The PLANETARY REPORT

Volume XXVII Number 5 September/October 2007

***Sputnik* Launches the Space Age**

From The Editor

"Let's change the world." Bill Nye the Science Guy®, our vice president, seems to end nearly every conversation with those words and, here at The Planetary Society, we've adopted the phrase as a kind of mantra.

We know it is possible to change the world, because we've seen it done. On October 4, 1957, in a burst of Cold War bravado, the Soviet Union launched *Sputnik 1* and changed the world. The Soviets' reasons may have been entirely mundane, little more than political posturing, but nonetheless, *Sputnik* opened a new frontier to humanity, gave us a new way to see our world, and challenged us to do it again.

For a brief time after *Sputnik*, space became an arena in which belief in the future flourished. Yes, nuclear-tipped missiles proliferated around the planet, but at the same time, people were willing to believe the message left, along with human footprints, on the Moon: "We came in peace for all mankind." A flickering hope ignited that this message on another world would shape the future on Earth.

But we don't want to spend too much time gazing back at the past. It's our mission in The Planetary Society to fulfill the hope, still nurtured, for a future among the worlds. You and I, working together, are making sure humanity reaches beyond *Sputnik*'s realm of Earth orbit. Together, we are changing the world.

—*Charlene M. Anderson*

On the Cover:

In Russian, the word "sputnik" translates to "traveling companion." Despite the friendly name and cute look of this 83-kilogram (184-pound) metal ball with its set of four leg-like antennae, the launch of *Sputnik 1* on October 4, 1957 shocked the world and set in motion events that resulted in the creation of NASA and the race to the Moon. The first artificial satellite, encased in a 56-centimeter (22-inch) sphere, stayed in orbit for 23 days, transmitting a continuous beeping signal to an astounded Earthbound audience. Image: NASA

Background:

The United States' and Russia's 12-year race to land humans on the Moon ended with the July 16, 1969 launch pictured here. In this photo, a Saturn V carrying *Apollo 11* climbs toward Earth orbit after liftoff from Kennedy Space Center. This photo was taken with a 70-millimeter (3-inch) telescopic camera mounted on an Air Force plane. On board are astronauts Neil A. Armstrong, Michael Collins, and Edwin E. (Buzz) Aldrin, Jr. Photo: NASA

The Planetary Report (ISSN 0736-3680) is published bimonthly at the editorial offices of The Planetary Society, 65 North Catalina Avenue, Pasadena CA 91106-2301, 626-793-5100. It is available to members of The Planetary Society. Annual dues in the United States are $30 (U.S. dollars); in Canada, $40 (Canadian dollars). Dues in other countries are $45 (U.S. dollars). Printed in USA. Third-class postage at Pasadena, California, and at an additional mailing office. Canada Post Agreement Number 87424.

Editor, CHARLENE M. ANDERSON
Associate Editor, DONNA ESCANDON STEVENS
Managing Editor, JENNIFER VAUGHN
Technical Editor, JAMES D. BURKE
Copy Editor, A.J. SOBCZAK
Proofreader, LOIS SMITH
Art Director, BARBARA S. SMITH
Science Editor, BRUCE BETTS

Contents

Contact Us

Mailing Address: The Planetary Society,
65 North Catalina Avenue, Pasadena, CA 91106-2301

General Calls: 626-793-5100
Sales Calls Only: 626-793-1675
E-mail: *tps@planetary.org*
World Wide Web: *http://planetary.org*

A PUBLICATION OF THE PLANETARY SOCIETY

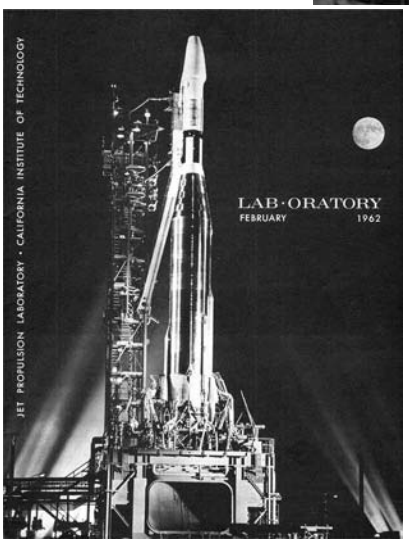
The Age of Space—

"It's up!" "What's up?" "The satellite!"

That's what we said when our boss at the Jet Propulsion Laboratory (JPL), Chuck Cole, came running out of his office on October 4, 1957. In an instant, we knew that our fondest hopes would now become reality. Yes, we had been beaten in a race, but that race was just the alarm bell for the age we had dreamed about since childhood—the age of space.

I shall start this tale with the image of a boy and a book. I am that boy, lying in the shade of a sheet of canvas propped up with branches of fragrant greasewood, the creosote bush, icon of the California desert. The book is *The Stars for SAM* by William Maxwell Reed. Living frugally during the Great Depression, my parents and best family friends went on long camping trips. We kids developed a lifelong love of the stark, lone lands and dark, deep skies beyond the barren mountains, and at night around the campfire we would listen to conversations about the expansion of the universe or the discovery of the neutron while gazing up sleepily at the stars. Not only did we read children's science; it also was the age of the great pulp fiction classics. We came to share imagined voyages to strange destinations in the endless cosmos.

Author James Burke appears in this 1960 photograph with a model of* Ranger 1. *The first two* Rangers *were test vehicles not aimed at the Moon. They carried magnetospheric science instruments. Both achieved orbit, but their apogees were too low to accomplish useful science.
Photo: NASA/JPL



The Atlas-Agena carrying* Ranger 2 *during countdown on November 18, 1961. This photo appeared on the cover of the February 1962 edition of* LAB-ORATORY, *published by the Jet Propulsion Laboratory.
Photo: NASA/JPL, courtesy of the author

From Fiction to Reality

By 1957 the dreaming, yearning boy was grown and sober, a naval reserve aviator and hardworking engineer with a motorcycle and a family. At JPL he was designing rocket engines and doing supersonic aerodynamic analyses and tests.

One JPL missile, the Army's Sergeant, was driven by a big solid rocket. For low-cost simulation, scale models of that engine were built and tested. They had excellent performance and so were chosen to be used in clusters for the spinning high-speed stages atop a Redstone booster built by Wernher von Braun's Army team in Alabama, ostensibly for hypersonic flight testing but really capable of launching an Earth satellite.

Both the Soviet Union and the United States had announced that they would put up satellites for scientific investigations in the International Geophysical Year. The U.S. Army's four-stage contraption had flown suborbitally in 1956, successfully taking hypersonic test payloads down the Atlantic Missile Range. Not much attention was paid by the outside world, however, until the shock of *Sputnik*. All of a sudden the Eisenhower administration was faced with a public clamor. Were we at risk of being annihilated by the technology of a brutal and primitive enemy? How could such a backward society have produced such a modern achievement? What was the matter with American education?

The tenor of the times is illustrated by Loudon Wainwright's allegory in *LIFE* magazine (see next page), then America's pictorial window on the world.

A Space Program Develops

Fortunately, cool heads prevailed. President Eisenhower, accepting the potential of satellites for national security, quickly advanced the Open Skies proposal to forestall moves toward prohibiting overflight, with the expected Soviet refusal not affecting anything. He demanded that the future U.S. space program be civil, not military, while at the same time secretly accelerating nonbelligerent surveillance satellite programs.

The Army's von Braun-JPL team, stung by its loss but confident in its engineering, was released from its suborbital restriction and allowed to prepare for a satellite launch. They used a spare vehicle that had been wisely sequestered by General John B. Medaris. The poker-playing JPL members of the team, invoking the old game's saying, "And the losers cried, 'Deal!'" gave the project its name. *Explorer I* rose from Cape Canaveral 80 days later.

Meanwhile, back at JPL discussions went on about what our role should be in the new political scenery.

A Fifty-Year Joyride

by James D. Burke

Very quickly, we realized that Earth satellites would become part of the business and space-applications landscape, and thus of limited importance to a research laboratory in a university setting. By the time NASA was formed in 1958 and von Braun's organization and JPL became parts of it, JPL already was committed to lunar and planetary exploration. This could include Earth satellite missions viewing Earth as a planet, but our main efforts would henceforth be in deep space.

The years 1958 and 1959 were chaotic as the Army, Navy, and Air Force quarreled over roles and missions in the new space game and NASA struggled to be born of an old and justly proud research institution, the National Advisory Committee for Aeronautics (NACA). We rocket hotshots began an uneasy relationship with our new masters, who were members of a more refined and placid culture.

Lunar vehicle proposals came and went in a dizzying sequence, with the agitation exacerbated by the success of Soviet lunar flights in 1959, including *Luna 3*, which ended centuries of speculation by sending images of the Moon's far side.

By 1960 a clumsy arrangement was forming, with NASA obtaining launch services from the Air Force

Euphoria and the Scythians

The U.S. public has shown its loud and justified alarm about the onset of the* Sputnik *era. A more satisfactory reaction than alarm is called for. . . . Here we have resorted to the lens of fable, which often gives a clearer picture of our values than the most extensive restating of facts.

It was the beginning of winter in the Republic of Euphoria. The first snows were melting harmlessly against the panes of the over-heated glass houses. The stores were bright with the artificial light at which the Euphorians excelled. The children of Euphoria, healthy, lithe and mobile, rushed about on mysterious four-tired errands, but faithfully came back by evening to cluster around the magic happy screens in every home. . . .

Critics occasionally questioned whether the happy Euphorians were not destroying their own traditional austerity of mind, valuable in repairing furnaces, inventing nuclear processes, and separating the components of hazy diplomatic situations. The modern Euphorians replied that mental austerity was as uncomfortable, unnecessary and outmoded as a kitchen without push-buttons, or a speech without slogans. Then they would repeat the new national anthem which the children were taught in the happiness schools:

"We are the biggest; we are the best;
We are ahead of all the rest."

It was at this point in their history, when the winter cruise season lured the mambo-dancing Euphorian vacationist and the schoolchildren in unprecedented numbers were learning how to drive cars and explore their own psyches, that Euphoria found out that it was not ahead.

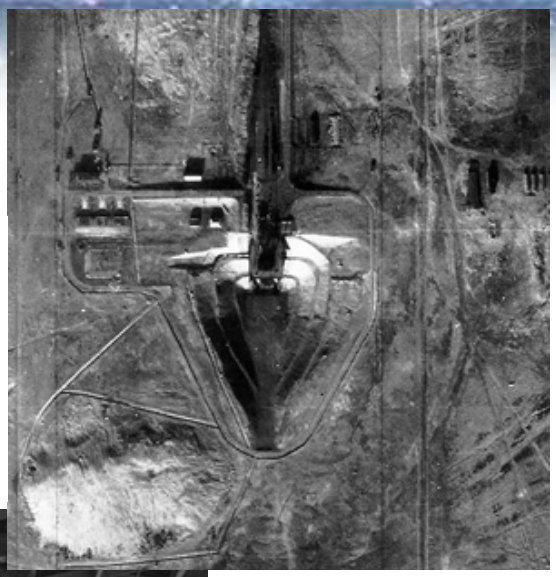
The latest "ultimate" weapon of destruction had been devised and perfected by the Scythians, a larger but traditionally dumber people whose national symbol, the scowl, had been warring with the Euphorian smile. . . . The Scythian schools, not sophisticated enough to give courses in life adjustment, had long been developing a formidable system of study and practice in the newer scientific disciplines.

Their best qualities were strangely effective variants of the two which had long been banished from Euphoria—discontent and curiosity. All the students were chronically discontented. Life in unhappy Scythia made them so. They were also unfailingly curious, if only in the limited tactical pursuit of learning. Under the Scythian system, only the intensive application of curiosity—and hard work—could produce rewards for the student, sufficient to raise him above the common level of discontent.

The cold shock of the Scythian menace was soon translated by the Euphorians into calls for "action." Military emergency measures were taken. Then the Euphorians settled down to do a little thinking. They had obvious alternatives before them. The first—to do business as usual, but a little faster—was made the more palatable as all the soothing resources of the smile country were brought into action. . . .

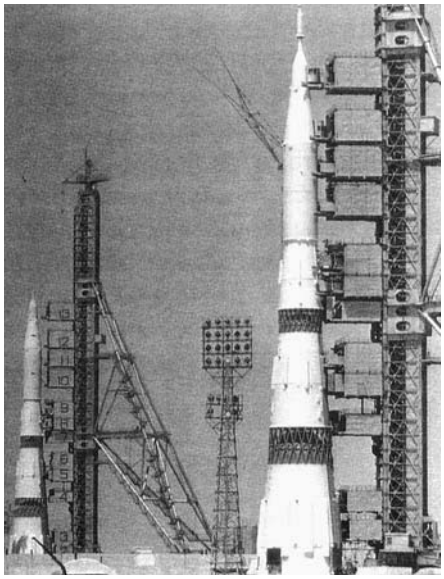
The second alternative was far less happy. It not only implied devoting even larger sums of Euphorian happiness money into tangible efforts at security but, even more drastically, it called for a rediscovery of the traditional austerity of mind. For the Euphorians (of all people) had grown so happy, so modern, so integrated in a new age largely of their own creation that they barely realized that another and still newer age was being discovered—right out from under them.

—Loudon Wainwright, Jr., LIFE*, December 16, 1957*



This aerial view of Sputnik*'s launch pad and flame pit was captured in the 1960s.*
Photo: Central Intelligence Agency

After Sputnik*'s launch stunned the world, the Army was released to launch the United States' first satellite,* Explorer 1*. The satellite carried instruments that measured temperatures and micrometeorite impacts.* Explorer 1*'s most famous instrument, designed by James Van Allen, studied the density of electrons and ions in space. These measurements led to the discovery of an Earth-encircling belt of high-energy electrons and ions trapped in our planet's magnetosphere; this band is now known as the Van Allen belt. Here,* Explorer *team members install the satellite onto its launch vehicle, Jupiter C, in January 1958.*
Photo: NASA/Marshall Space Flight Center



In the early 1960s, Russia began work on a super-heavy rocket booster that would later be named N-1. Although it was originally proposed as a multiuse vehicle for scientific and military tasks, the N-1 evolved into a project with one purpose only—to beat America to the Moon. Four test launches of the N-1 failed catastrophically, however, dooming those plans. In this photo, two N-1 rockets sit on their launchpads at Baikonur Cosmodrome in July 1969.
Photo: NPO Energomash

and its contractors, leaving some members of the von Braun team in the anomalous position of being intermediaries on JPL's behalf in dealing with former competitors. There was a coordinating board, whose title says it all.

Reaching for New Worlds

Meanwhile, in the secret world, urgent projects were afoot. In the United States, the so-called Discoverer biosatellite project, actually the Corona imaging system, was almost ready to take over surveillance when a U-2 was shot down over central Russia. In the Soviet Union, preparations were finished for launches during the October 1960 Mars launch window, an opportunity long known in both countries as the first chance in history for a real interplanetary mission.

On October 10 and 14, two giant rockets, up to that time the most heavily loaded ever, lifted off at exactly the right instants for a Mars departure, climbed slowly away from Tyura Tam, and delivered their monster upper stages to separation. The next engines' turbines started but never attained full speed. Intercepted telemetry from the lost missions was immediately analyzed in the United States and provided a powerful secret stimulus to our efforts.

The Soviets tried again at the Venus window in February 1961. This time, one heavy payload reached Earth orbit and the other was ejected toward Venus, with the spacecraft failing later en route.

In October 1960 I was appointed project manager of *Ranger*, the first American attempt to place operating scientific instruments on the surface of the Moon. Subsequent events are well described in R. Cargill Hall's book *Lunar Impact* (1977; NASA SP-4210). For various reasons, the first six *Ranger* missions failed, but by 1964, led by my expert friend and fellow Navy flier H. M. (Bud) Schurmeier, the last three worked perfectly and delivered many thousands of beautiful close-up images of the Moon.

Meanwhile, two *Mariner* spacecraft, in a project led by another admired friend, Jack James, were prepared for the 1962 Venus opportunity. The first launch failed, but *Mariner 2*, despite many perilous in-flight events, made it to a Venus flyby and returned data confirming the planet's hellish greenhouse climate.

In 1962 the Soviets staged a massive effort for Venus and Mars, launching three huge rockets in each window, but only one spacecraft, *Mars 1*, went on its way. It failed months later, having lasted long enough to reach Venus but not enough for Mars.

Those missions showed beyond doubt that we were in a deep-space contest with a determined competitor. During the same years, a larger drama opened upon a wider stage. On April 12, 1961, Yuri Gagarin made the first human orbital flight, and shortly thereafter, President Kennedy, having asked his advisers to define a space effort in which "we could win," committed the United States to *Apollo*.

Historians now know that the Soviet response to *Apollo*, though enormous, was seriously flawed from its beginning. An excellent book on this subject is Asif Saddiqi's *Challenge*

to Apollo. At the time, however, what we could see via overhead reconnaissance gave us reason to believe that immense construction projects would soon yield a worthy contestant.

After the *Ranger* experience, I entered upon one of the most exciting and rewarding episodes in my long career. Another remarkable person who went by the name of Bud—Albert D. Wheelon—asked JPL Director William H. Pickering for a detailee to strengthen the Central Intelligence Agency's technical intelligence collection and analysis. I was chosen. Over the next few years I participated in some of the most energetic, unconstrained, fast, ingenious, and successful operations of the deep-space intelligence community.

Our efforts would not have had a chance without the support of people in many countries, proving the good regard for the United States that then existed throughout the world. Award-winning reports of our work were later declassified and placed in the U.S. National Archives.

Years of Abandonment, Then Renewal

Returning to JPL with no publicity but with an abiding admiration for the people on both sides of the lunar and planetary contest of the mid-1960s, I began a frustrating spell. The *Apollo* program, halted for a time by the *Apollo 1* fire that killed three astronauts, was in the critical run-up to its first lunar flight, the risky *Apollo 8* in December 1968. Meanwhile, the Soviets were launching heavy scientific *Luna* spacecraft and the circumlunar human-precursor *Zond* missions 4 through 8, while also readying the Tyura Tam launch facilities for their monstrous N-1 lunar rocket.

We at JPL began trying to gain support for a program of robotic lunar scientific missions to accompany a proposed *Apollo* extension that struggled along for a while under various names, "Apollo Applications" being one. We did some desert simulations of teleoperated lunar roving navigation and geology, enjoying the desert as always. But the work led nowhere, because the country was mired in Vietnam and turning inward away from the Moon, even before the whole show collapsed as a result of the four failed flights of the giant N-1. By 1976 it was all over.

JPL went on to glory with more *Mariners*, the *Vikings* to Mars, and the magnificent *Voyagers* (first led by Bud Schurmeier), while the lunar program languished.

I worked on a variety of preproject studies in planetary science and astrophysics, enjoying rich and broad learning resulting from contact with world leaders in those fields. As an exciting sideline (strongly supported by JPL for our innovations and advances in project management), I was a member of Paul MacCready's team that won the Kremer prizes for human-powered flight. All the while, I continued to follow the scientific literature of the Moon. In 1989 I was privileged to lead the Artemis lunar team project of the International Space University.

At last, with the *Clementine* and *Lunar Prospector* missions in 1990 and 1994, American lunar exploration resumed. Together those two missions achieved exactly the goals of Artemis. Now, the European Space Agency's *SMART-1*, Japan's *Kaguya* (the renamed *SELENE*), India's *Chandrayaan-1*, and China's *Chang'E 1* all are signs of a vigorous worldwide renaissance of robotic lunar exploration. But many years will pass before humans again bestride the Moon.

A high point in Jim Burke's career was the invitation in 1980 by Carl Sagan, Bruce Murray, and Louis Friedman for Jim to become technical editor of The Planetary Report. *He continues happily in that role to this day.*

This view of the rising Earth greeted the* Apollo 8 *astronauts as they came from behind the Moon after the lunar orbit insertion burn on December 25, 1968. The image is displayed here in its original orientation, though it is usually shown with the lunar surface at the bottom of the photo. The Moon's horizon is approximately 780 kilometers (485 miles) from the spacecraft. *Image: NASA*

OUT OF THIS WORLD BOOKS

After Sputnik: 50 Years of the Space Age
by Martin Collins
Collins, 256 pp., $35.00, hardcover

There's nothing like the anniversary of an early space exploration milestone to make people of a certain age feel old. Can it really be 50 years since *Sputnik*? I was born a couple of years after that epochal launch, but most of the remaining space "firsts" are vividly etched in my memory.

After Sputnik: 50 Years of the Space Age tells the story of space exploration through an examination of artifacts from the Smithsonian National Air & Space Museum's extensive collection. It is divided into five sections, ordered chronologically, beginning with Robert Goddard's rocket experiments in the 1920s. Each section begins with an insightful and lucid essay written by Martin Collins. Although brief and necessarily lacking in depth, these essays provide a reasonably complete overview of the political, social, and technical dimensions of the eras described—"Cliff Notes" for the Space Age.

Most of the book is composed of full-page pictures of hardware flown in space, along with models, prototypes, toys, log books, paintings—even the hair band that astronaut Pamela Melroy used to subdue her unruly hair on two shuttle missions—accompanied by a few paragraphs describing each item. It's a fascinating way to look at the extraordinary achievements of the scientists and engineers who pioneered the final frontier. The downside of this approach is that it leaves important threads of the space exploration narrative untold. In the past decade, for example, we've learned a great deal about the Soviet plan to beat *Apollo 11* to the Moon, yet this fascinating effort receives no coverage, presumably because the museum holds no artifacts from the Soviets' manned lunar program.

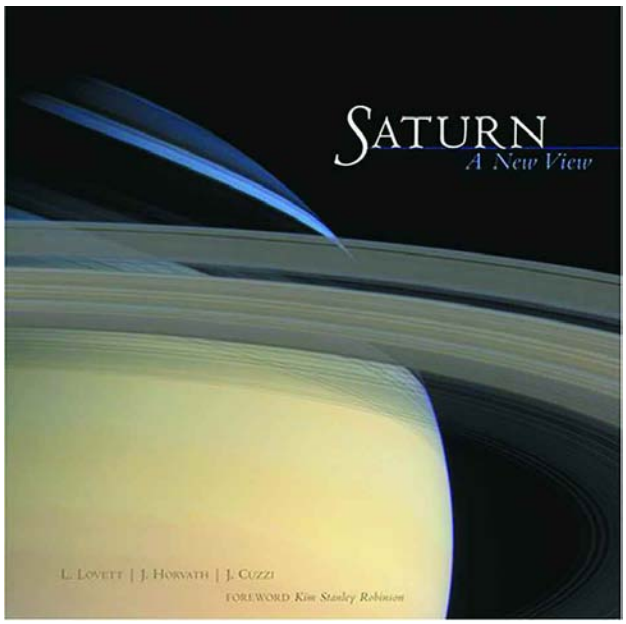
The shock waves that spread across the Western world as *Sputnik* circled overhead in 1957 are nearly forgotten today. The Soviet Union's stunning accomplishment sparked a fevered soul-searching in American society. The author notes that the launch of *Sputnik* "raised fundamental questions . . . about the effectiveness of the nation's political leaders and institutions, and the character of the populace." A *Christian Science Monitor* editorial lamented the "vast expenditure on creature comforts and a preoccupation with soft materialism" at the heart of American culture. Lyndon Johnson opined that it was imperative that the United States control outer space to "prevent domination of the world by a nation with evil intent." Our way of life and the very fate of the nation seemed to be at stake. (Younger readers can substitute 9/11 for *Sputnik* and Islamic terrorists for the Soviet threat to glean some sense of the impact on the American psyche.)

Ironically, Soviet leaders had no idea that their hard-scrabble satellite would have such a jarring effect on their rivals. *Sputnik* barely earned coverage in the Soviet press—until it became clear that it scared the living daylights out of the United States. A photo of a *Sputnik* music box from the museum's collection is intended to "represent the far-ranging cultural and psychological impact of *Sputnik*." A picture of an anxious American family stocking the home bomb shelter with canned goods might have been a better choice. The author also notes how the suffix "nik" immediately became a popular addition to common words in the American vocabulary. Probably the only example still familiar today is *beatnik*.

The heroic era of the Moon race years is contrasted with the more pragmatic decades that followed, with an emphasis on the space shuttle, robotic planetary exploration, and the literally thousands of Earth-orbiting satellites that have

become indispensable for national defense and modern commerce. The final section of the book illustrates how, thanks in large part to space technology, the "global village" imagined by Marshall McLuhan in 1960 is finally becoming a reality.

Despite the minor complaints noted above, *After Sputnik* is an often surprising and very engaging book. Everyone with an interest in the history of space exploration will want to own a copy.
—Andre Bormanis, writer and producer

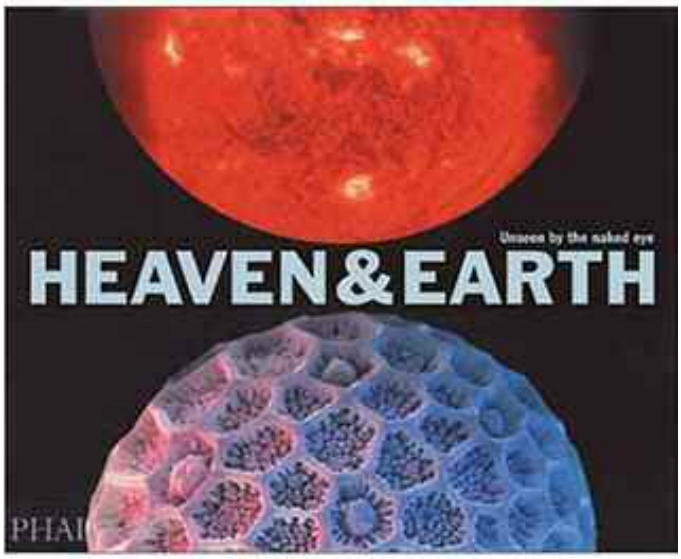


Saturn: A New View
by Laura Lovett, Joan Horvath, and Jeff Cuzzi, with foreword by Kim Stanley Robinson
Harry N. Abrams, Inc., 192 pp., $40.00, hardcover

With its gossamer-thin rings and its jewel-like moons, it is not hard to make Saturn beautiful. The best thing for any author of a book about *Cassini* at Saturn to do is to stay out of the way of the pictures, and in *Saturn: A New View*, *Cassini*'s amazing photographs are spread across the pages from edge to edge with little interference from text. Each turn of the page surprises with a dramatically different view of some element of the Saturniun system: striated rings; a thin crescent view of Dione, its mountain peaks glinting in scattered light; lumpy moons and round moons framed against Saturn or dissected by rings; colorful swirling storms in Saturn's midlatitudes; the wrinkled southern hemisphere of Enceladus, blue with fresh ice; a potato-shaped ring-moon, lit by the Sun on one side and Saturnshine on the other; breathtaking color panoramas of the entire ring system. Each image rewards, and the brief but well-written captions provide insight into the processes that operate in each place.

If you can manage to tear your eyes away from the photos, you'll find excellent text accompanying the pictures. I especially enjoyed the introductory essay, "Saturn Sublime," by science fiction author Kim Stanley Robinson. Two chapters, one on Saturn and its rings and another on the moons, are contributed by *Cassini*'s Interdisciplinary Scientist for Rings, Jeff Cuzzi; not surprisingly, the planets-and-rings chapter is more in-depth than the one on the moons, which treats each little world briefly.

Although the book was published in 2006, based on image selections made barely a year after *Cassini* began its four-plus-year tour of the Saturn system, the image selections are likely to hold up very well with time. *Cassini* both collected far-off views of Saturn and its rings and made numerous close flybys of the rings and moons in its first year, and many of the images collected in this book will not be improved upon during the rest of the mission.
—Emily Lakdawalla, Planetary Society Science and Technology Coordinator



Heaven & Earth: Unseen by the Naked Eye
by David Malin and Katherine Roucoux
Phaidon Press, 384 pp., $24.95, softcover

The human eye, in all its wondrous complexity, is a limited thing. Through it we see only a thin sliver of the planet and universe in which we live. Fortunately, our creations—the electron microscopes, telescopes, spacecraft cameras, and other technological marvels that fill the gaps in our vision—grow more capable all the time.

Heaven & Earth: Unseen by the Naked Eye takes us on an amazing sight-seeing trip, through photographs, to regions of the natural world too small, too fast, or too far away for our unaided eyes to see. These views are rolled out in a procession of striking images whose subjects range in size from the tiniest specks of our planet—such as a single atom of gold—to the immensity of a cluster of galaxies two billion light-years away.

The pictures, collected from a broad range of sources, reveal a continuity of shapes and forms in everything around us: for example, the feathery fronds of a marine

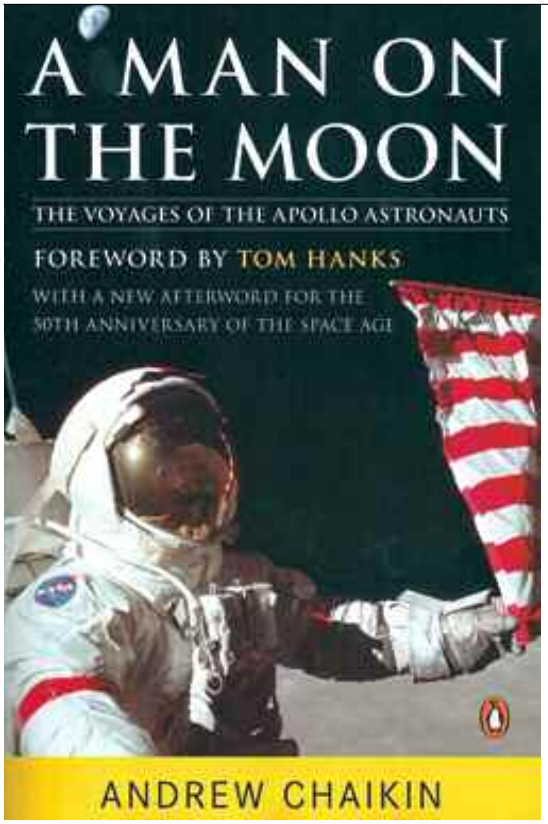
plant that are actually crystals of vitamin C, and the channels in a river delta that resemble an intricate network of blood vessels. Farther away, loops and jets of plasma shooting out of hot spots on the Sun's surface are seen so close up they look like strange volcanic eruptions viewed from a plane.

Heaven & Earth is organized into five chapters, presented in sequence according to scale and distance: "Beneath the surface," "Just out of reach," "Planet Earth," "Into the heavens," "And beyond." The book begins with the illuminated trails of subatomic particles and culminates with the still-hard-to-fathom Hubble Deep Field, humankind's deepest, most detailed view into the origins of the universe.

David Malin contributed the introductory essay for *Heaven & Earth* and served as scientific adviser. Malin is famous for the beautiful pioneering deep-space imagery he produced while working for the Anglo-Australian Observatory in New South Wales. Editorial research was done by Katherine Roucoux, who also wrote the book's generous image captions and thorough glossary.

Heaven & Earth is a coffee-table book unlike any other. First published in 2002, it has been re-released in paperback. It makes an impressive gift for anyone who'd like a closer look at the beautiful and mysterious universe around and inside us.

—Donna Stevens, Associate Editor of The Planetary Report



A Man on the Moon
by Andrew Chaikin
Penguin Group, 720 pp., $18.00, softcover

A Man on the Moon, an amazingly thorough and easy-to-read history of the *Apollo* program, has been reissued for the 50th anniversary of the Space Age, with a new afterword by author Andrew Chaikin. In creating this book, Chaikin interviewed 23 of the 24 *Apollo* astronauts as well as many others involved with all aspects of *Apollo*, providing unparalleled background and personal insight. The book, originally published in 1994, became the inspiration and source book for the HBO miniseries *From the Earth to the Moon*, as discussed in the Tom Hanks foreword that was added in a 1998 edition.

It was a pleasure for me to revisit this book. Chaikin covers all aspects of *Apollo* from beginning to end. He tells the stories, including those of each *Apollo* mission, in a way that makes you feel as if you are there on the inside, an obvious outflow of his thorough interviews. From the tragedy of the *Apollo 1* fire, to the triumph of *Apollo 11*, to the cancellation of the later *Apollo* missions, Chaikin gives details as well as analysis of what really happened.

Make no mistake, the book is big, but once you start reading, it is very hard to put down. The *Apollo* program was an amazing undertaking, in scope and time scale. Reliving it through this book is both fascinating and inspirational. The book also includes helpful appendices with basic information on each *Apollo* mission and astronaut, as well as a plethora of detailed footnotes and an extensive bibliography.

Chaikin's new, pensive afterword wrestles with where *Apollo* fits within history and within the space program. Chaikin says of *Apollo*, "How could the most futuristic thing humans have ever done be so far in the past?" This struck a chord with me, and I'm sure it will with others. We went to the Moon within a decade after John F. Kennedy's challenge, put 12 people on the surface of the Moon, then quickly retreated to low-Earth orbit, where we have remained for more than three decades. Chaikin writes, "In the narrative of the space age, *Apollo* is a chapter that is jarringly out of sequence."

In his afterword, Chaikin also addresses the success of robotic spacecraft exploration, as well as the present and future of human exploration. There is hope that outward human exploration will restart, with plans to return to the Moon and on to Mars as part of NASA's Vision for Space Exploration, as well as nascent plans by other countries to send humans to the Moon. In the meantime, Chaikin's tome provides us with detailed, entertaining, and very human looks into how getting there was accomplished the first time around.

—Bruce Betts, Planetary Society Director of Projects

World Watch

Washington, D.C.—The United States government's consideration of the NASA budget is full of inconsistencies. Although there is consistent support for the redirection of the U.S. human spaceflight plans away from the shuttle and space station and toward the Moon and Mars, there is also less-than-adequate funding for the program.

The administration has chosen to finance the redirection not with new funds, which were planned when the Vision for Space Exploration (VSE) was announced in 2004, but by cutting back on planned activities in science, research and data analysis, and aeronautics. Congress has objected to some of these cuts, and committees in both the House and the Senate have stated their support for increases over the administration's request. In fact, as occurred last year, the appropriations committees added funds for science and increased the total funding for NASA. These were victories for The Planetary Society and for space exploration. We have details of the committee actions on our website as part of The Planetary Society's Save Our Science! campaign.

But even with congressional support, space program funding often gets mired in larger budget battles and maneuvering in U.S. politics. That happened last year, when the committees' actions were put aside, and an omnibus bill was passed with decreased NASA funding. This year, we're seeing similar maneuverings, and all decisions about funding could again end up being made at the last minute, resulting in an omnibus bill of some type.

Thus, there is a great deal of uncertainty about the future of the VSE program. In addition to the funding battles, the Mars vision has been eliminated from the program. This happened two years ago, when Mars funding was deleted from the NASA Exploration program and work on Mars sample return was canceled. Facing a combination of insufficient funding and other budget pressures, the VSE is at risk of becoming a compromise program with no vision and merely a replacement rocket for servicing a space station.

Furthermore, a new administration coming in 2009 may have its own priorities for NASA, which could threaten the future of the VSE. The Planetary Society, as always, will work with the incoming administration to make the strongest case for continued human and robotic planetary exploration.

Washington, D.C. and Paris, France—Although NASA's Vision for Space Exploration is no longer clearly aimed toward Mars, the new associate administrator for science, Alan Stern, has directed that Mars sample return be reinserted into science mission planning. This parallels an effort already under way in the European Space Agency (ESA) to develop a Mars sample return as a follow-on to the ESA's 2013 planned *ExoMars* mission. ESA has been studying a possible 2020 sample return mission.

Stern's redirection caught many planetary scientists by surprise. Recent cuts to the Mars program and de-emphasis of space science over the past two years had caused some scientists to give up on a sample return mission. Others worry that other science mission plans for the 2011–2020 decade will suffer if too much focus is put on sample return.

Although a Mars sample return would be a very expensive robotic mission (but still much less costly than a human mission), there are ways to share the cost. For instance, an international Mars sample return mission could consist of a flexible number of missions that take place over several launch opportunities, so we wouldn't have to put all our eggs in one basket. Several years ago, the Jet Propulsion Laboratory, ESA, and the French and Italian space agencies developed a mission plan that identified many different vehicles and several sub-missions that would make a strong and cohesive Mars program.

It is worth reminding ourselves that only the Soviet Union has carried out a successful robotic sample return mission from the surface of another world (at the Moon in the 1970s). The Japanese may yet succeed with *Hayabusa*, and the Russians are trying again with the Phobos sample return scheduled for launch in 2009. An international mission led by NASA and ESA could offer other promising international roles.

Beijing, China—The International Space University held its summer session in Beijing this year. The Chinese hosts arranged special visits for the students, staff, and faculty (including myself, who conducted a workshop on Mars sample return mission design, and our own Jim Burke, who led a student team project). The group visited the Chinese Academy of Launch Vehicle Technology Long March rocket assembly area, the Astronaut Training Center, the Beijing Aerospace Command and Control Center, and the Chinese Academy of Space Technology, which is responsible for approximately 90 percent of Chinese satellite development.

The visits featured China's desire to commercially market the Long March family of rockets and the increasing breadth of Chinese space science, applications, and human space activities. China is also becoming active in international space efforts, with cooperative arrangements in Asia, Africa, and Europe.

Not addressed was the significant political fallout from the Chinese anti-satellite weapon test last January. The test, which was conducted by the military, appears to have caught many of those in the civil space community by surprise.

While in Beijing, I also presented a public lecture at the Beijing Planetarium, with which The Planetary Society has established a cooperative relationship.

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

Defining a Global Strat

by Louis D. Friedman

Space exploration enriches and strengthens humanity's future. Searching for answers to fundamental questions such as: "Where did we come from?," "What is our place in the universe?," and "What is our destiny?" can bring nations together in a common cause, reveal new knowledge, inspire young people, and stimulate technical and commercial innovation on Earth. The Global Exploration Strategy is key to delivering these benefits.

So begins a remarkable document, *The Global Exploration Strategy: The Framework for Coordination*, authored by 14 space agencies and recently published on their behalf by the European Space Agency. The report presents a broad global consensus and concise rationale for human exploration of the solar system.

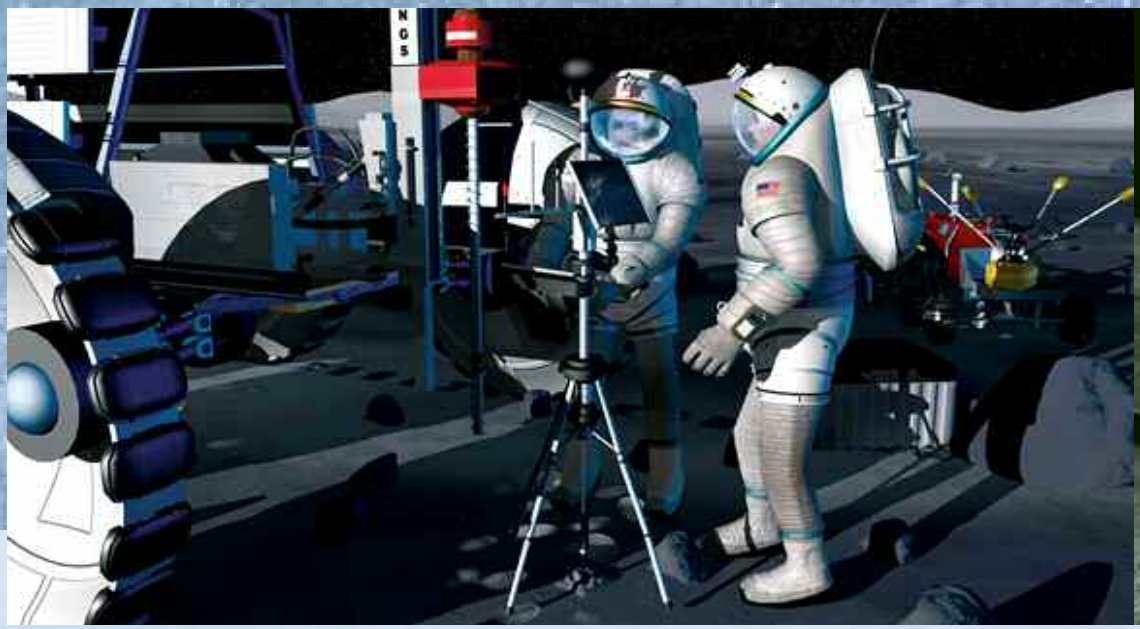
Combining Our Efforts

These 14 space agencies came together in response to the increase in the number of spacefaring nations that intend to explore the Moon and Mars with both robots and humans. The report states, "With increasing intent and determination, we are resolved to explore our nearest companions—the Moon, Mars, and some nearby asteroids. Our goal is not a few quick visits, but rather a sustained and ultimately self-sufficient human presence beyond Earth supported by robotic pathfinders."

The United States' Vision for Space Exploration calls for humans to go back to the Moon in preparation for trips to Mars and further exploration of the solar system. The European Space Agency's Aurora program includes ambitious robotic missions to Mars so as to prepare for European roles in an international human Mars mission.

The 14 space agencies that contributed to *The Global Exploration Strategy: The Framework for Coordination*

In alphabetical order: ASI (Italy), BNSC (United Kingdom), CNES (France), CNSA (China), CSA (Canada), CSIRO (Australia), DLR (Germany), ESA (European Space Agency), ISRO (India), JAXA (Japan), KARI (Republic of Korea), NASA (United States of America), NSAU (Ukraine), Roscosmos (Russia).



The United States' Vision for Space Exploration sees a future in which humans return to the Moon to learn to live and work in space. This work is a stepping-stone to the more challenging task of going to Mars and, possibly, some nearby asteroids. These astronauts are setting up a work site with scientific instruments that will help collect data to stream to Earth-based researchers.
Illustration: NASA

The Japanese hav preparations for a an astronaut wat to collect samples

egy for Space Exploration

In the 1990s, Japan adopted a plan leading to a robotic lunar base; the plan was revised in the early 2000s to include participation in a human mission to the Moon. China has a human spaceflight program as well as a lunar robotic program and is also developing its first Mars spacecraft to fly on the Russian Phobos sample return mission. India has a lunar program and recently described a plan for both robotic Mars missions and human spaceflight.

Although Russia has not yet publicized long-range plans, its human spaceflight capability remains strong. The Russians are working on a sample return mission to Mars' moon Phobos and have said they are developing a lunar orbiter/lander mission known as *Lunar Glob*.

The 14 space agencies developed what they call a "framework for coordination" because, as the report states, "sustainable space exploration is a challenge that no one nation can do on its own." With all this activity and interest, the creation of a coordinated framework is extremely timely. International cooperation may sustain ambitious national programs even as they come under budget constraints and face inevitable delays and setbacks.

The report further explains the rationale for international cooperation:

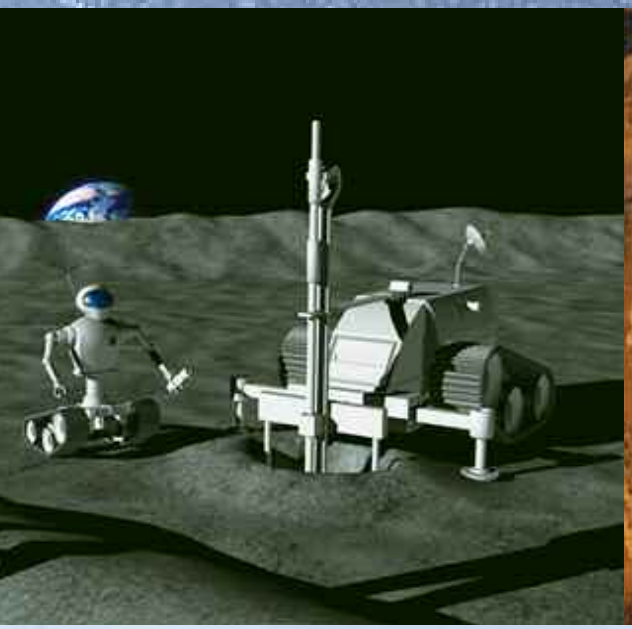
This Global Exploration Strategy will bring significant social, intellectual, and economic benefits to people on Earth. We will learn about the evolution of the solar system and how to protect against harsh environments. By understanding how planets work, we learn more about our Earth. The technologies created will help build a more sustainable society.

Space exploration also offers significant entrepreneurial opportunities by creating a demand for new technologies and services. These advances will encourage economic expansion and the creation of new businesses.

Finally, this new era of space exploration will strengthen international partnerships through the sharing of challenging and peaceful goals. It will inspire people everywhere, particularly youth. It will steer many students toward careers in science and technology and provide them with challenging jobs that encourage innovation and creativity.

How Will We Go?

The Global Exploration Strategy recognizes that "A partnership between humans and robots is essential to the success of such ventures. Robotic spacecraft are our scouts and proxies, venturing first into hostile environments to



ve revised their plans for a robotic lunar base to include a human mission to the Moon. In this futuristic scene, ches over two robotic explorers as they work together s from just beneath the lunar surface. Illustration: JAXA

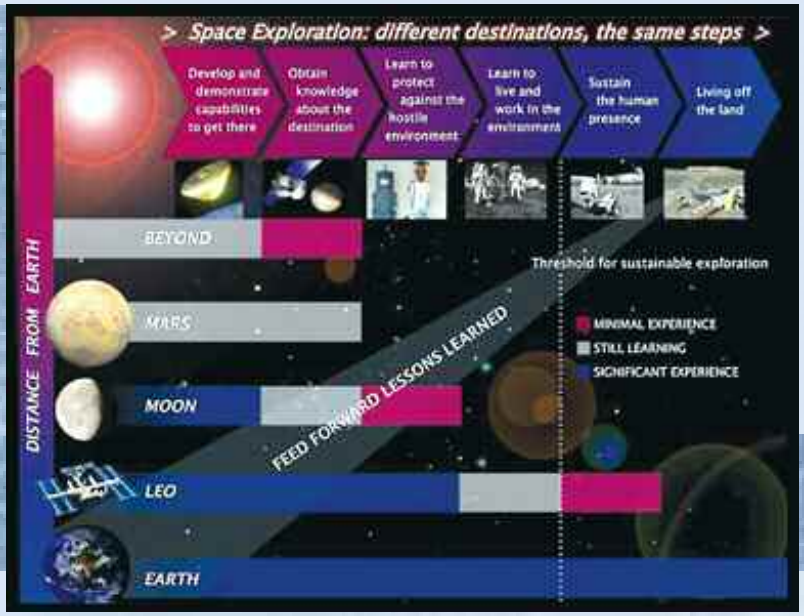
The European Space Agency (ESA) has developed Aurora, a program comprising complex robotic explorers, to prepare for an international human mission to Mars. This version of ESA's Mars sample return would take place in two stages. First, a spacecraft carrying a return capsule would be inserted into Mars orbit. It would be followed two years later by a second spacecraft carrying a descent module and a Mars ascent vehicle. Illustration: ESA

gather critical intelligence that makes human exploration feasible. Humans will then bring their ingenuity, creativity and problem-solving skills to these destinations."

Balancing the robotic and human missions, the science and engineering requirements, and the differing national goals will be challenging—to say the least. The report recognizes the challenge: "This Framework is *not* a proposal for a single programme, but recognizes that individual space exploration activities can achieve more through coordination and cooperation. Nations have varying scientific, technological, and societal objectives for their space activities, and—inevitably—some can afford to do more than others."

The only human destinations that currently can be considered are the Moon, Mars, and near-Earth asteroids. "But exploring even the first group of feasible destinations will require both robotic and human missions of all sizes and complexity," the authors assert. "A coordinated strategy will help individual nations with shared objectives to engage in joint projects that will maximize their return on investment. The scientific and technical successes—and even the failures—of each project can be used to improve the ones that follow."

The report stops short of defining how coordination will be accomplished. It vaguely states, "The Framework calls for the development of an international exploration coordination



This diagram shows where we stand in our efforts to live and work in space continuously. The vertical dotted line at right of center shows the boundary that must be crossed for humans to be able to do so. This means not simply managing to get by in a new environment for a short time, but actually living there and using local resources with little or no support from Earth. *Diagram: ESA/ASI*

"Mapping the Space Exploration Journey"

Chapter 3 of *The Global Exploration Strategy: Framework for Coordination*

We have chosen to reprint one chapter of the report here in *The Planetary Report*. A PDF of the full document is on our website at *planetary.org/action/opinions/*.

Space exploration follows a logical set of steps, starting with basic knowledge and culminating, it is hoped, in a sustained human presence in space. This journey requires a variety of both robotic and human missions. The Global Exploration Strategy provides a framework to coordinate the efforts and contributions of all nations so that all may participate in the expansion into space and benefit from it.

Since the first satellite was launched in 1957, space exploration has evolved in a characteristic way, progressing steadily from short-term, very focused missions to longer and more comprehensive ones.

During the Apollo programme in the 1960s and 1970s, humans visited the Moon for fewer than three days on each mission. With space stations such as Salyut, Skylab, Mir, and the International Space Station, we learned how to live for months in space. Russian cosmonaut Valeri Polyakov holds the record with 14 months on board Mir.

By building upon these experiences, we are now preparing to establish a sustained human presence on the Moon and, eventually, in other parts of the solar system. The long-term space exploration envisioned in this document is very different from the International Space Station. It is not a single space project but instead will comprise multiple missions and projects, large and small, to several destinations. Nations not involved in the ISS can [make] and are making valuable contributions to space exploration.

Individual projects may emphasize certain goals more than others—for example, focusing on robotic science on Mars or testing technology needed for resource utilization on the Moon. Each project will support the overall goal of extending the human frontier, step by step.

The diagram above shows how far we have progressed toward continuous living and working at key destinations. The central vertical bar in the diagram shows the threshold

The International Lunar Decade: An Implementation Tool for the Global Strategy?

The launch of Japan's *Kaguya* mission to the Moon kicked off the International Lunar Decade (ILD), which will conclude in 2020, by which time it is hoped that humans will have returned to the Moon and begun looking outward to Mars. The Planetary Society proposed the ILD and called upon the international organizations and the nations conducing lunar missions to create programs that both encourage and facilitate cooperation.

We believe the ILD will also provide a mechanism for scientists and engineers from developing nations and other countries not directly involved in space missions to participate in science programs or smaller engineering developments. We also believe the ILD will excite the public and increase interest in human exploration of space.

The Planetary Society is working in partnership with the Secure World Foundation on this project. The ILD has been endorsed by the Committee on Space Research of the International Council of Scientific Unions and by the International Lunar Exploration Working Group. This year, we presented the proposal to several of the countries formulating the Global Exploration Strategy. We hope the ILD can help both the public outreach objectives and the national interests described in the Global Exploration Strategy. —*LDF*

tool to enhance mutual understanding among partners and to identify areas for potential cooperation. By jointly creating a common language of exploration building blocks, planners and engineers will be able to agree how practical features such as communications, control, life support, and docking systems could be made to work together. Such 'interoperability' between space vehicles will lower the risks of space exploration and could assure crew safety in case of life-threatening emergencies."

That's a goal. Now, the next steps must be taken by the space agencies: defining the tactics and plans to reach this goal and implementing the strategy. The agencies plan to take these next steps and are continuing to meet and work toward this end.

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

that must be crossed to achieve sustainable space exploration. This means not just simply tackling a new environment for a brief time, but actually living there and using local resources, with little or no support from Earth.

We have not yet reached this level of autonomy for either robotic or human missions. Our activities in low Earth orbit approach the threshold of sustainability but crossing it remains an enormous challenge, even for robotic missions. For example, in principle, we have the technology to refuel communications satellites but we lack the infrastructure to make this a reality.

Robotic exploration is a key first step in expanding human presence into the solar system. Several generations of robotic exploration may be required to gain basic knowledge about a target destination before human exploration is useful or justified.

First, we send orbiters to remotely sense the surface and identify safe locations for landing. They are followed by landers that investigate the surface directly and then by robotic sample-return missions that carry material back to be examined in terrestrial labs.

Today, we have a limited amount of material on Earth that has been returned from outer space. Within the next decade, this knowledge will be increased by robotic missions returning material from certain asteroids and one of the moons of Mars.

The first robotic sample-return mission from the surface of Mars will likely occur around the same time that humans return to the Moon—an indication of just how large a technical challenge it represents.

Robotic probes that have explored the major bodies in the solar system have generated much valuable data but, for the more distant destinations ("Beyond," in the terms of the diagram), the knowledge accumulated so far has been limited by the constraints of our space technology.

We have glimpsed a riverbed and rocks of ice on Titan, but we do not know the composition of the ice, or if rivers still flow there. We believe the ice of Europa covers a liquid ocean, but we do not know whether it might contain life.

We have accomplished only the first tentative steps towards understanding these destinations; we cannot speculate if and when humans will reach them or what technology we will use.

This schematic picture of exploration shows that experience gained at each step of the journey enables the next one. Equally important, parallel progress toward several destinations may well generate valuable experience that is useful for all. Progress along the pathway to each destination will be assisted by increased coordination between projects. ❍

We Make It Happen!

by Bruce Betts

Planetary Society Member Names Headed to Mars and the Moon

In August, NASA's *Phoenix* mission successfully launched toward Mars, and in September, the Japan Aerospace Exploration Agency's *Kaguya* mission (also called *SELENE*) successfully launched for lunar orbit. Both carried the names of all Planetary Society members as part of our Messages from Earth program.

Phoenix Launches to Mars

Phoenix launched on board a Delta II rocket from Cape Canaveral, Florida on August 4, 2007. On board the spacecraft is a Planetary Society–created DVD that contains a quarter million names and a collection of Mars literature and art called *Visions of Mars*. Works from Isaac Asimov, Ray Bradbury, Arthur C. Clarke, and other science fiction authors, as well as historical works of Schiaparelli, Percival Lowell, and more, are on their way to the Red Planet to become the first "library" on Mars.

Phoenix will land on Mars near 70 degrees north latitude and will be the first lander to explore the Martian arctic. It is a fixed lander with a suite of advanced instruments and a robotic arm that will dig half a meter to a meter into the subsurface to study the water ice that is expected to be there. *Phoenix* will uncover clues in the Martian arctic soils about the history of water and the planet's potential for habitability.

It has been a long journey to prepare the *Phoenix* spacecraft for launch, as it has for our *Phoenix* DVD. Remember, this is not a standard DVD—it's an archival-quality silica glass mini-DVD designed to last hundreds of years in Mars' hostile environment.

The mini-DVD hardware heritage goes back to a design for the canceled 2001 Mars lander. A few years later, with the LEGO Company, we flew a similar DVD on the landers for both Mars Exploration Rovers. Now, our DVD is flying on the very spacecraft base for which it was originally designed, as *Phoenix* is the "rebirth" of the 2001 Mars lander—risen from the ashes and improved.

Visions of Mars, the first Martian library, has also risen from the ashes for inclusion on *Phoenix*. Its heritage goes back to 1993, when Louis Friedman, executive director of The Planetary Society, first came up with the idea to send stories, essays, and art about Mars on the Russian *Mars '96* mission. It flew, albeit briefly, on

On September 14, 2007, Kaguya *lifted off from Tanegashima space center at the tip of an H-IIA rocket and began its voyage to the Moon.* Image: JAXA

A Delta II rocket lit up the early morning sky over Cape Canaveral Air Force Station in Florida on August 4, 2007 as it carried the Phoenix *spacecraft on the first leg of its journey to Mars.* Image: NASA

What's **Up?**

In the Sky—October and November

Venus is extremely bright in the predawn eastern sky, and Saturn continues to get higher in the predawn eastern sky during this period. Check out the Moon, which appears between Venus and Saturn on November 4. Jupiter is the brightest object in the evening sky, falling lower in the post-sunset western sky over time. Mars is rising in the mid- to late evening, headed toward a late-December opposition. Mars looks like a reddish, mildly bright star. It will appear very close to the Moon on November 26. Mercury is very low in the predawn eastern sky in early November, moving higher on the morning of November 8.

Random Space Fact

Saturn's moon Iapetus is very unusual, with a dark leading hemisphere and bright trailing hemisphere, and a raised ridge around its equator. *Cassini* recently did a close flyby that will, we hope, shed light on this strange dark and light place.

Trivia Contest

Our May/June contest winner is Scott Walker of Middletown, Connecticut. Congratulations!

The Question was: Where in the solar system is the Hellas Basin, also known as Hellas Planitia?
The Answer: Mars.

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

Who has more time in space than any other human?
(Hint: The time was accrued over several missions.)

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

Submissions must be received by December 1, 2007. 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.*

Mars '96 but ended up at the bottom of the Pacific Ocean after a launch failure. Now, *Visions of Mars* has been updated and revamped and is headed for Mars' surface.

To prepare our DVD for flight—for the 2001 lander, Mars Exploration Rovers, and now *Phoenix*—our engineering models have been violently shocked, shaken, placed in vacuum chambers, baked, and redesigned, with all the abuse carefully documented to show its spaceflight-worthiness.

So, as *Phoenix* begins its cruise to Mars, we look back at the years of preparation and give thanks. We also enthusiastically look forward to a successful landing in the north polar region of Mars on May 25, 2008.

Kaguya Soars to the Moon

The Japanese mission *Kaguya* launched on an H-IIA rocket from Tanegashima Space Center in Kagoshima, Japan on September 14 (Japan Standard Time). Following a beautiful launch, the mission was injected into an eccentric Earth orbit. The spacecraft is set to enter lunar orbit on October 3 and begin science operations on October 21. On board *Kaguya* are more than 400,000 names and messages that The Planetary Society helped gather from well-wishers around the world.

The Planetary Society worked with The Planetary Society of Japan and the Japan Aerospace Exploration Agency (JAXA) to promote a "Wish Upon the Moon" campaign to send names and short messages on *Kaguya*. The names and messages were micro-engraved onto sheets of material that are carried on board the spacecraft. Messages included some from well-known individuals. *Apollo 11* astronaut Buzz Aldrin's plan for the future was "Back to the Moon and on to Mars," and Ray Bradbury sent the comment, "Beyond the Moon, Mars beckons."

Kaguya has a wide variety of science instruments to study and learn about the lunar environment, from high definition cameras, to particles and fields instruments to a laser altimeter and more. *Kaguya* also has two small subsatellites that will allow detailed tracking that will yield careful gravity measurements, including some from the far side of the Moon. These data have been sorely lacking in our understanding of the Moon and a limiting factor for future exploration.

The launch of *Kaguya* also kicked off the International Lunar Decade, a period when several nations are actively planning missions to the Moon, leading to a proposed human-occupied lunar base. The Planetary Society came up with the concept of the International Lunar Decade to encourage international coopera-

tion in lunar exploration. China's *Chang'E* mission is scheduled to launch in the next few months, and India's *Chandrayaan-1* and NASA's *Lunar Reconnaissance Orbiter* are both scheduled to launch in 2008. All are robotic orbiters with a wealth of science instruments.

More on Messages from Earth

You can learn more about our Messages from Earth project and print out certificates documenting your travels on *Phoenix* and *Kaguya* at *planetary.org/programs/projects/messages/*. There you can also learn more about the *Phoenix* DVD, *Visions of Mars*, and the *Phoenix* and *Kaguya* missions.

Also, keep checking our website—or keep your eye on this column in future issues—for the next Message from Earth opportunity.

Bruce Betts is director of projects at The Planetary Society.

Members' Dialogue

Readers Respond

In his May/June 2007 "World Watch" column, Louis D. Friedman asked for your comments on NASA's budget cuts and The Planetary Society's Save Our Science! campaign. Here are excepts from a few of the letters we've received.
—Editor

I read with growing sadness your "S.O.S." article in the May/June 2007 edition of "World Watch." It's encouraging that four members of Congress attended the hearing, yet this 65-year-old's dismay grows at our nation's lack of support for planetary science.

I grew up reveling in our nation's progress toward space, secure in the knowledge that in my time we would have outposts on the Moon and, perhaps, missions to Mars, or at least preparations for Mars missions. Now it is difficult to keep the phrase, "Abandon hope, all ye who . . ." from entering my thoughts about our future in space.

Here's hoping someone can turn the thinking in Washington around so that future generations can once again take pride in America's contribution toward humanity's understanding of the outer solar system and universe.

Thank goodness for the Jet Propulsion Laboratory, *Spirit*, and *Opportunity*!
—WILLARD WHITMON,
Bourbonnais, Illinois

As a very early member of the Society I am compelled to write, I believe for the first time, to say what a wonderful job the principals and workers of the organization are doing. I am quite proud to be a member supporting these myriad global interests.

I am also proud and happy that my father discovered The Planetary Society through my membership, and he was an interested member for 10 years before he died. He had the opportunity to attend a few of your functions and was proud of the association and education he received as a member.

There has been discussion in the past of which path to take with exploration. I know you must try to please as many members at one time as you can, but I hope your primary focus—and I believe it is—is toward nonhuman flight. It seems a great waste of time and money to transport . . . oh, you know the argument.

I am very excited over all the new discoveries in space. The more I discover—along with the rest of mankind—the more I want to know. I grow impatient for answers before I die. Thanks for all the good years.
—RICHARD T. GRASS,
Des Moines, Iowa

The American space program is a history of successes despite missed opportunities. When I was working on the *Apollo* project at Grumman, way back in 1964, I proposed the use of an *Apollo* to visit a near-Earth asteroid (NEA), and Grumman, at least, was interested enough to forward the idea to NASA, which then dropped it.

Skylab was lost. The shuttles wasted their external fuel tanks after lofting them into a minimal Earth orbit. For a bit more energy, the tanks could have provided giant capsules as nuclei for space stations, after suitable modifications in orbit.

I am happy at least to see that some thought is being given to visiting some NEAs this time. (Of course, in 1964 eight were known, while Spaceweather now lists 869.)

NASA should be expected to have at least one deep space launch per year in each of these categories: inner planets, outer planets, telescopic, and solar studies—and should have funding to accomplish this.
—THOMAS W. HAMILTON,
Staten Island, New York

Why We Explore Space

An investment in the future never shows immediate gain, despite immediate cost. It took a long time and a lot of money to find out how to get to India by ship, but on the way toward this target, America was discovered. In the long term, the work of The Planetary Society to raise public awareness of the necessity of space exploration will contribute more to peace and the future of humankind than all armies put together.
—KARL H. GRABBE,
Bremen, Germany

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

Society News

Give the Gift of Exploration!

Looking for a special gift? Give a Gift Membership.

As a holiday present, birthday gift, "thank you" for your teacher or favorite astronomer, or gift to your library or community center, your gift of membership in The Planetary Society is perfect for that person or group on your list who wants to explore space.

Your fellow explorer will receive a personalized gift card with your special note, a welcome packet with a personalized membership card, a free set of "The Solar System in Pictures," six issues a year of *The Planetary Report*, invitations to special events, and discounts at planetariums.

In addition to the satisfaction you'll get from having given a unique gift, you'll receive the gift of knowing that you are supporting an international team exploring new worlds, understanding our own world, and seeking other life. Giving a gift membership is easy: Make your gift securely online at *https://planetary.org/join/membership/gift.html,* call the Membership Department at (626) 793-5100, or e-mail us at *tps@planetary.org.*

What better way to wrap a year's worth of space exploration, advocacy, and discovery?

—Andrea Carroll,
Director of Development

Stardust@home Enters a New Phase

In August, Stardust@home launched Phase 2 of the project, marking a new chapter in the ongoing search for interstellar dust particles brought to Earth by the Stardust spacecraft.

With the launch of Phase 2, "dusters" (as project volunteers are called) can now search for interstellar dust particles at an unprecedented level of sensitivity. Even the subtlest tracks and particles, which may have eluded detection in the first phase of the project, now stand an excellent chance of being found.

You too can help find the elusive grains from distant stars! With Stardust@home's easily downloadable "virtual microscope" and some basic online training, any computer user can be part of Stardust@home.

You can find out more on our website, *planetary.org/stardustathome*.

—Amir Alexander,
Writer-Editor, planetary.org

Do We Have Your E-Mail Address?

If you have not received an e-mail from us in the last few months, we don't have your e-mail address. Please drop us a note at *members@planetary.org* or go online at *planetary.org/emailupdate*, and we will make sure your e-mail address is added to your membership information.

Your e-mail address is your ticket to exciting space information and activities. Each month, we will send you notices about upcoming programs, Society projects, events, and news in the space community.

And don't worry—we will never sell or share your e-mail address.

Stay informed by staying connected with The Planetary Society.

—Monica Bosserman Lopez,
Marketing and Interactive Manager

May 25, 2008:
Phoenix lands on Mars!
Save the Date!

Planetfest 2008

Questions and Answers

We know that the asteroid impact that wiped out most of the dinosaurs occurred at the Cretaceous-Tertiary (K/T) boundary. The smoking gun is the iridium layer that covers Earth's surface at the time of the impact in our planet's geologic history.

Do all asteroids have a heavy concentration of iridium? If so, why are they so different from Earth?

—Darlene Lacey
Sierra Madre, California

Iridium is a rare chemical element from the platinum family. It is extremely hard but also very brittle. Iridium is found on Earth's crust in minute quantities (about 0.3 parts per billion, or ppb). Remote sensing operations tell scientists it exists in larger concentrations in certain types of asteroids or comets (the latter is less known since we do not have a comet sample yet). This high concentration of iridium was indeed the main link between the mass extinction that occurred at the K/T boundary and the asteroid impact first proposed by Luis and Walter Alvarez in 1980. A concentration of about 6.3 ppb of iridium provided a geologic marker on a global scale for the K/T boundary.

Other lines of evidence strongly show that the mass extinction at the K/T boundary was precipitated by an asteroid or comet impact. This evidence includes shocked quartz, tektites, and tsunami deposits.

As often happens in science, the answer to a question comes not from looking at a single piece of evidence but from looking at the whole picture. This is the case for the K/T mass extinction. Iridium is only one piece of a larger set of evidence.

A typical "stony" asteroid has an iridium concentration of about 500 ppb. The Alvarez team calculated the iridium layer at the K/T boundary to be about 0.5 million tons. For that concentration of iridium to have accumulated would have required a meteorite 10 kilometers (6.2 miles) in diameter, or slightly larger than the nucleus of Halley's comet. The 500 ppb concentration of iridium in stony meteorites is an average for this type only. Some less refractory chondrite meteorites (for example, Orguel and Murchison) have less iridium than do ordinary chondrite meteorites. Nickel-iron meteorites have much more iridium than the average. Asteroids are the parent bodies for these meteorites, and they vary in iridium content depending on their compositions.

Missions such as *Rosetta*, which will visit comet 67P/Churyumov-Gerasimenko, and *Dawn*, which will fly by asteroids Vesta and Ceres, respectively, will provide greater understanding of the composition of these enigmatic building blocks of our solar system and their impact on Earth's history.

—ADRIANA OCAMPO,
NASA Headquarters

How far across is our galaxy? And how can scientists tell, considering the density of stars near the center? Wouldn't the extreme brightness there make measurements difficult?

—Rene R. Shaw
Potomac, Maryland

The Milky Way (also called simply "the Galaxy" by astronomers) is about 100,000 light-years across. Interestingly, this measurement is based on the measured motions of stars observed in many directions *away* from the center, not toward it.

The density of stars and their brightness in the direction of the Milky Way's center is not the problem in making measurements there. Although the star density is high, it doesn't counteract the effect of the great distances to those stars, which makes them look faint.

The real problem is the tremendous amount of dust between us and the galactic center, which makes it impossible to see stars near the center in visible light. If we could take the amount of dust between us and the center of the galaxy and put it between us and our Sun, the brightness of the Sun as seen at noon from Earth would be reduced to that of the brightest stars we see at night. You can imagine then, what effect this dust would have on our ability to see faint stars! However, by making observations with infrared radiation—which can penetrate all the dust—telescopes can distinguish individual stars and their motions as they orbit the black hole at our galaxy's center.

Such observations are very exciting because, using Kepler's laws of planetary motion and the measured orbital periods of the stars, they permit measurement of the mass of the black hole. But it is still difficult to measure an accurate distance to the galactic center. In order to do that, astronomers would like to measure the trigonometric parallax of the Milky Way's center.

You can demonstrate parallax for yourself. Hold up a finger at arm's length. Looking with only one eye, note the position of your finger against the background. Now use only the other eye. Notice that the background behind your finger has shifted. Using the distance between the pupils of your eyes, you can determine the distance from your eyes to your finger. But now try this observation with the pole of a streetlight or sign down the street. If it is too far (more than about 30 meters), the separation of your eyes is not enough to detect the parallax, so you can't measure the distance with your eyes alone. You have to take a step or two sideways to make a measurable change in the sign's position against the background.

This is essentially the technique that scientists will use to determine the distance to the galactic center, although the stars to be measured are near our galaxy's outermost neighborhoods. The distances to be measured will tell us that the Milky Way's center is around 26,000 light-years away, and the sideways motion to make the measurements is essentially from one side of Earth's orbit around the Sun to the other side.

Because of Earth's atmosphere, telescopes on its surface cannot measure the parallax to the galaxy's center, even using the diameter of Earth's orbit for the separation of the "eyes." Even the Hubble Space Telescope cannot make the measurement (it wasn't designed to). In the future, SIM PlanetQuest (formerly the Space Interferometry Mission) will be able to take parallax measurements of a population of stars that will permit scientists to determine accurately the distance to the Milky Way's center as well as the Galaxy's overall diameter. But SIM won't take parallax measurements of the Milky Way's core, again, because of the obscuring dust.

Determining the parameters of the Milky Way relies on direct measurements of many stars, but not necessarily in the direction you might expect.

—STEPHEN J. EDBERG,
Jet Propulsion Laboratory

Factinos

A large amount of water vapor has been detected inside a dusty preplanetary disk around an embryonic star called NGC 1333-IRAS 4B. The observations provide the first direct look at how water, an essential ingredient for life as we know it, begins to make its way into planets, possibly even rocky ones like Earth. With the help of the Spitzer Space Telescope, scientists discovered water—enough to fill Earth's oceans five times over—inside the collapsing nest of the forming star system depicted here. "Water is easier to detect than other molecules, so we can use it as a probe to look at more brand-new disks and study their physics and chemistry," said Dan Watson of the University of Rochester in New York. "This will teach us a lot about how planets form." *Illustration: NASA/JPL-Caltech/R. Hurt (SSC)*

NASA's Spitzer Space Telescope has detected enough water vapor inside the collapsing nest of a forming star system to fill the oceans on Earth five times. Scientists say the water vapor is pouring down from the system's natal cloud onto a dusty disk where planets are thought to form (see image above).

"For the first time, we are seeing water being delivered to the region where planets will most likely form," said Dan Watson of New York's University of Rochester. He is the lead author of a paper on this "steamy" young star system that appeared in the August 30, 2007 issue of *Nature*.

The star system, called NGC 1333-IRAS 4B, is still growing inside a cool cocoon of gas and dust. Within this cocoon, circling around the embryonic star, is a burgeoning, warm disk of planet-forming materials. The new Spitzer data indicate that ice from the stellar embryo's outer cocoon is falling toward the forming star and vaporizing as it hits the disk.

"On Earth," says Watson, "water arrived in the form of icy asteroids and comets. Water also exists mostly as ice in the dense clouds that form stars. Now we've seen that water, falling as ice from a young star system's envelope to its disk, actually vaporizes on arrival. This water vapor will later freeze again into asteroids and comets."

—from the Jet Propulsion Laboratory

Scientists are shocked to learn that Mira (pronounced my-rah), a star known to Earthly observers for more than 400 years, has a long, comet-like tail. A new ultraviolet mosaic from NASA's Galaxy Evolution Explorer (Galex) shows that the speeding star is leaving an enormous trail of "seeds" for new solar systems (see image below). Mira is shedding material that will be recycled into new stars, planets, and possibly even life as it hurtles through our galaxy.

Mira appears as a small white dot in the bulb-shaped structure at the right side of the image and is moving from left to right in this view. The cast-off material can be seen in light blue. The dots in the picture are stars and distant galaxies. The large blue dot at left is a star that is closer to us than is Mira.

Galex discovered Mira's strange comet-like tail during part of its routine survey of the entire sky at ultraviolet wavelengths. Mira has been studied for centuries, yet nothing like this has been documented before.

The star's tail stretches 13 light-years across the sky. The material in Mira's tail has been blown off slowly over time—the matter at the end of the tail was released about 30,000 years ago. —from NASA

Recent observations by NASA's Galaxy Evolution Explorer (Galex) have detected this long, bright tail streaming off Mira, one of the stars in our galaxy that is most familiar to us. Mira, a small white dot in the bulb-shaped feature at right, is ejecting a large fraction of its mass in the form of gas and dust. That material will eventually go into the making of new stars and planets. This mosaic is made of individual images taken between November 18 and December 15, 2006 by the far-ultraviolet detector on Galex. To read about this surprising discovery in more detail, go to **http://planetary.org/news/2007/0815_Familiar_Star_Surprises_Scientists_with.html.** *Image: NASA/JPL-Caltech*

2008 PLANETARY SOCIETY CATALOG

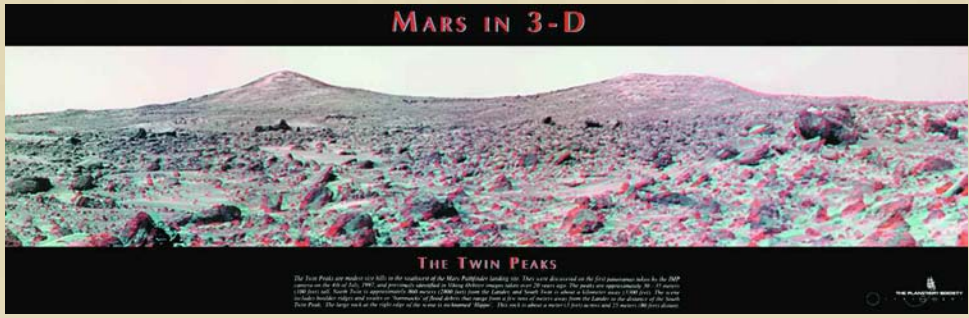
NEW! Commemorative Mars Marble Key Fob

We're going to Mars! The names of a quarter-million people—including all Planetary Society members—are on the way to Mars on board the *Phoenix* spacecraft, which launched in August 2007.

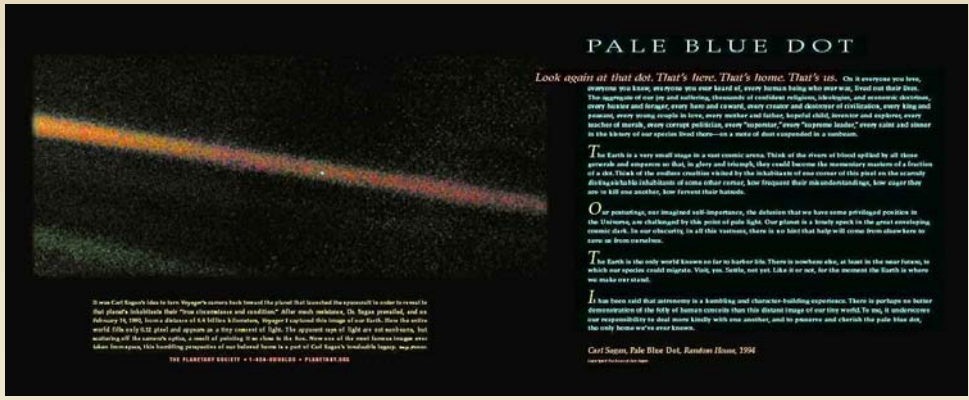
Our Mars replica key fob is emblazoned with the words "I'm Going Here!" with an arrow pointing to the Martian north pole. Don't miss your chance to get this commemorative Mars marble key fob, which features:

- 1-inch-diameter Mars marble made from recycled glass
- Geographical details, including white polar caps, dark canyons, mountains, and volcanoes
- Silver-plated hardware allows Mars to spin freely

1 lb. **#605**
Regular price: $6.39
Member price: $5.75



Mars in 3-D Poster Put on your red/blue glasses and step onto the Martian surface, where *Mars Pathfinder* still rests today. Red/blue glasses included. 12" x 39" 1 lb. **#306**
Regular price: $15.00 **Member price: $13.50**



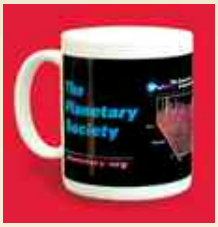
Pale Blue Dot Poster

In February 1990, *Voyager 1* looked back at its home planet for the first time. The image of Earth as a tiny bluish dot inspired Carl Sagan to write one of his best-known essays, which starts off his book *Pale Blue Dot*. The poster features Carl's timeless words and the full frame of the profound image captured by *Voyager 1*. 12" x 30" 1 lb. **#326**
Regular price: $11.11 **Member price: $10.00**

"Is Anyone Out There?" T-Shirt

As we gaze out at the heavens toward a vibrant spiral galaxy, the question arises, "Is anyone out there?" This dramatic T-shirt captures the feeling of wonder when pondering our place in the universe.

Adult sizes: S, M, L, XL, XXL 1 lb. **#586**
Regular price: $22.17 **Member price: $19.95**



SETI@home Mug

More than 5 million participants have contributed their time and computers to SETI@home, the largest distributed computing experiment ever undertaken. Our new 11-ounce mug features a wraparound image of the SETI@home screensaver. 2 lbs. **#550**
Regular price: $11.11 **Member price: $10.00**

Future Martian T-Shirt

The future is full of possibilities, and today's Earth child just might be a future Martian.

Child sizes: S, M, L
1 lb. **#565**
Regular price: $15.00
Member price: $13.50

Planetary Society Cap

Our redesigned Planetary Society cap is 100% cotton with an adjustable Velcro band. The royal blue cap features our logo on the front and *planetary.org* on the back. 1 lb. **#673**
Regular price: $15.00
Member price: $13.50

Planetary Society Key Ring Medallion

This elegant key ring medallion features our Planetary Society logo—planet, rings, and sailing ship—etched in black on solid brass. 1 lb. **#677**
Regular price: $17.78
Member price: $16.00

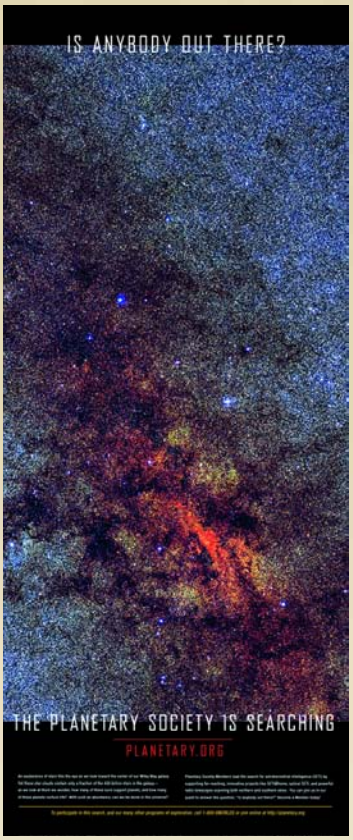
Planetary Society Lapel Pin

This striking pin is approximately 1 1/4 inches long, with a vibrant blue background and gold lettering. 1 lb. **#680**
Regular price: $3.33 **Member price: $3.00**

Order Today! ***Phone: 1-626-793-1675***
Fax: 1-800-966-7827 *(U.S. and Canada)* ***1-626-793-5528*** *(International)*

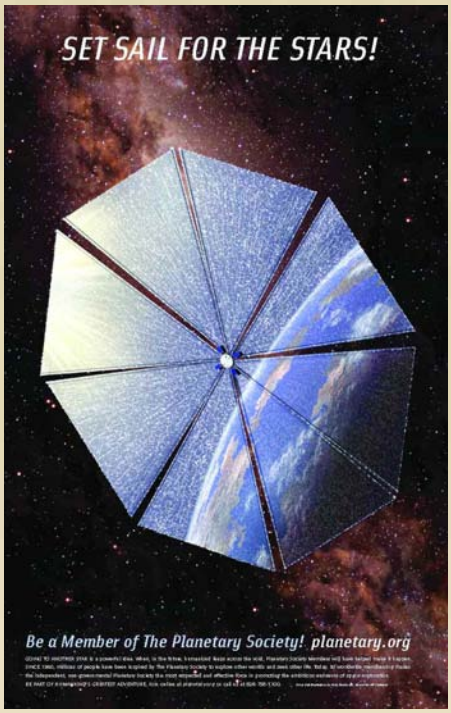
Shop online at the Planetary Store! ***http://planetary.org***

Use the Members-Only Coupon Code: planet



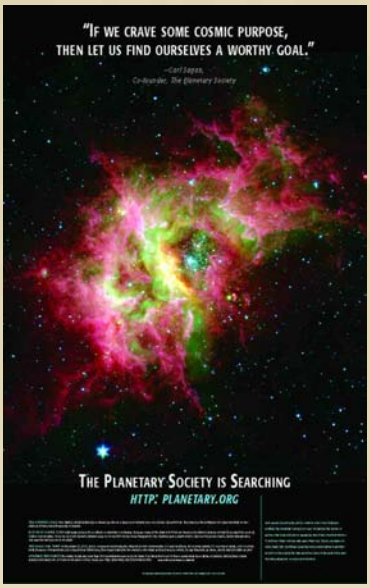
"Is Anybody Out There?" Poster

This astounding image, obtained by the Two Micron All Sky Survey, reveals only a fraction of the 400 billion stars in our own Milky Way galaxy.
39" x 16"
1 lb. **#320**
Regular price: $15.00
Member price: $13.50



Set Sail for the Stars! Poster

A solar sail takes off in flight, leaving its home planet behind. In the distance, the Milky Way beckons. This stunning illustration created by Rick Sternbach captures both the elegance and the promise of solar sailing, the only known technology that may one day take us to the stars. 22" x 34" 1 lb. **#571**
Regular price: $15.00 **Member price: $13.50**

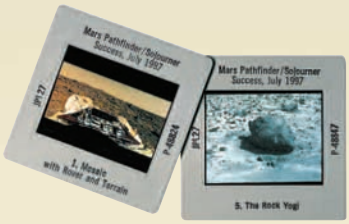


Nebula Poster

This awe-inspiring image from NASA's orbital Spitzer Space Telescope shows a false-color infrared view of nebula RCW 49—a birthplace for many hundreds of new stars and likely many thousands of planets.This stunning poster features one of Carl Sagan's poignant statements: "If we crave some cosmic purpose, then let us find ourselves a worthy goal."
22" x 34" 1 lb. **#315**
Regular price: $15.00
Member price: $13.50

We're Saving Space for You!

Bumper sticker 1 lb. **#695**
Regular price: $3.33 **Member price: $3.00**



Pathfinder Images of Mars

This collection features some of the most notable *Pathfinder/Sojourner* images, including the color panorama and images of *Sojourner* at work. 20 slides.
1 lb. **#215**
Regular price: $8.34
Member price: $7.50

An Explorer's Guide to Mars Poster

Images from *Mars Global Surveyor,* speculative paintings of the Red Planet's past and future, informative captions and charts, and images of Mars' surface from the *Pathfinder* and *Viking* spacecraft enhance a detailed U.S. Geological Survey map. 24" x 37" 1 lb. **#505**
Regular price: $16.95 **Member price: $15.25**

Surf Titan T-Shirt

A Planetary Society classic—we first introduced this shirt after *Voyager* passed by Titan, revealing hints of a methane ocean. Now that *Cassini-Huygens* has arrived for a closer look at the mysterious moon, we decided to bring this old favorite out of retirement. This shirt is long-sleeved with "The Planetary Society" printed on the left sleeve. Adult sizes: S, M, L, XL, XXL
1 lb. **#593**
Regular price: $22.22 **Member price: $20.00**

Spacecraft Science Kits

Build your own spacecraft and learn how it works. All models are accurate representations of the robots now exploring the universe. Intricate, laser-precut paper elements make these models highly detailed yet easy to assemble. All models contain details such as trusses, baffles, and even movable scan platforms and are accompanied by fact sheets giving the particulars of the mission.
Each sold separately. 1 lb.
Regular price: $17.50
Member price: $15.75

#525 Hubble Space Telescope
#530 *Lunar Prospector*
#560 *Voyager*

"Worlds to Discover" Presentation

This fully scripted assembly presentation includes the original "Worlds to Discover" 55-slide package plus the 8-slide "Worlds to Discover Addendum," updated fact sheets, posters, program announcements, a follow-up teacher's packet, and copies of The Planetary Society's magazine, *The Planetary Report.* Adaptable to multiple grade levels.
2 lbs. **#791**
Regular price: $51.05
Member price: $45.95

(Not Shown)

Planetary Report Binder

Each hardcover binder will hold two years worth of issues.
2 lbs. **#545**
Regular price: $16.11
Member price: $14.50

Special Value—order two binders for $25.00
($27.78 for non-members)!

Attention, teachers—submit your order on your school letterhead and receive a 20% discount.

When Chesley Bonestell's painting *Assembling the Mars Ships* first appeared, Americans were enthusiastic to the point of obsession with anything related to space. Although it would be another year before *Sputnik 1* launched, the public was deep in what is now referred to as the Golden Age of spaceflight. This began in 1952 with the first issue of the *Collier's* magazine spaceflight series. The eight monumentally influential *Collier's* articles were written by Wernher von Braun and his team, and illustrated by Bonestell, Fred Freeman, and Rolf Kemp. They covered every aspect of spaceflight and convinced both the public and the U.S. Congress that space exploration was no longer just a dream.

The *Collier's* articles were later reassembled into various books. *Assembling the Mars Ships* appeared in *The Exploration of Mars* (1956), written by von Braun and Willey Ley.

Chesley Bonestell (1888–1986), often referred to as the "dean" of space artists, or the father of modern space art, had an immeasurable impact on the early American space program. His long, varied career began with architectural drawing; and he designed the façade of New York's Chrysler Building and helped to design the Golden Gate Bridge. In the 1930s, he worked as a special effects painter in Hollywood, contributing to films such as *Citizen Kane* and *The Hunchback of Notre Dame*. Painting: Courtesy of Bonestell Space Art

THE PLANETARY SOCIETY
65 North Catalina Avenue
Pasadena, CA 91106-2301

PRINTED ON RECYCLED PAPER
Printed in USA