as Venus passed in front of the Sun, but the best views were from spacecraft. This image is composed of fifteen photos of the event, taken through an extreme ultraviolet filter by NASA's Solar Dynamics Observatory. Venus is silhouetted against the solar corona, where ionized plasma reaches a temperature of a million degrees, radiating brightly in extreme ultraviolet light. The image has been rotated so that the Sun's north pole is at left. *Image: NASA/GSFC/SDO*



CONTACT US
The Planetary Society
85 South Grand Avenue
Pasadena, CA 91105-1602
General Calls: 626-793-5100
E-mail: tps@planetary.org
Internet: planetary.org

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Editor JENNIFER VAUGHN
Senior Editor DONNA ESCANDON STEVENS
Art Director LOREN A. ROBERTS for HEARKEN CREATIVE
Copy Editor A. J. SOB CZAK
Proofreader LOIS SMITH
Technical Editor JAMES D. BURKE
Science Editor BRUCE BETTS



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Fifty Years So Far

Innovation Has Just Begun

FIFTY YEARS AGO, humankind sent its first spacecraft to another planet when *Mariner 2* flew by Venus. It was a modest ship, repurposed from a lunar vehicle called *Ranger*. *Mariner 2* didn't even carry a camera. In those early days, a sentiment prevailed that mere photography was not science. By the way, it was largely due to the influence of one of The Planetary Society's cofounders, Bruce Murray, that spacecraft nowadays have exquisite cameras.

Pictures aside, *Mariner 2* showed us that Venus is not a wonderful tropical paradise inhabited by great-looking people. Instead, it's a hellishly hot place under crushing atmospheric pressure that sustains clouds made of sulfuric acid. For me, the *Mariner 2* flyby was not only the start of the space age for scientific studies but also the beginning of my understanding of the greenhouse effect and the remarkable environment of our own world.

Forty years ago, Ed Stone, a veteran of the early days of interplanetary excursions, became project scientist on the *Voyager* mission, which was undertaken by two spacecraft that made grand tours of the solar system and are now on their way beyond the influence of the Sun—beyond the heliopause. He had been on the job for only five years when the spacecraft launched, and he's been on the job ever since.

Recently, in Washington, D.C., Ed was on stage along with three other solar system scientists: Marggy Kivelson, who discovered an ocean under the ice on Jupiter's moon Europa using a compass (a magnetometer) on the *Galileo* spacecraft; Kevin Hand, who develops ways to look for life way out there on the Jovian moons and on Saturn (as well as in Antarctica); and Bethany Ehlmann, a planetary geologist looking hard at the rocks on Mars. I was on stage as well, doing what I could to keep up and make sure we took

questions from the audience. It was part of a week-long festival called "The Solar System at 50," celebrating a half-century of interplanetary spacecraft and discovery. Our event was graciously hosted by the National Geographic Society. Kevin Hand, I might add, was a National Geographic Emerging Explorer last year.

I hoped there would be a nice crowd. There was, and in it were a great many young people—students and young professionals who are passionate about finding what's out there. I'm sure a lot of them, like many of us, dream of flying in space someday. I hope their enthusiasm will carry humankind forward to new horizons on distant worlds.

The next day, Planetary Society Chief Operating Officer Jennifer Vaughn and I carried several thousand of your petitions to the Congressional Acceptance Site, a small building within a flying disk's throw of the U.S. capitol. We're keeping up the steady drumbeat, reminding the representatives who fund the world's largest space agency of the great importance of planetary science. A budget cut of \$309 million is considered small in the league of line items in the federal budget, but multiplied by the next few years, it is enough to create or eliminate a strategic class (formerly called "flagship") mission.

In early December, NASA announced a new Mars rover mission that will fly in 2020. It's great news. Scientists hope it will become part of the effort to return a sample of Martian rocks and soil. We're also hoping for a Mars microphone, at last. I'm certain this new mission announcement is a result of our advocacy. Once again, thank you for your continued support and your diligence in helping The Planetary Society save our science. You've shaped history.

After 4,671 orbits of Earth, the *Endeavour* space shuttle is now resting comfortably

on display at the California Science Center in Los Angeles. *Endeavour*, by the way, is the ship that carried our Living Interplanetary Flight Experiment (LIFE) sample tubes on their first trip into space during its last flight, the STS-134 mission. Plenty of luminaries attended the welcoming ceremony: the governor of California, Jerry Brown; the mayor of Los Angeles, Antonio Villaraigosa; and James Ingram, who sang the inspiring “I Believe I Can Fly.” I had the remarkable privilege of being the master of ceremonies. It was quite a show. For me, however, the greatest sight to see that day was the thousands of people, especially young people, who came to see *Endeavour* and welcome her to her new home. They all believe they can fly in space someday. Their enthusiasm filled all of us with great hope for our future.

On November 9, we celebrated Sagan Day. It would have been Carl’s 78th birthday. We assembled a fantastic panel of his former colleagues and collaborators, as well as young scientists, to describe Carl’s influence on them. We reminded the world of our celebrated cofounder’s legacy and his influence on the course of human affairs. He showed us just how expansive the universe is, how we are part of the cosmos—of star stuff—and how we are one of the ways the cosmos has come to know a small part of itself. The audience, at radio station KPCC in Pasadena, was about as good as it gets. The event was a wonderful celebration and part of our deep legacy as promoters of space science and the human spirit.

A great many of us have supported our *LightSail*® spacecraft project. We’ve built two complete spacecraft and are very hopeful that we will secure a launch opportunity soon—in 2013. It’s been a long road, with a good bit of waiting at the station for a suitable rocket to stop by. At the behest of our board of direc-



tors, we assembled a team of experts to give the spacecraft and its associated program a detailed review. Everyone agrees that the spacecraft are remarkable and will be a significant advance in both solar sail and deployment system technology. Stay tuned.

I am delighted to report that C. Wallace Hooser, one of our excellent Planetary Society Charter Members, is now a member of our board. Wally is a radiologist from Texas who loves space exploration and who understands the great value that space technology brings to society. Wally attended his first board meeting and infused us with valuable insights. Along with his technical expertise, he is helping us think strategically as we plan for the long-term health of the Society.

It’s an exciting time: the *Curiosity* rover is preparing to ascend Mount Sharp, and already we’ve found riverbed rocks that formed at a time when there could have been life on Mars. Imagine what such a discovery would mean to humankind! We are working to set up missions to the moons in our solar system that may harbor life. We are an outreach partner on the *New Horizons* mission to Pluto. We are helping people everywhere to know and appreciate our place in space. You are part of the mission. Thank you. Let’s change the world. 🚀

Bill Nye

ABOVE This past October, Bill Nye hand-delivered thousands of your signed *Save Our Science* petitions to Congress in Washington, D.C.



ANDREW CHAIKIN
writes, speaks, and blogs
about space exploration.

With Curiosity alive, well, and working beautifully on Mars, it's easy to forget our collective fear that this mission might not succeed. On August 5—the night of Curiosity's scheduled landing—however, we needed someone to calm us down and give us some perspective as we waited for the crazily complex landing maneuver that would place the rover safely on the surface of the Red Planet. In Pasadena, space historian and author Andy Chaikin did just that. As the thousands of us who were assembled at Planetfest 2012 tensely waited for Curiosity's entry, descent, and landing, Andy reminded us of our late adviser and friend, Ray Bradbury, and of Ray's admonition to us all. We share an adaptation of that talk here. To watch a video of Andy's talk in its entirety, go to BIT.LY/TPS121206.

—Donna Stevens

The Bradbury Imperative

WHAT HAPPENS TONIGHT IS GOING to be terrifying, and yet I have to say that this is an extraordinary day no matter how it turns out. It's extraordinary because once again, we are writing a new chapter in what I believe is the most magnificent adventure that human beings have ever undertaken.

When I was a senior in high school and I read *Mars and the Mind of Man*, Ray Bradbury taught me that passion is as crucial as rocket fuel when you're trying to leave Earth. I know that all of us in this room share that passion.

When I see the animation of *Curiosity's* landing sequence, I think of Ray's statement about what it takes to make impossible dreams come true. He said, "Jump off the cliff and build your wings on the way down." At first glance, it looks like *Curiosity* is going to demonstrate that in real time! When I had a chance to think about it, I realized that's not true—because Rob Manning and everyone over at JPL on the Mars Entry Descent and Landing team have already given *Curiosity* its wings. We'll find out tonight whether or not that audacious procedure—it's almost like a performance, like an artistic expression—works the way we all hope it will. Even if it doesn't, that doesn't mean it wasn't the right thing to do. It doesn't mean that the money was wasted. No, it means that we tried something that's at the very limits of what we're

able to do—and that's what we have to do.

If everything does work, then I have no doubt we're going to be surprised and amazed by Mars, just as we were back in 1971. Back then, most scientists thought Mars was mostly just an expanse of craters, a very Moon-like world, which is what the previous flyby missions had shown us—a world with a threadbare atmosphere of carbon dioxide, a frigid, radiation-bathed desert that had been given up for dead. In fact, *The New York Times*, in an editorial in 1965, called Mars "the dead planet."

Then *Mariner 9* went into orbit around Mars. It arrived at the height of a global dust storm; it was almost as if Mars was hiding from humans' prying eyes. After a few weeks, as the dust cleared, *Mariner* revealed an astonishing Mars, a world that was an absolute geologic wonderland. It has giant volcanoes, one of which is three times the height of Mount Everest; a canyon system that would stretch most of the length of the United States; and layers of ice and dust at the poles that amount to a hundred-million-year history book of Martian climate. Most surprising and most intriguing of all were the channels that looked for all the world like dry river valleys; in fact, that's what they turned out to be.

Mars was trying to teach us something: we have to leave our hubris at the door. We live



"There is
life on Mars,
and it is us.
From now on,
we are the
Martians."

- RAY BRADBURY

in a culture that says everything should be black and white, and once decided, it should stay decided: "Don't confuse me with the facts, my mind's made up." Mars, however, is trying to teach us that when we think we have it all figured out, we're wrong. Mars has shown us that again and again.

I had the thrill of taking part in the next Mars mission, *Viking*, as a college intern at JPL. It was incredible to be in the imaging team area on the morning of July 20, 1976, when *Viking 1* successfully landed on Mars and sent back the first pictures from the surface. That morning, Ray Bradbury was asked by a TV reporter whether, as the author of *The Martian Chronicles*, he was sorry that there were no signs of life in those pictures. He said, "Don't be silly! There is life on Mars, and it's us. From now on, we are the Martians."

What Ray said was profound, because every spacecraft that we send to Mars or anywhere in the solar system, all those incredible creations, are extensions of us.

Maybe it's because robots can't come back and get parades that we don't give them as much attention as we do the astronauts who walked on the Moon, or the ones who fixed the Hubble Space Telescope, or any of the other human space explorers. All of us in this room need to take over as their PR agents.

In 2000, when I was the editor of a short-lived magazine called *Space Illustrated*, I had the honor of working with Ray. I commissioned from him an essay about Mars, and about why it still has such a hold on our spirits and our imaginations. The essay he wrote was called "Too Soon from the Cave, Too Far from the Stars." In it, he gave me, and all of us, one of the best expressions I've ever heard of why we do space exploration and why we have to keep doing it. He said, "We have been given eyes to see what the light-year worlds cannot see of themselves. We have been given hands to touch the miraculous. We have been given hearts to know the incredible. Can we shrink back to bed in our

funeral clothes? Mars says we cannot.”

Now, that moves us, here in this room, but think about all the people out there who are just trying to pay the mortgage or the rent,

the crust of that Jovian moon, and so many other things that we could do that would be magnets for young people to go into science and engineering. Along with kids who are in



WHERE WE STAND

Welcome to the long wait.

We find ourselves in the tail end of an election year with a lame-duck Congress focused entirely on the so-called fiscal cliff. The budget for 2013 remains in “continuing resolution” limbo, and the 2014 budget is in its final, secretive stage. A slew of exciting planetary missions remain unfunded and unstarted. Several months will pass before any action on future budgets is taken by either the White House or Congress.

Despite the larger turmoil, The Planetary Society has pursued a persistent and focused campaign to reverse the \$309-million-per-year cut that threatens the next decade of planetary exploration.

In October, the Society launched a letter-writing campaign directed at the White House in an effort to influence next year’s budget, which is assembled each fall. It became our most successful campaign of the year, with many tens of thousands of e-mails sent to President Obama.

I traveled to Washington, D.C., and personally met with the chiefs of staff of multiple representatives and staff members on the House authorization committee. The

following week, Bill Nye and Jennifer Vaughn arrived in D.C. to meet with top NASA brass and encourage them to fight for our unique planetary program.

Our first indication as to whether our efforts have been successful will come in early February, when the president releases his 2014 budget request. It is possible, though unlikely, that the proposed budget will contain full funding for our planetary exploration efforts. March 27, 2013, will see the expiration of the continuing resolution that currently funds the federal government. Congress must pass a budget for 2013, and current drafts direct some of the money back to the program, though not enough to pursue the most important and exciting planetary missions.

We’re not letting up: we’ve planned more visits to Washington, D.C., in December 2012 and January 2013, to press the issue. We may have to wait for next year to find out if NASA’s planetary sciences budget is restored, but we don’t have to do so quietly.

If you haven’t yet participated in our Save Our Science Campaign, you can take action at BIT.LY/TPS121203.

—Casey Dreier

who are trying to figure out how to put their kids through college, or even how to put food on the table. They can’t think about the long-term future of humanity. That’s not on their radar screen. So guess what? Guess who has to spread this message? We do. Budget cuts are threatening to shut down much of the planetary program and already have ruled out for the foreseeable future another mission like *Curiosity*, or a mission to explore Europa to find out whether there might be life under

school now and soon will be, what about the scientists who are just starting their careers? What are they supposed to do if there are no missions?

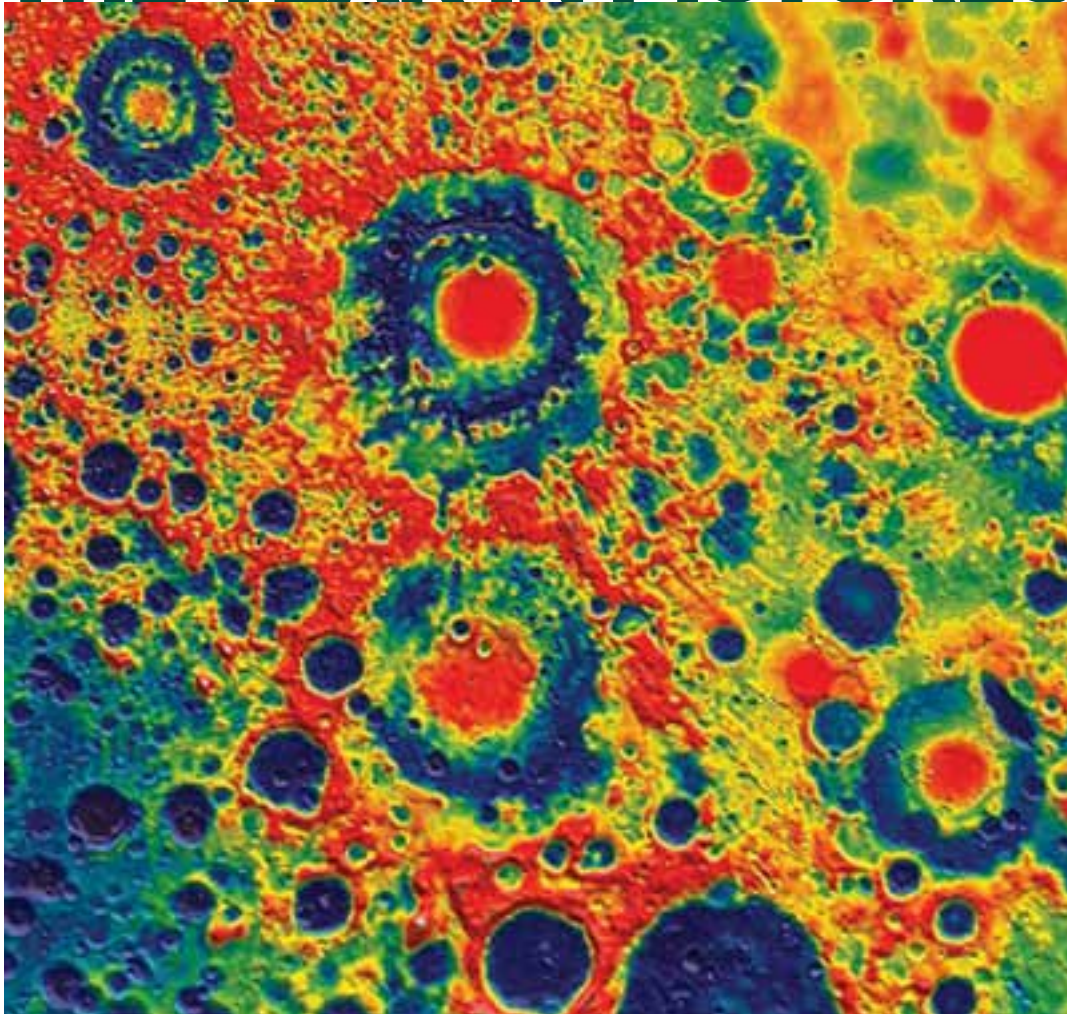
I’m going to end by asking all of you to go to The Planetary Society’s website, BIT.LY/TPS121203. When you get to that page, send a message to the president, and share the link with anybody that you can. Give them a simple message: “We must explore.” Thanks. 🐾

*Award-winning science journalist and space historian Andrew Chaikin is best known as the author of *A Man on the Moon: The Voyages of the Apollo Astronauts*. This book was the main basis for Tom Hanks’ 12-part HBO miniseries *From the Earth to the Moon*. His website is ANDREWCHAIKIN.COM.*



EMILY STEWART LAKDAWALLA
blogs at planetary.org/blog

THE YEAR IN PICTURES

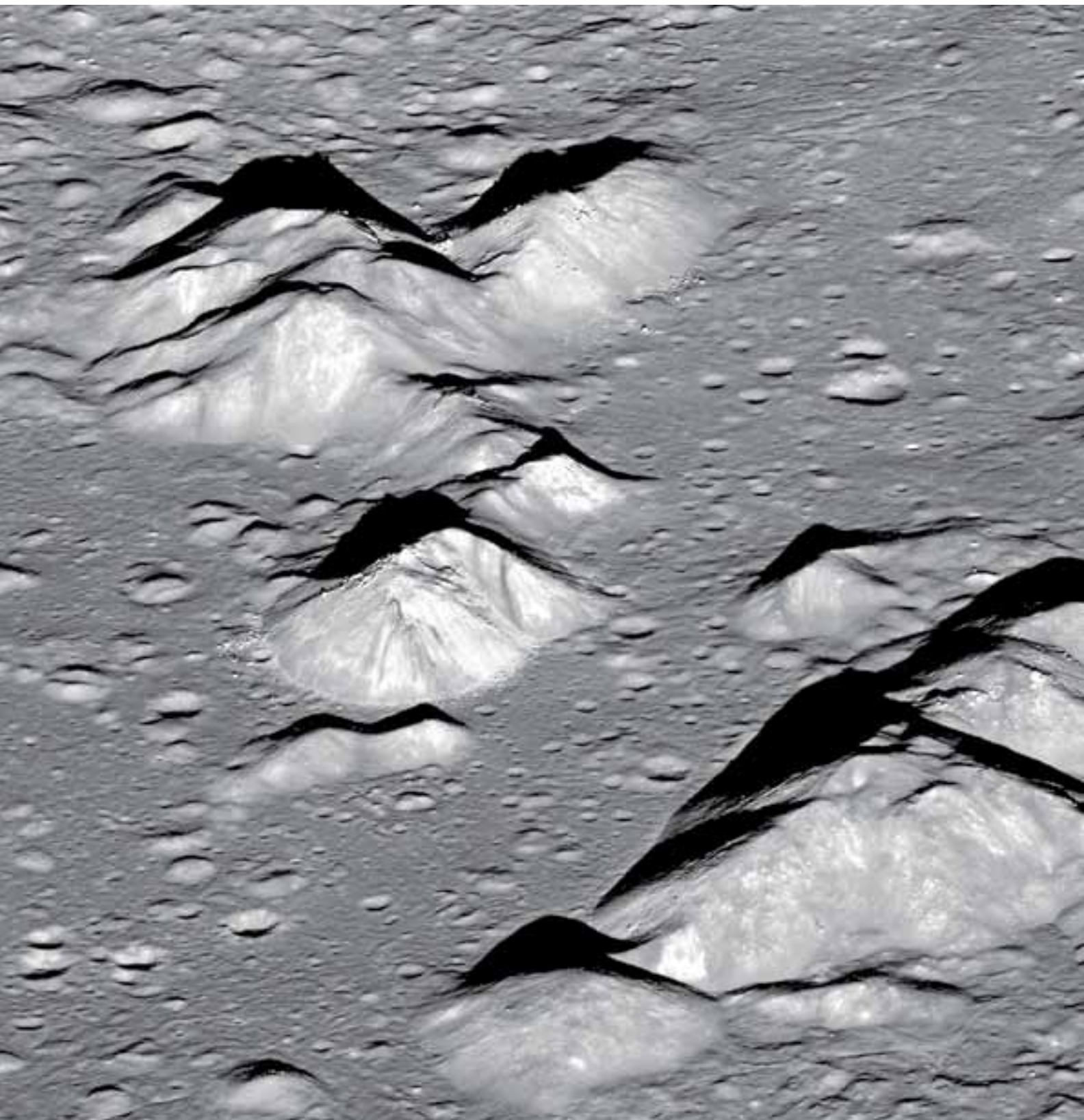


LEFT The twin GRAIL orbiters have mapped the Moon's gravity field with unprecedented detail. Here, red represents high gravity and blue, low gravity. Most of the variation in the map is caused by lunar topography (high mountains have high gravity, deep craters low gravity). Some variation results from subsurface geology, however. Many basins like Orientale, at upper center, have high-gravity centers where they were filled with dense mare basalt.

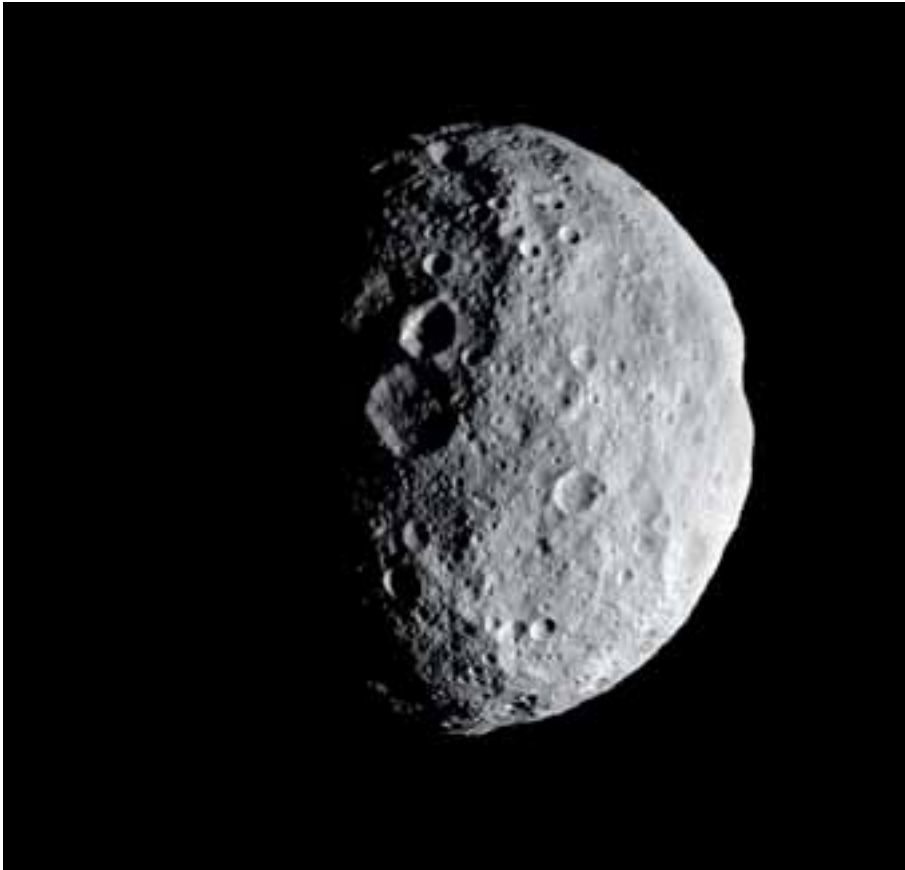
The brightest star of 2012 was *Curiosity*, whose August 6 landing in Gale crater on Mars captivated the world with its complexity and daring. The rover's cameras immediately returned photos that seem more real than those from previous missions, thanks to their ability to capture native color.

Curiosity joined more than 20 other deep-space explorers busily returning huge quantities of data and pretty pictures to Earth. It's a rich time for planetary photography. For this embarrassment of riches, we can thank the designers of robust spacecraft, most of which are operating on extended missions, many of them on multiply extended missions. *MESSENGER*, *Venus Express*, *Lunar Reconnaissance Orbiter*, *GRAIL*, *Chang'E 2*, *Mars Odyssey*, *Mars Express*, *Mars Reconnaissance Orbiter*, *Opportunity*, *Deep Impact*, and *Cassini* are all serving well beyond their primary tours of duty. *GRAIL* ended its mission as planned with a crash into the Moon on December 17, but we have every reason to hope and expect that all of the rest will survive 2013 in the same condition that they enjoy today.

Here are a few highlights from this productive year in space. →



LEFT This is the central-peak complex of the lunar crater Copernicus, seen from the west by Lunar Reconnaissance Orbiter on July 11. The image is about 10 kilometers (six miles) wide; the central mountain climbs 1,300 meters above the floor. Huge boulders, as large as 20 or 30 meters wide, have rolled from the peak to the base. Intriguingly dark, dusty trails down the peak's slopes hint at subsurface geologic diversity.



ABOVE Dawn escaped asteroid Vesta's gravitational grip at a leisurely pace on September 5. Its departing views of the protoplanet were of terrain that had been hidden from the spacecraft for most of its mission: the vernal equinox had brought sunlight to Vesta's north pole only weeks prior.

ABOVE RIGHT Like everything else in the Saturn system seen for the first time by Cassini, Methone was a surprise. That moon is fewer than 3,000 meters long and is as smooth as an egg. It might be made of dust gently coalesced from a ring arc in which it orbits. The darkening of one side was likely caused by impacts with tiny meteoroids and plasma.

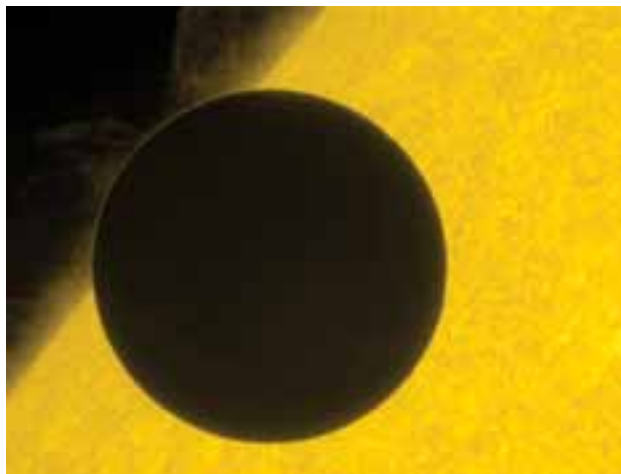


THE YEAR IN PICTURES

RIGHT Cassini arrived at Saturn at the height of the planet's southern summer. Since then, Saturn and all its moons have passed through equinox and are now approaching northern summer. The atmospheres of Saturn and Titan have shifted with the seasons. A fast-spinning vortex has developed over Titan's south pole, where chilled winter air is sinking downward.

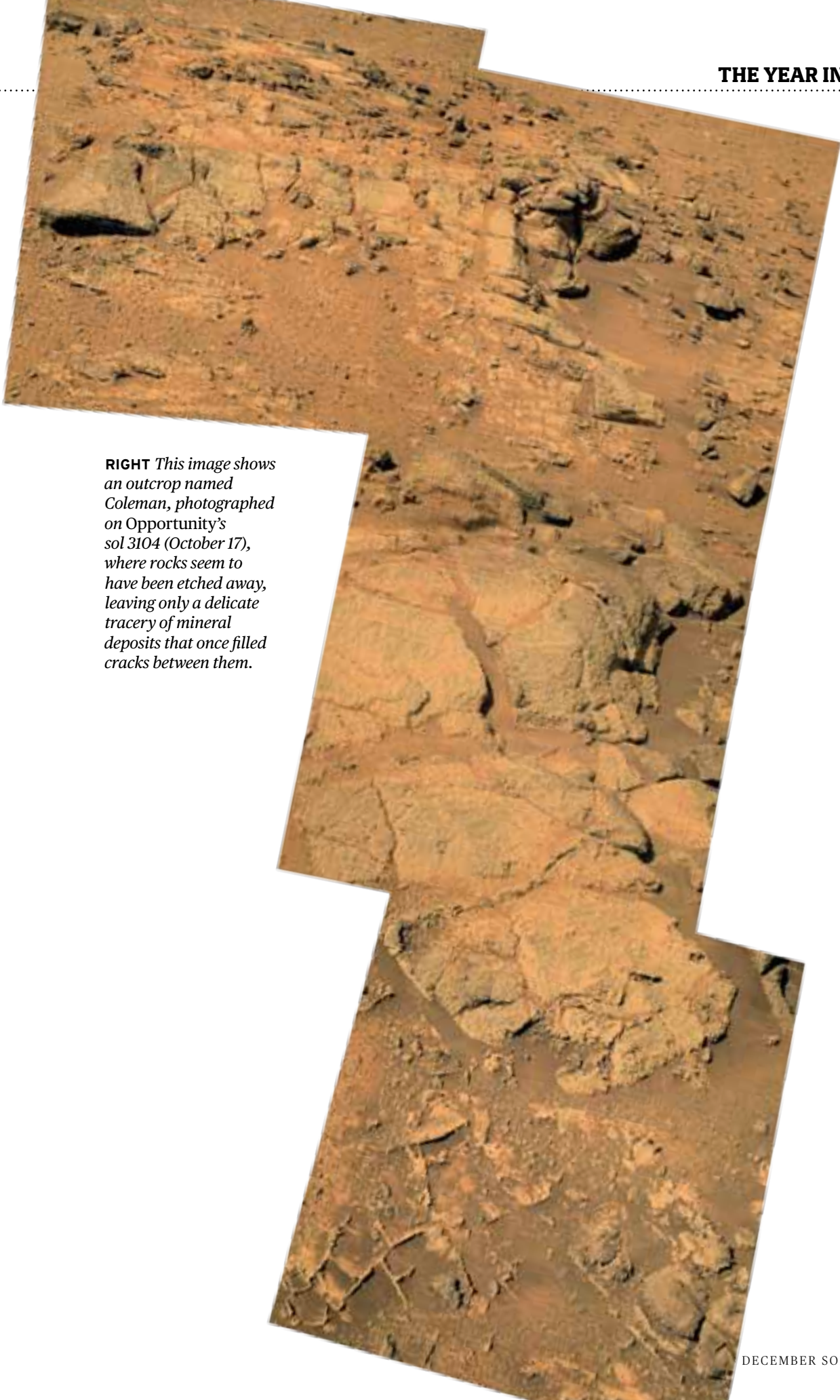


LEFT Millions watched as Earth's sister planet passed between us and the Sun on June 5 and 6. The best views were from above Earth's atmosphere. Here, JAXA's Hinode actually caught sunlight scattered through the top of Venus' thick atmosphere, highlighting a skinny ring of Venusian sky. On the cover, NASA's Solar Dynamics Observatory watched Venus blot out prominences visible in ultraviolet light.



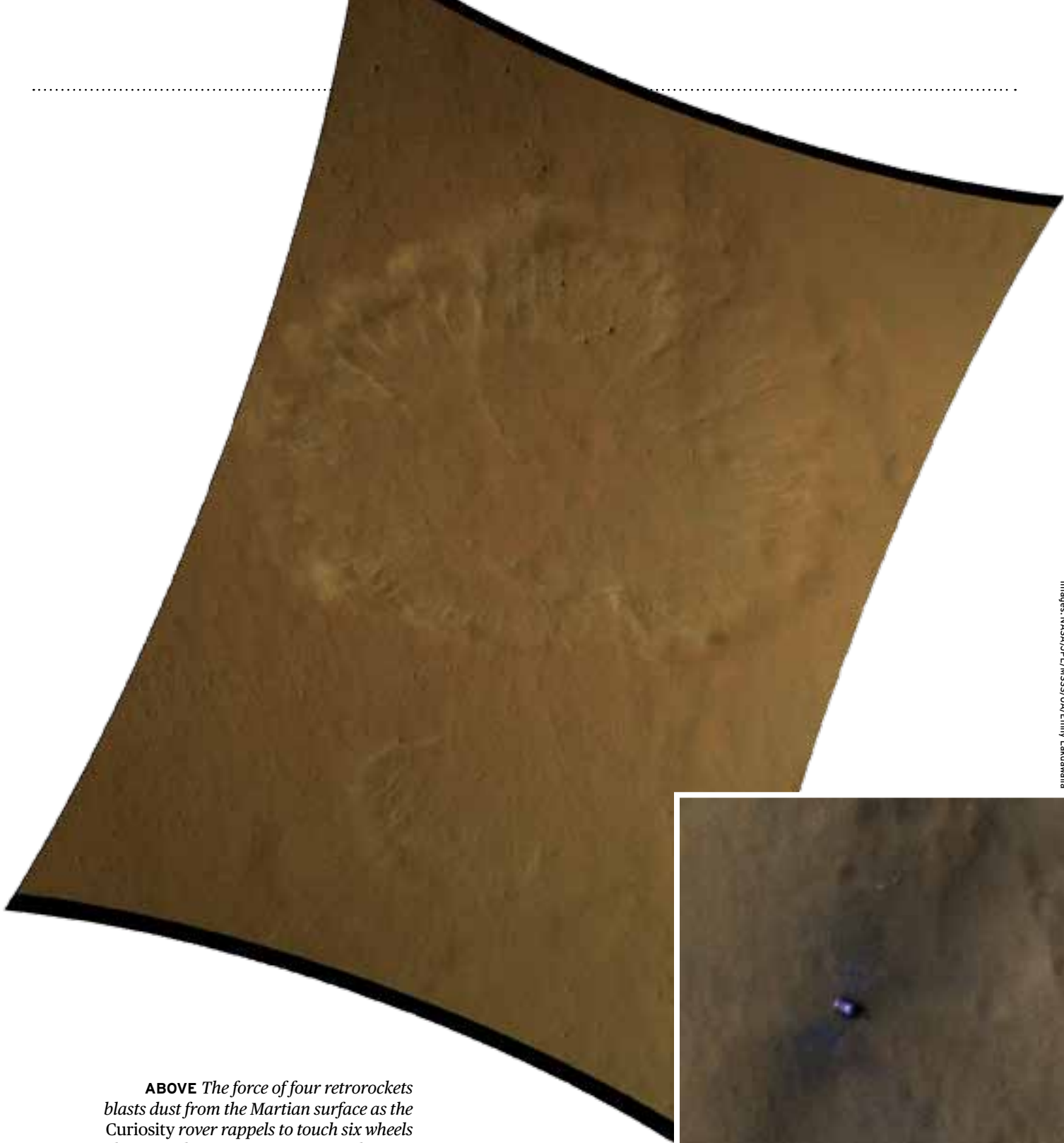
RIGHT On Curiosity's 27th day on Mars, the rover captured slam-dunk evidence that the mission had achieved its goal of landing in a place that had once seen long-lasting liquid water. This rock, Link, is a conglomerate, made of rounded rocks cemented together. The only known process that can round the edges of rocks in this fashion is tumbling in a stream of fast-moving water.





RIGHT *This image shows an outcrop named Coleman, photographed on Opportunity's sol 3104 (October 17), where rocks seem to have been etched away, leaving only a delicate tracery of mineral deposits that once filled cracks between them.*

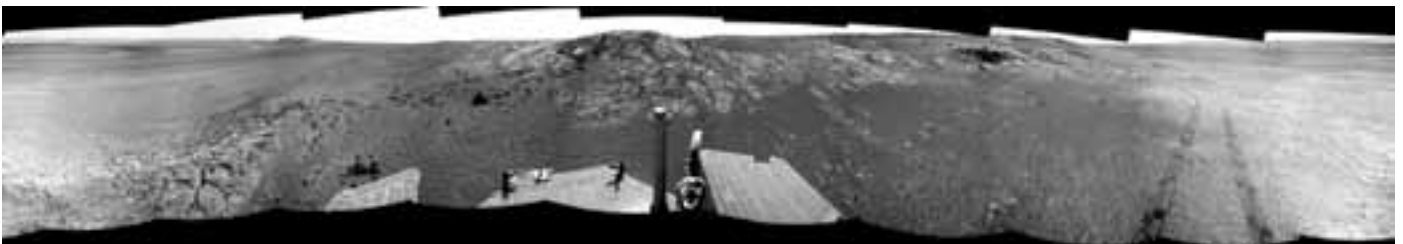
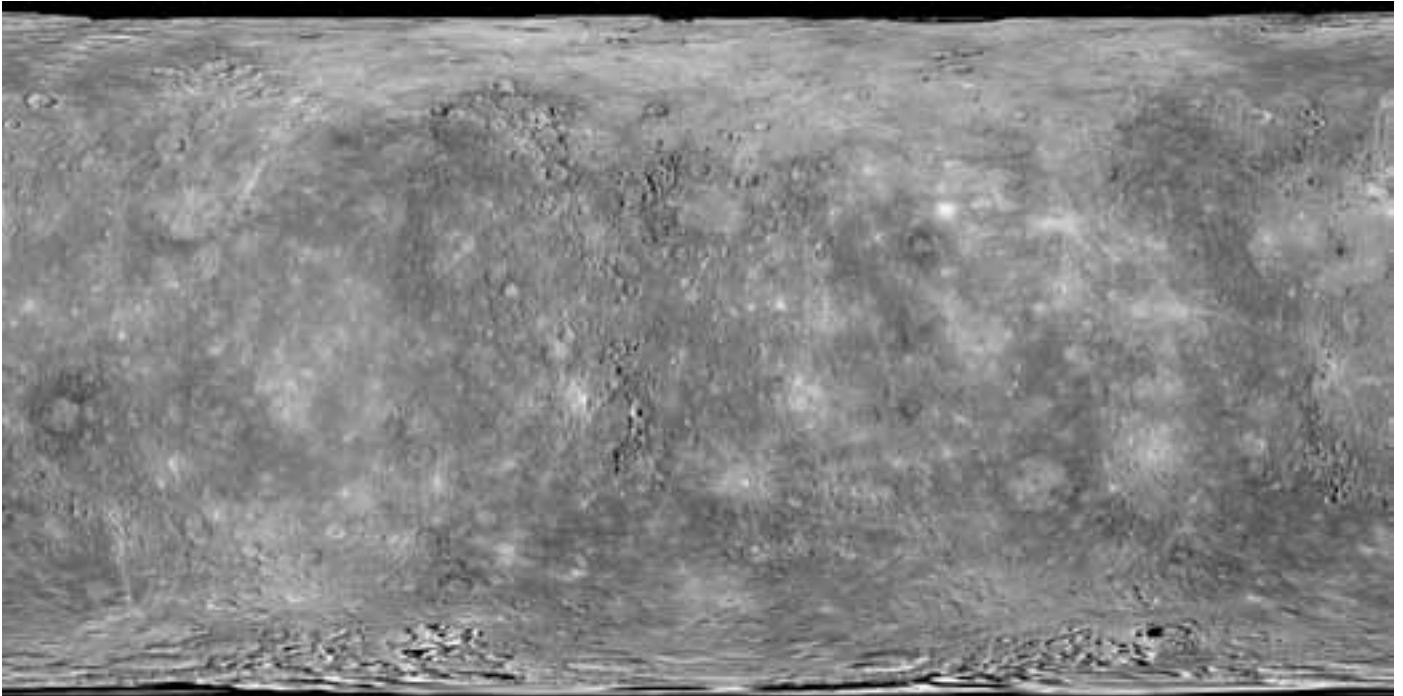
Image: NASA/JPL/Jean van Driel



ABOVE *The force of four retrorockets blasts dust from the Martian surface as the Curiosity rover rappels to touch six wheels to the ground on Mars on August 6—shooting video all the way down with its Mars Descent Imager. The small image below, taken by Mars Reconnaissance Orbiter of exactly the same area 12 days later, shows a butterfly pattern where bright dust has blown away from dark rock. At its center is the white rectangle of the Curiosity rover, sitting safely on Mars.*



Images: NASA/JPL/MSSS/UA/Emily Lakdawalla



TOP Among MESSENGER's most important goals at Mercury was to produce the first global map of a world that contained, until MESSENGER arrived, the largest as-yet-unseen area on any known body in the solar system. With three flybys and a one-year primary mission complete, MESSENGER accomplished that goal and more. It has moved on to an extended mission to map more of the planet at higher resolution from lower altitude.

BOTTOM Summer sunlight has given Opportunity the energy to clamber all over the Cape York outcrop on the rim of Endeavour crater. The fruits of the nine-year-old rover's energetic examinations are photos of rocks of types completely new to the mission. The panorama is from sol 3107 (October 20), as Opportunity gazed upon a rocky promontory named Garson. Behind Opportunity—at the left and right edges of the panorama—is the bowl of Endeavour crater.



BRUCE BETTS is
director of projects for
The Planetary Society.

Vacuumping Planets and Targeting Asteroids

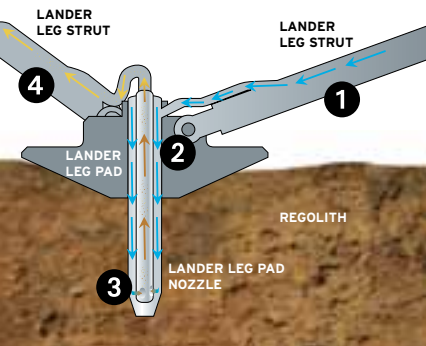
PLANETVAC: SUCKING UP PLANETARY REGOLITH

I am excited to introduce you to the latest Planetary Society project: PlanetVac (Planetary Vacuum), a project with Honeybee Robotics. PlanetVac is a new technique to sample planetary regolith (the upper surface materials that overlie bedrock). It has the potential to be comparatively low in cost and very reliable, in part because of a lack of moving parts. It can be used on Mars, the Moon, or asteroids. It could facilitate a rapid and reliable way to get samples either into *in situ* instruments on the spacecraft or into a sample return capsule.

PlanetVac uses a puff of pressurized gas to push regolith up a lander leg into a sample container or instrument (effectively acting like a planetary vacuum cleaner). The technique is extremely efficient because of the ratio of the pressure of the gas being used to the ambient pressure, and pressures on Mars, the Moon, and asteroids are low. Landers typically have high-pressure helium already on board, which is used to pressurize the fuel tanks, and this gas could be used for PlanetVac.

The next crucial step with PlanetVac is to take it from theory and piecemeal tests to a full-scale test in Honeybee's 3.4-meter (11-foot) vacuum chamber. If we can demonstrate experimentally that the technique is effective, PlanetVac has the potential to move to higher levels of development and to become another arrow in the quiver of tools available for sampling planetary surfaces.

Honeybee built the rock abrasion tools (RAT) for the Mars Exploration Rovers, the scoop for the *Phoenix* lander, and the brush and portions of the sampling system for Mars Science Laboratory's *Curiosity*. The company is a world leader in sample manipulation on planetary surfaces.



ABOVE Diagram of how PlanetVac works, showing a lander leg example: ① Gas flows down lander leg strut from gas cylinder, to ② outer tube of collection nozzle, to ③ side holes in inner tube of collection nozzle, forcing regolith up the inner tube through the lander leg strut ④, and up to a science instrument or to a sample return capsule container.

RIGHT Kris Zacny, director of the Exploration Technology Group of Honeybee Robotics, with the 3.4-meter (11-foot) vacuum chamber and associated equipment at Honeybee Robotics that will be used to test the PlanetVac prototype system.



To learn more about PlanetVac, you can read a summary from the project's principal investigator, Kris Zacny, who is director of the Exploration Technology Group of Honeybee Robotics; or listen to Kris on *Planetary Radio*; or check out the video of Kris and me at Honeybee's cool Pasadena facility talking about PlanetVac. You can find links to all of those at

BIT.LY/TPS121201.

You can help support PlanetVac online at PLANETVAC.PLANETARY.ORG.

CALLING (REALLY SERIOUS) ASTEROID HUNTERS: NEW SHOEMAKER NEO GRANT CALL FOR PROPOSALS

I am happy to announce a new call for proposals for The Planetary Society's Gene Shoemaker Near Earth Objects (NEO) grant



program, which is celebrating its 15th anniversary. Proposals are due February 4, 2013. The Shoemaker NEO Grants are designed to assist amateur observers, observers in developing countries, and underfunded professional observers in contributing to vital NEO research.

I am very excited to announce that Timothy Spahr, director of the Minor Planet Center (MPC), has agreed to be our new Shoemaker NEO Grant coordinator. Tim will guide the direction of the program and coordinate the review panel that will make recommendations for funding. Among other tasks, the MPC, run by the Smithsonian Astrophysical Observatory under the auspices of the International Astronomical Union, is responsible for the collection of astrometric (position) measurements of NEOs and dissemination of those measurements. Tim's background at the MPC makes

him the ideal person to help guide the Shoemaker NEO Grants.

I want to express the appreciation of The Planetary Society as a whole, as well as my personal thanks, to outgoing Shoemaker NEO Grant Coordinator Dan Durda of the Southwest Research Institute. Volunteering his time for many years, Dan has done a great job and has been instrumental in maximizing the contribution of the Shoemaker NEO Grants to addressing the near-Earth asteroid threat. We have limited resources, and having people like Dan, Tim, and the expert panels they engage is crucial for ensuring that we spend our resources where they can make the biggest difference.

This round of grants will continue to focus on improving capabilities for follow-up observations of near-Earth asteroids and for characterizing the physical properties of asteroids (which is important for deflecting dangerous asteroids). Even though these are the foci, Shoemaker NEO Grant winners also have made some interesting recent discoveries, including objects in close-by passes of Earth, among them 2012 DA14, a 50-meter asteroid that will pass as close as geostationary satellites on February 15, 2013, and the recently discovered 2012 SY49. Grants typically go for hardware improvements to take already productive observatories to the next level—for example, through sensitive cameras or equipment to robotically control an observatory.

Find the Call for Proposals and more information on the Shoemaker NEO program, including recent discoveries and other updates, at bit.ly/shoemakerneogrant. There, you can also find links to past winners' appearances on *Planetary Radio*. 🐾



ABOVE Pioneering planetary geologist Gene Shoemaker, for whom The Planetary Society Gene Shoemaker Near Earth Objects (NEO) Grants are named. Gene's work was crucial to recognizing impact cratering as a major force in shaping bodies in our solar system. He took part in early searches for NEOs and was instrumental in raising awareness of their threat to Earth.

LEFT Images from the discovery of near-Earth object 2012 SY49, discovered by Shoemaker NEO grant recipient Gary Hug. The images show the movement of the asteroid (indicated by the arrows) over 45 minutes. The object, temporarily designated by Hug as 1b3720, was moving about 2.1 arcseconds per minute at the time of discovery. The object is a very few tens of meters in diameter.

Planetary Society Members have helped make PlanetVac and the Shoemaker NEO Grant program possible.

Thanks!

This fall, we launched a feature on our website called **INFINITE VISIONS**. There, we asked you to give us your opinions by answering the questions below.

Your responses were thoughtful and inspiring. Here, we share a random sampling of your replies. To read many more—and to watch some videos of space scientists sharing their own visions—go to PLANETARY.ORG.



What do you want to see next in space exploration?

The search for life should lead The Planetary Society's focus for years to come. If life is found, it would be a game changer like no other. It would change our perception of who we are and our place on this planet and in the universe. It would reinvigorate interest in the space program and would generate badly needed funds for the embattled space program.

—ANDREW FAIN

In addition to searching for former life on a desert planet like Mars, I'd like to see some robot missions to places where there is a greater probability of exist-

ing life-forms. It appears that Jupiter's moon Europa has an ocean of liquid water—beneath a frozen layer. There may be other moons in our solar system with environments that may harbor existing life-forms. Let's go to these places!

—DAVE LUKASZEWSKI

I want to see a progressive plan that is not changed with each administration. Slow and steady wins the race. It does not have to be grand—just positive movement forward.

—PHILIP R. WOLF

Life, as we know it, requires liquid water, and there is increasing evidence that some of the moons of Jupiter and Saturn have water oceans covered by crusts of ice. These are probably our best bet for extraterrestrial life,

and exploring them should be our highest priority.

—WILLIAM S. DARTER

I would simply like to quote one of my favorite astronauts, Story Musgrave, from a live TV interview with Ted Koppel on December 7, 1993, from space shuttle *Endeavour*, during the first Hubble repair mission. I thought his rationale for humans going into space was the most true and honest thing I've ever heard anyone connected with NASA say.

—MICHAEL MCNABB

Koppel: As we look at what you're doing up there, there are still people down here on Earth who are saying, "Why? Why go to the trouble? Why go to the expense? Why endanger lives to do what you're doing?"

Musgrave: We have no choice, sir. ... It is the nature of humans to be exploratory and to push on. Yes, it costs resources, and it does cost a lot, and there is a risk, there is a penalty, there is a down side, but exploration and pioneering, I think those are the critical things. It's the essence of what human beings are, and that is to try to understand their universe and to try to participate in the entire universe and not just their little neighborhood.

I would like to see observatories and manned support centers established on the Moon (both light and dark sides). The observatories could be used to monitor Earth, the Sun, and deep space. The support centers could also be used as bases to explore the polar craters for ice for mining water and converting it into oxygen and hydrogen.

—JOHN ROBINSON

Like a lot of people, my first inspiring moment was the Moon landing in 1969. I vividly recall sitting on our living room floor, watching the flickering black-and-white TV screen—a man was walking on the Moon! I was hooked, but I have to credit *Cosmos* by Carl Sagan for opening my eyes to the size and wonder of the universe and to the possibility of life elsewhere. I look at Earth, at all the wonderful diversity of life, and I can't help but wonder what

we may find among the stars. I hope to live long enough to see proof of ET. That is what drives my interest in science and space.

—SUE ROBINSON

What might the future be like without space exploration?

Space exploration in general, and NASA's contribution in particular, represent to me the flowering of human scientific and engineering achievement. Returning to a world without the work of NASA, ESA, and other space agencies would be the equivalent of returning to the Dark Ages.

—CLINT

We are born explorers. It turns out that that urge to explore never leaves us as we continue to grow, as individuals and as a civilization. Nowadays, our fascination with the unknown compels us to explore not just the world around us but also the limitless frontiers of distant planets, stars, and galaxies.

A world without space exploration is a world with limited frontiers, without grand adventures that push our species and our technology to their limits, and without the means to answer the Big Questions that humans have always asked about our origin and ultimate destiny.

—JIM BELL

What sparked your passion for space?

As a young man, I was fascinated that we all live on a relatively small spinning piece of rock and water that revolves around a burning ball of gas, which in turn revolves around the core of our galaxy, which in turn moves around in relation to other galaxies. ... When I learned from Carl Sagan that we are all made of "star stuff" and that our connection to the cosmos is exceptionally intimate, it just increased my desire to explore and learn more.

—RICHARD SURWILLO

When I was about 10 years old, a man with a refractor asked me if I would care to take a look. What I saw took my breath away. It was Saturn. Today, I am the director of Tenagra Observatories, and, despite all the research and discoveries, it is this feeling—my merging with the sublime—that will always motivate me.

—MICHAEL SCHWARTZ

Seeing *Challenger* explode when I was seven years old immediately communicated to me how hard getting to space really is. Why would people expose themselves to such risk to go there? It must be worth it, I thought; it must be awesome. It turns out it's way more than that. It's where we all came from and where we belong. 🌌

—FABIO MIQUEZ



EMILY STEWART LAKDAWALLA
blogs at planetary.org/blog.

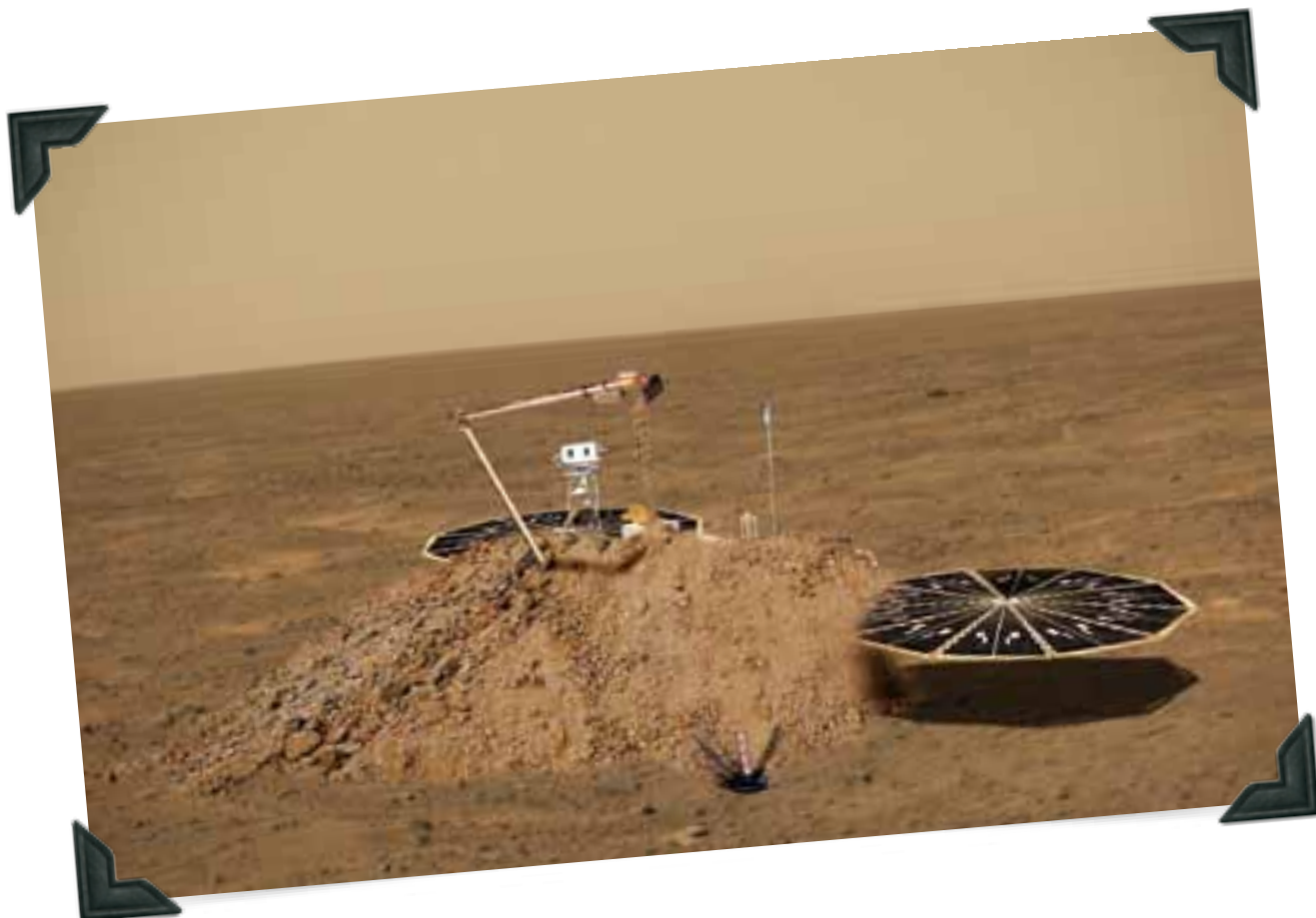


Photo: NASA/JPL/online moderator "AstroO"

Phoenix Attempts Another Sample Delivery!

PHOENIX LANDED NEAR MARS' NORTH POLE in May 2008 and immediately discovered water ice buried just below the surface. In the weeks that followed, the spacecraft struggled mightily to obtain any samples of that material and deliver them to the science instruments, achieving only limited success and leaving piles of dirt all over its deck. UNMANNEDSPACEFLIGHT.COM moderator AstroO ("astro-naught") responded to that frustration with humor. This cartoon has since been seen in presentations given by *Phoenix* team members, including Principal Investigator Peter Smith. AstroO's work helped the team publicly acknowledge *Phoenix*'s sample-processing problems without dwelling on the negative. 🪄

—Emily Stewart Lakdawalla

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

SEE MORE EVERY DAY! PLANETARY.ORG/BLOGS

SOCIETY TRAVEL



Explore Arizona Skies...Plus Mars, the Moon, and more!
April 21-28, 2013



Travel with The Planetary Society to the "Astronomy Capital of the World." Join us in **TUCSON, ARIZONA**, for an illuminating discussion with Peter Smith (at left), the principal investigator of NASA's *Phoenix* Mars Lander—the mission that found water ice at the north Martian pole as well as compounds that have the ability to support life.

In addition, we'll tour Biosphere 2, see the optical telescopes at Kitt Peak, visit historic Mission San Javier del Bac, and explore the origins of life at the Arizona-Sonora Desert Museum. In Flagstaff, you'll explore our own Milky Way from Lowell Observatory and take a trip to famous Meteor Crater.

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CONGRATULATIONS TO STEVE CARIDDI!

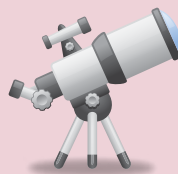
His *Year in Space 2013 Wall Calendar* has been named the Science Geek Gift of the Year for 2012.



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.

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<http://bit.ly/PSkclQ>

WHAT'S UP? by Bruce Betts



IN THE SKY

In the early evening sky, **Jupiter** is currently high overhead and the brightest starlike object, and it is close to the reddish star **Aldebaran** in Taurus. Jupiter is close to the **Moon** on January 21. Reddish **Mars** is very low in the west after sunset, dropping below the horizon by about mid-February. In February, **Mercury** is low in the west, passing 0.3 degrees from Mars on February 8, then getting highest around mid-February. In the predawn sky, super-bright **Venus** is very low in the east throughout January. Yellowish **Saturn** is high in the southeast, moving west as the weeks pass, and is quite close to the Moon on March 2. Mercury is very low in the east in late March and early April.



RANDOM SPACE FACT

Scale models: If running about 3 or 4 steps (more specifically, 4.7 meters, or 15.4 feet) represents the distance from the Sun to Neptune, you'd have to run a marathon (42.2 kilometers, or 26.2 miles) to get to the nearest star system (Alpha Centauri).



TRIVIA CONTEST

Our March Equinox 2012 contest winner is Reggie R. Reid of Fresno, California. Congratulations! **THE QUESTION WAS:** Relative to the Sun, what was the fastest spacecraft ever? **THE ANSWER:** *Helios 2*, which achieved 70.2 kilometers/second (43.6 miles/second).

Our June Solstice 2012 contest winner is Jose A. Alvarez of Col del Valle, Mexico. Congratulations! **THE QUESTION WAS:** Who were the members of the International Space Station Expedition 2 crew? **THE ANSWER:** Commander Yury Usachev and Flight Engineers Susan Helms and James Voss.

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

In what constellation is the Crab Nebula, which is a remnant of a supernova observed in 1054 by astronomers around the world?

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 February 1, 2013. 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.

VOLUNTEER SPOTLIGHT



GEOVANNI SOMOZA is
*The Planetary Society's
southern California regional
volunteer coordinator.*

IN THE STAR TREK MOVIE *The Wrath of Khan*, Spock said, “The needs of the many outweigh the needs of the few—or the one.” Therefore, it was not totally out of character when actor Leonard Nimoy was quoted as saying, “The miracle is this—the more we share, the more we have.”

Recently, we hosted an open house event at our Pasadena headquarters, where our Members and the general public were able to meet and greet our local volunteers. Visitors saw some pictures and sample setups of the events our volunteers organize and participate in to find out if joining our team would be a trek they'd like to be a part of. The event was a great success, and we had a lot of fun answering our guests' questions. Some of the most common questions and answers appear below.

Q How can I become involved with The Planetary Society?

A Volunteering is a great way to help us promote our goals and make a valuable contribution to our communities. It's also an excellent way to develop new skills and can lead to making key professional contacts. Last but not least, volunteering is fun and often leads to the formation of new friendships through spending quality time with like-minded people.

Q Do I have to be a scientist or engineer to volunteer?

A No. The majority of volunteers are everyday people who want to help make a difference. They are accountants, nurses, police officers, and stay-at-home parents, all with one common interest: they love space exploration and believe in the goals of The Planetary Society to create, educate, and advocate.

Q What are some of the types of events in which volunteers participate?

A Volunteers set up displays at local libraries, museums, shopping centers, and other public places. They work at big events like PlanETFest and Yuri's Night, helping to distribute information such as free magazines and brochures and informing the public about current Planetary Society projects. Volunteers also help recruit new members and make it easy for current members to renew their membership. We also visit elementary, middle, and high schools with lectures and science demonstrations, and we set up solar and evening telescopes for students and the public to enjoy views of the Sun, planets, and other celestial bodies.

Q What else can volunteers do?

A Some of our local volunteers come to Society headquarters and help with office paperwork such as processing petitions and sorting mail. They also place advocacy and marketing calls.



Q I don't own a telescope or know how to use one. Can I still help?

A Yes. Several times a year, we hold several telescope training classes to teach you how to use the telescopes that The Planetary Society provides for use at events.

Q Do I have to be a member of The Planetary Society to volunteer?

A No. Although we encourage membership, you do not have to be a dues-paying member of the Society to volunteer.

Q When, where, and how often do you meet?

A We hold a volunteer meeting on the second Tuesday of every month at 85 South Grand Avenue, Pasadena, CA 91105. The meetings run from 5:00 to 9:00 p.m.

Join our volunteer team and start making a difference today. We are saving a spot just for you, and, together, we can spread the excitement of science and space exploration. For more information, check out the volunteer section of our website at PLANETARY.ORG/GET-INVOLVED/VOLUNTEER. 🐾



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.

I enclosed a photo I took in the amazing natural park of Timanfaya, which you can easily see is comparable to a view of Mars’ surface. This is a very extensive lava “sea” on Lanzarote island in the Canaries. Because the volcanic activity was relatively recent, the basalt and rock morphology are very similar to some Mars surfaces we have seen in *Spirit* photos, with a lack of water erosion and before plants have colonized the area. I felt I was in a very special place on our planet—with Mars analogs. Some Sahara desert dust allowed for the red atmosphere. I took this photo on December 3, 2011, just 20 minutes before sunset, with an Olympus E510. —*Roberto Quevedo, Canaria, Canary Islands, Spain*



My photos are of the eclipse of December 10, 2011. I watched the eclipse with the San Francisco Amateur Astronomers along the Ocean Highway in San Francisco. The club had telescopes set up that were accessible to all. My photos were taken with a little Nikon Coolpix camera, which I held over a club member’s Dobsonian telescope set up along the seawall.

I am a docent at the California Academy of Science, and we are celebrating 60 years of the Morrison Planetarium. I walk around with a Mars globe, talking about missions to Mars. I found everything I need at PLANETARY.ORG! I also am carrying around one of your magazines to encourage people to explore this wonderful resource. —*Juliet Rothman, San Francisco, CA, USA*

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.



THE PLANETARY SOCIETY
85 SOUTH GRAND AVENUE
PASADENA CA 91105-1602 USA



When he was a young man, Dan Durda's imagination was captured by Carl Sagan's vision—in Cosmos—of a universe brimming with alien planets. That vision inspired him to become the space scientist and artist he is today. In The HD99109 System, Dan depicts the planets around a star 197 light-years away in the constellation Leo.

You're an explorer, a seeker of answers, a dreamer, a pragmatist. You are shaping space exploration.

You are a Planetary Society Member.

Thank you.

The new year brings hope and resolutions, potential journeys, and the anticipation of discoveries about and throughout the cosmos.

Your generous support is crucial.

You provide this in so many ways—with your Membership dues and your donations, as a Legacy Society Member, and with your participation in the Discovery Team and the New Millennium Committee.

Whether you joined when Carl Sagan, Bruce Murray, and Louis Friedman put out a call for Members in 1981, or you signed up online a week or two ago in response to CEO Bill Nye's invitation, or you connected with The Planetary Society somewhere in between—as a Member, you set the pace for space exploration.

Thank you, Planetary Society Members, one and all.

NOW, FIND OUT HOW YOU CAN DO EVEN MORE AT bit.ly/supporttps

ANDREA CARROLL, CHIEF DEVELOPMENT OFFICER
ANDREA.CARROLL@PLANETARY.ORG
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