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# LPI Celebrates 40 Years!

## Lunar and Planetary Information BULLETIN

Lunar and Planetary Institute — Universities Space Research Association

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[www.lpi.usra.edu/lpiib](http://www.lpi.usra.edu/lpiib)

— Renee Dotson, LPI Staff Writer

This year, the Lunar and Planetary Institute (LPI) is proud to celebrate its 40th anniversary. Since its inception, the Institute has focused its efforts on cultivating and supporting a community of scientists who lead interdisciplinary research efforts, and remains strongly committed to its service role for the science community and the public. While we look toward the future, we also recognize our past, and would like to take this opportunity to revisit some of the people and events that have shaped the course of the Institute's history.

The idea for the Institute was actually conceived in the mid-1960s. As NASA was aggressively working toward the goal of realizing President John F. Kennedy's desire to land a man on the Moon by the end of the decade, NASA Administrator James Webb recognized the need to actively engage the academic community in its efforts. At Webb's request, Dr. Frederick Seitz, President of the National Academy of Science (NAS), met with representatives of 49 universities to establish a Committee on NASA/University Relations.

In July 1967, this Committee began to meet under the chairmanship of Dr. Kenneth Pitzer, President of Rice University, and the concept of a Lunar Science Institute developed out of frequent exchanges between NAS and NASA. On March 1, 1968, President Lyndon B. Johnson visited the Manned Spacecraft Center (MSC) in Houston, Texas (now the Johnson Space Center). After thanking and congratulating the men and women of MSC for the work they were carrying forward, Johnson made the following pronouncement:

*We are close to a landing on the Moon. Our space programs for the decade of the sixties are drawing to a close. Yet a mighty intellectual and technological effort, such as you are engaged in here, cannot just be turned on and off. We must stay the course. We must continue to build new strength by using the strength we have. We must continue to cross over new frontiers. This will certainly be our certain course in the next decade.*

*As a further step toward joining hands with the world's scientific community, I want to announce that we will build facilities here in this great space capital of Houston to help the world's scientists work closer together more effectively on the problems of space. We are going to establish here in Houston a new Lunar Science Institute along the side of this great center which you have here.*

*The new institute is a center of research designed specifically for the age of space. Here will come scientists — and their students — from all over the world. We will welcome here all who are interested in the sciences of space. We will strengthen the cooperation between NASA and our universities. And we will set new patterns of scientific cooperation which will have profound effects on man's knowledge of his universe.*

*This new Lunar Science Institute will provide new means of communication and research for the world's scientific community. It will help unite the nations for the great challenge of space. Let this great new institute stand as a symbol. Let it show the world that we do not build rockets and spacecraft to fly our flag in space, or to plant our banner on the surface of the Moon. We work to give all mankind its last great heritage. We are reaching for the stars.*



And so, on October 1, 1968, the Lunar Science Institute was formally established by a NASA contract with the National Academy of Science, which operated the new facility in cooperation with Rice University. In addition to providing monetary and advisory assistance, NASA administrators agreed to make the MSC Lunar Receiving Laboratory (LRL) facilities available to all Institute scientists. On October 31, Dr. William W. Rubey, professor of geology and geophysics at the University of California, Los Angeles, was appointed as the first Director. Rubey and his administrative officer, Robert Wimberly, began operation of the Institute in temporary offices located at MSC.

Obviously, the first order of business was to find a permanent home for the Institute. The structure proposed for its use was the West mansion, an Italian-Renaissance-style building located on a wooded tract of land adjacent to MSC. The mansion was named after James Marion West, who built it for his family residence in 1929. West — whose fortune was derived from lumber, oil, and investments — used only the best materials and fixtures in construction of the stucco mansion, which was two stories high and enclosed 17,000 square feet of floor space. The mansion had been unoccupied since 1941, when Mrs. West moved into Houston soon after her husband's death. Mrs. West died in 1953, and the mansion and land surrounding it were deeded to Rice University in 1959, with a stipulation that the property be used for research purposes. Rice University agreed to lease the property to the Institute on a long-term basis.



As the mansion had remained unoccupied for so many years, a tremendous amount of renovation was needed before the building could be habitable by the Institute staff. The projected price tag for the renovation was more than \$500,000. On April 1, 1969, the Institute moved into temporary offices leased on Upper Bay Road in Nassau Bay, across the street from MSC. The Institute staff remained in this location until the renovation of the West mansion was completed.

As formally stated, the objectives of the Institute were to enhance communications among scientists, universities, and governmental organizations; to encourage use of the unique LRL facilities to the common benefit of NASA and the academic community in the discovery and application of scientific knowledge; to provide all universities with appropriate services for associate and postgraduate education at the MSC; and to provide general assistance and support to the principal investigators of university contractors for research on lunar material. Since the primary responsibility of the Institute was to develop closer working relationships among the various organizations engaged in space research, the concept of the Institute was that it should encourage scientific discussion and exchange of ideas; the convocation of seminars, workshops, symposia, and the like; accessibility of government employees and facilities such as the LRL to university representatives; and the participation of interested scientists in spaceflight operations and LRL scientific activities.

Needing a more permanent entity to manage the Lunar Science Institute, in March 1969 the National Academy of Sciences, at the request of NASA, chartered the Universities Space Research Association (USRA), a nonprofit consortium of universities. The stated purpose of USRA was to foster cooperation among universities, other research organizations, and the U.S. government for the advancement of space research, and in December 1969 USRA assumed management of the Lunar Science Institute under contract to NASA.

After the long-awaited completion of the renovation of the West mansion, the Institute moved into its new home in October 1969, and the building was formally dedicated on January 4, 1970. Speakers at the dedication ceremony included NASA Administrator Thomas Paine, who concluded his speech with reading the words cast on the commemorative plaque, which still hangs outside the doors of the current Institute building: "Dedicated to the scientists of the Earth who seek to understand the nature, origin and history of our solar system."

In keeping with the stated goals of the Institute, the scientific staff included a very small in-house staff to supply continuity and aid the orientation of visitors, with the predominant population of the staff consisting of a unique array of visiting scientists and postdoctoral fellows. In May 1969, the first visiting scientist, Dr. S. Ross Taylor, arrived; in June 1969, Dr. Friedrich Hörz was appointed as a visiting scientist; and in July 1969, Dr. Harold Urey was appointed as the first senior visiting scientist. Reviewing the list of scientific visitors during that era is like reading a veritable "Who's Who" of lunar science: Ralph Morganstern, Luciano Ronca, Keith Runcorn, A. E. ("Ted") Ringwood, Ewen Whitaker, David Criswell, Chi-Yu Shih, Petr Jakeš, Fred Singer, Wulf Gose, Zdenek Kopal, and Jafar Arkani-Hamed. NRC postdoctoral fellows in residence at the Institute included such names as Thornton Page, Ken Aitken, Arch Reid, Charles Meyer, and John Lindsay.

The Institute's primary activities focused on providing an atmosphere conducive to research, as well as organizing and hosting a number of symposia and seminars. When the Institute began its seminar series in September 1969, Dr. Gerard P. Kuiper was the first speaker. The Institute had already begun co-sponsoring the Lunar Science Conference, and assumed many of the administrative duties for the conference when it moved from downtown Houston (where the first two conferences, known as the "Houston Rock Festivals," were held) to MSC.

In March 1971, Dr. Joseph W. Chamberlain took over the duties of Director of the Institute. As word of the Institute's visiting scientist program continued to spread throughout the lunar community, the increase in visitors reached a new high. During the period June 1971 through May 1972, the Institute staff included 4 staff scientists, 21 visiting scientists, 1 visiting postdoctoral fellow, and 6 graduate fellows. Notable names on the scientific roster included Stuart Agrell, Gerhard Neukum, Colin Pillinger, Richard Shorthill, and Ian Ridley.

*My association with the LPI goes back to April 1969, when I was the second Visiting Scientist (following Harold Urey) at the (then) Lunar Science Institute (LSI), which was temporarily located in the Nassau Bay shopping center, and was present at the dedication of the Institute at the West Mansion (whose loss I keenly regret) in November 1969. Since that time I have made many visits to the Institute, being present during the tenure of every Director except Arch Reid.*

*LPI has had a remarkable and beneficial effect on my career and has made it possible for me to contribute to the scientific objectives of NASA's lunar and planetary programs in a way that would not have been possible without the existence of the Institute. I have been able to make an extensive network of friends and colleagues both at the LPI and in the planetary science community. The LPI staff have always gone out of their way to assist me, and the openness and hospitality extended by the LPI to a scientist from "down under" are a remarkable tribute to the generosity of the United States. During my visits, Petr Jakeš and I formulated the Taylor-Jakeš model of lunar evolution (1975) that is still reasonably robust. Utilizing the superb library facilities of the Institute, I was able to write three books (Lunar Science: A Post Apollo View in 1975; Planetary Science: A Lunar Perspective in 1982; and Solar System Evolution: A New Perspective in 1992) as well as work on many scientific papers dealing with various aspects of lunar and planetary science. The latest is the Taylor-cubed paper on the Moon, co-authored with Jeff and Larry.*

*In my opinion, the LPI is essential to the interpretation of the planetary data generated by the NASA space program. Its organization of the yearly Lunar and Planetary Science Conferences, the many interdisciplinary meetings, and the extensive publications that began in 1970 with the publication of the Proceedings of the Lunar Science Conference have been crucial. The unifying presence of the LPI resembles the role of the conductor of an orchestra. Without the Institute acting as a coordinator, it is doubtful that the full flowering of lunar and planetary science in the U.S., which is the great achievement of the space program, would have taken place.*

*— S. Ross Taylor, frequent visiting scientist  
Australian National University*

In the summer of 1973, Chamberlain returned to his research activities, and Dr. David Strangway agreed to serve as Interim Director for two months while the future of the Institute was under review. After NASA made the decision to continue supporting USRA in the operation of the Institute, the future role of the Institute in support of the lunar science community was determined to lie in (1) the establishment of a lunar data center (photo, map, and document library; lunar sample information library; geophysical data files; and lunar science publication library); (2) visiting scientist program; (3) scientific symposium program; (4) publications and communications; and (5) management of the Lunar Sample Review Panel. With the future of the Institute secured, the search for a new director continued with renewed vigor. In August, the decision was made to appoint a second interim director, rather than be rushed in the search for a permanent director. As of August 31, Strangway returned to the University of Toronto and Dr. James Head of Brown University accepted the position of Interim Director for the following nine months, or until a permanent director was appointed. Head's background in Apollo mission planning and knowledge of lunar data were a perfect fit with the Institute's goals, and his appointment represented a new dimension for the Institute.

Recognizing that one of the major goals of the Institute was to facilitate communication between investigators working in lunar science, and in an effort to promote the interaction between lunar science investigators and workers in other areas of science to maximize the quality and diversity of lunar research, in December 1973 the Institute announced that it would begin distributing an informal short communication to a wide audience in lunar science and related areas. The publication would be known as the *Lunar Science Information Bulletin*, and would be distributed as significant information was available and the need arose. The first issue of the *Bulletin* was published in February 1974. In addition to short notes about information of interest to the lunar science community, it also contained a lunar science calendar and a list of lunar articles recently received in the Institute library. (Obviously, 35 years and 113 issues later . . . the *Bulletin* is still going strong!)

*The intensity of meetings at LPI was remarkable. Planning for the next Apollo mission provided a focus. The many intense meetings in the Hess Room [at the West Mansion] led someone to install a little-noticed device that released deodorant "air-freshener" into the room.*

*But my favorite Hess Room memory? During a LAPST meeting, the JSC flight operations group was having a chili cook-off on the outside lawn, and the stage area was just outside the Hess Room window. During one lunar sample allocation discussion, four "cowboys" just outside the window were playing "Deep in the Heart of Texas" by revving up their chainsaws.*

— Don Brownlee, former visiting scientist  
and frequent meeting attendee  
University of Washington

of Institute or JSC scientists. Twenty-two potential projects were defined by the scientists, with 62 students submitting applications to participate in the program. Ten projects and ten students were selected for the first year of the program.

In June 1977 the position of Director was passed on to Dr. Thomas McGetchin, a recognized expert in field, experimental, and theoretical investigations of volcanic and igneous processes. In August 1977 John R. ("Jack") Sevier was added to the Institute staff as Associate Director. During the Apollo program, Sevier had served as Chairman of the Lunar Surface Traverse Planning Team, and his background in working with lunar scientists along with his engineering background enabled him to begin working toward the goal of developing means for effective integration of scientific goals and plans with engineering possibilities.

During McGetchin's tenure, the scientific staff at the Institute remained robust, the Basaltic Volcanism Study Project thrived, and the Institute made important new strides in expanding into the direction of increased emphasis on planetary and terrestrial research. Effective January 1, 1978,

*My first interaction with LPI was back in the days when it was the Lunar Science Institute (LSI). The first meeting I attended was the Impact Versus Volcanic Crater meeting back in 1970. LSI was generous enough to pay page charges for my contribution to the publication that resulted from that meeting. That paper was one of my first publications in lunar geology, and it is one of the most often cited. It is unfortunate that its premise is no longer valid.*

*As a lone planetary geologist at the colleges where I have taught, the Lunar and Planetary Institute has been my chief lifeline to the rest of the planetary community.*

— René De Hon  
Texas State University, San Marcos

In April 1974, the USRA Board of Trustees announced the appointment of Dr. Robert O. Pepin as Director of the Institute. Pepin took a two-year leave of absence from the University of Minnesota in order to assume these responsibilities, and ably served the Institute and the science community during his tenure as Director. The roster of scientific visitors at the Institute during these years included such names as Doug Macdougall, Niroshi Nagasawa, Robert Reedy, Sean Solomon, Jeff Taylor, Ernst Zinner, Wing-Huen Ip, Ian Steele, John Wood, Roy Lewis, Ted Maxwell, and Richard Grieve.

As the Institute continued to grow, the staff began to seek ways in which they could take advantage of opportunities to provide added value to the community. In the summer of 1977, the Institute began the LSI Summer Undergraduate Intern Program. The program was created to provide an opportunity for undergraduate or newly graduated students to work on interesting experimental, theoretical, or library research problems for a period of ten weeks under the supervision

*I was an LPI intern in 1988 and have been to every LPSC since (so my 20th was this year). I had a great internship and have enjoyed the meetings tremendously. I have made great friends and professional relationships because of LPI and LPSC. Keep up the good work!*

— Nathan Bridges, former intern  
Jet Propulsion Laboratory

the name of the Institute was officially changed from the Lunar Science Institute to the Lunar and Planetary Institute. At the same time, the name of the annual science conference was changed to the Lunar and Planetary Science Conference (and therefore the name of the Proceedings volume changed as well), the name of the NASA proposal review panel was changed from the Lunar Science Review Panel (LSRP) to the Lunar and Planetary Review Panel (LPRP), and the name of the *Bulletin* was changed to the *Lunar and Planetary Information Bulletin*.

In June 1979, McGetchin resigned from his position for health reasons. Sevier served as Acting Director until October of that year, when Roger J. Phillips was appointed Director. Recognizing that the Institute desperately needed more physical space, the decision was made to renovate one of the other buildings on the property, and what used to be the barn became a new, state-of-the-art building designed to house the photo collection and computer center, as well as provide additional offices for staff and scientists. Named McGetchin Hall in honor of the late Thomas McGetchin, who had died the previous October, the new building was dedicated on July 31, 1980. McGetchin's widow, Carlé Pieters, christened the building during a ceremony held on the grounds of the Institute. McGetchin Hall provided 5400 square feet of additional space.

Expanding the Institute's physical facilities meant that there was more room for an expanded roster of scientific visitors, as well as the addition of new support staff. The Institute now had a fully-staffed production department, including typesetters and graphic artists, and was able to provide full prepress services for publication projects such as the *Proceedings of the Lunar and Planetary Science Conference* and *Basaltic Volcanism on the Terrestrial Planets*. Staff and visiting scientists during these years included such names as Pete Schultz, Stan Zisk, John Delaney, Elbert King, Dieter Stöffler, Jonathan Lunine, Lew Ashwal, Wolf Reimold, Augustin Chicarro, and Matt Golombek. The newly formed Planetary Geology Review Panel began meeting at the Institute, and the LPI assumed sponsorship of the Lunar and Planetary Sample Team (LAPST).

In April 1982, Dr. Kevin Burke joined the Institute staff, assuming the position of Deputy Director. Burke's research on plate tectonics led to an expansion in the Institute's participation in terrestrial research. In August 1983 Roger Phillips ended his tenure as LPI Director, and Kevin Burke assumed that position effective September 1. Later that fall, the new Mars Data Analysis Panel and the new Early Crustal Genesis Panel began meeting at the LPI. Scientific additions to the staff that year included Bruce Bills, Mark Cintala, and Graham Ryder, and Steve Clifford joined the staff the following February.

During the late 1980s, the Mars Data Analysis Study Project and Mars: Evolution of Volcanism, Tectonics, and Volatiles Study Project were added to the growing list of topical initiatives sponsored and managed by the LPI. A collaborative effort between the scientific staff, photolibrary, computer center, and publications department led to the production and dissemination of a number of educational slide sets covering such topics as Apollo landing sites, space shuttle views of oceans from space, and volcanoes on Mars. The LPI also continued to provide support for the Lunar and Planetary Sample Team (LAPST) and a number of NASA review panels.

*My favorite memory of the Institute, aside from Petr Jakeš wearing a Spanish moss moustache for the annual staff photo, was of a late afternoon as a group of us left the LPI building during a panel review meeting. It was after a typical tedious and long day reviewing proposals, and I looked up and caught several turkey vultures sitting on the lamp post. I thought that was supremely appropriate for a panel meeting . . . Perhaps we should have invited them in and let them help with the selections!*

— Paul Schenk, staff scientist  
Lunar and Planetary Institute

*My favorite memory of LPI is a Workshop on Mars Sample Return that I convened in the late 1980s at the Hilton on Clear Lake. As usual, it had been brilliantly coordinated logistically by LPI. But LPI could not coordinate the weather.*

*We were about 5 minutes into the opening keynote speech by Mike Carr (USGS Menlo Park and renowned Mars expert) when a water spout raced up Clear Lake and cut off all power to the area. Registration was set up with the backs of LPI workers to large plate glass windows. I remember the windows bulging and watching the ladies from LPI literally leap over their desks to get away from the windows that appeared to be ready to implode. In the meantime, Ross Taylor, curious as always, walked up to the window and put his nose against it. Someone (I am told it was me) pulled him away to a safer location.*

*When it became clear that power would not be returning in the foreseeable future, it was noted that JSC had power and a decision was made to move the workshop onto JSC. The workshop was international, and we had Soviet citizens present. Now these were pre-9/11 days, but there was sensitivity even then to non-U.S. citizens going on base. Somehow NASA HQ got wind (no pun intended) of what was happening, and I was chairing a session. When I finally talked to NASA HQ the next day, things in Washington had calmed down a bit (all was well in Houston). But I suspect that my name was not spoken of kindly for a while in Washington.*

*That was perhaps the most memorable meeting that I have ever attended run by LPI.*

— Michael J. Drake  
Director, Lunar and Planetary Laboratory, University of Arizona

In 1988, Kevin Burke resigned from the position of LPI Director to begin a full-time teaching position at the University of Houston. Appointed as the new Director was Dr. David C. Black, who came to the LPI from the NASA Ames Research Center, where he had served as Chief Scientist for Space Research. Black's research background was in theoretical astrophysics and planetary science, specializing in studies of star and planetary system formation.

Among Black's first goals was to refocus the scientific research taking place at the Institute. He also recognized the need to expand in the area of education and public outreach, particularly its involvement with the local community. The Institute hosted an open house in July 1989



to coincide with Spaceweek and the 20th Apollo anniversary celebrations taking place at JSC. More than 1800 people toured the building and grounds, watching various scientific demonstrations and participating in a demonstration of the image processing capabilities of the newly acquired Stardent graphics supercomputer. The Institute also partnered with the University of Houston–Clear Lake (UHCL) in organizing a series of public lectures entitled “Beyond Earth’s Boundaries.”

Black reorganized several elements of LPI support functions, structuring the Institute’s activities along more functional lines. The panel and projects offices were combined to become the Program Services Department; the library and photolibrary were combined into the Center for Information and Research Services; and the publications and production services departments were combined into the Publications Services Department. Black also formed an advisory council, whose role was to provide guidance to the Director’s Office on ways in which the capabilities of the Institute could be used effectively to further the educational and technical stature and health of the Clear Lake and greater Houston areas, potentially expanding programs to include other areas in the state of Texas.

One of the biggest challenges facing Black in the early years as Director was the question of a permanent home for the Institute. The term of the lease on the West mansion property was nearing an end, and Rice University had already made the decision to sell the property. Unfortunately, Rice was only willing to consider selling five acres to USRA, as they had already begun discussions with area developers about using the remaining land for commercial endeavors such as hotels, retail establishments, etc. Not only would that leave the LPI with less space than they currently had, but would eliminate the possibility of future growth and would negatively impact the idyllic ambiance of the Institute’s physical setting.



After a series of negotiations with one of the area development companies, USRA purchased a nine-acre tract of land located in close proximity to JSC and adjacent to the University of Houston–Clear Lake. The wooded setting and physical design of the new 48,000-square-foot facility not only provided an atmosphere conducive to scientific research and support activities, but was also much more suitable for the functions of the Institute. The new building included a Lecture Hall, two large meeting rooms (one of which could be split into smaller breakout rooms), and three additional conference rooms, as well as a much-needed increase in space for both the scientific and support staff and critical support facilities such as the library, image center, and computer center. The building also provided enough space to house the other Houston divisions of USRA, the Division of Space Life Sciences and the Division of Educational Programs.

By January 1992, the Institute was up and running in its new facility, continuing to thrive and flourish. Throughout the next decade, the LPI continued to provide sponsorship and logistical support for many scientific workshops and conferences, expanded its education and public outreach activities through such programs as “Explore!,” and provided a dynamic research environment for dozens of scientific visitors. Staff scientists in residence at the time included Stephen Clifford, Renu Malhotra, Graham Ryder, Paul Schenk, Benjamin Schuraytz, Virgil (“Buck”) Sharpton, Paul Spudis, and Tomasz Stepinski, and the Mars Surface and Atmosphere Through Time (MSATT) Study Project was added to the list of LPI initiatives.

Other LPI-supported task efforts included the Chicxulub Impact Basin Drilling Project, the Lunar Mars Exploration Program, and Origin of the Solar System steering committee. Supported working groups and review panels included the Planetary Cartography Working Group, Planetary Science Data Steering Group, Planetary Geology & Geophysics Working Group, Planetary Astronomy Review Panel, Mars Watch Review Panel, Near Earth Objects Review Panel, Planetary Atmospheres Review Panel, Lunar and Planetary Sample Team, Meteorite Working Group, Planetary Materials & Geochemistry Working Group, Planetary Instrument Definition & Development Program, and Venus Data Analysis Review Panel.

By 1994, a new technology known as the “World-Wide Web” was all the rage, and in the fall of 1994 the LPI released its first website. By 1997, the Institute was publishing all meeting announcements, programs, and abstracts online.

In 2000, David Black was named as the President and CEO of USRA, necessitating the need to find a new LPI

*The LPI has been a refuge of stability in decades of change. One could not ask for better support (ask anyone who has ever worked on a book project with the LPI staff). We all do our little bits of research, but the constancy of the LPI staff has glued it all together. Thanks!*

— David Vaniman, frequent visitor  
over the past 32 years  
Los Alamos National Laboratory

*LPI was a fantastic place to go right out of graduate school. Both the staff and the facilities were a great support to building my own research program. I have many fond memories of experiences in McGetchin Hall, out behind the old LPI (at the West mansion).*

*I was privileged to be able to oversee the LPI intern program for three years (1985–1987), during which time I was able to observe and interact with a bunch of great students. Many of the interns from those years are still active in planetary sciences, including some leaders in the field. I believe the intern program will be one of the LPI programs that history will view as a major contribution to the growth of planetary sciences.*

— James Zimbelman, former postdoctoral fellow and staff scientist  
National Air and Space Museum, Smithsonian Institution

## LPI Celebrates 40 Years *continued...*

Director. After a long and extensive search, during which time Arch Reid served as Interim Director, USRA announced that the position of Director had been offered to Dr. Stephen Mackwell, Director of the Bayerisches Geoinstitute in Bayreuth, Germany. The search committee was impressed with Mackwell's international reputation as a scientist, his dynamism, and his leadership and management skills.

Under Mackwell's leadership, the Institute continues to improve and expand the services it provides to NASA, the science community, and the public. Participating in such programs as the NASA Office of Space Science Broker/Facilitator Network has enabled the Education and Public Outreach Department to extend to a national impact rather than simply providing independent services to diverse communities.

The breadth and quality of research pursued at the Institute has dramatically increased as new programs such as the Heritage Scholar Program and the Urey Fellowship Program have been added. The relationship with the Astromaterials Group (ARES) at JSC has been strengthened, the number of visiting scientists has increased, and the LPI Summer Intern Program in Lunar and Planetary Science is now in its 32nd year.



The LPI's service and support roles continue to expand as the Institute constantly seeks new ways to improve the service it offers to the community. The Publications and Program Services Department continues to organize and sponsor a great number of workshops and conferences. The most notable of these is the annual Lunar and Planetary Science Conference, which continues to grow at an outstanding rate, with 1556 attendees and 1532 abstracts submitted to this year's conference. The collaborative agreement with the University of Arizona Press has added a new role for the department, providing all pre-press and production services for the prestigious Space Science Series. Six volumes in this series have already been produced under this agreement, with a seventh volume currently in production.

The LPI's website continues to be an indispensable and dynamic resource for the science community. The site evolves constantly as new material becomes available. Recent additions to the resources available via the LPI's website include the Lunar Science and Exploration portal; a searchable abstract database that allows users to use advanced search options on all abstracts associated with LPI-sponsored meetings since 1997; and community news and feature articles. As one of the NASA's Regional Planetary Image Facilities (RPIF), the LPI continues to expand access to planetary image and cartography, recently adding in digital form the Ranger VII photographs of the Moon; Lunar Cartographic Dossier, USGS Geologic Atlas of the moon, and Lunar Topophotomap series.

Over the last 40 years, the complexion of the Institute has changed and evolved as NASA has altered course and shifted strategic focus. However, amidst the dynamic environment in which the Institute operates, its underlying mission and key objectives of scientific excellence and service have not changed. Today, the LPI is an intellectual leader in lunar and planetary science. Our mission remains: to serve as a scientific forum attracting world-class visiting scientists, postdoctoral fellows, students, and resident experts; to support and serve the research community through publications, meetings, and other activities; to collect and disseminate planetary data while facilitating the community's access to NASA science; and to engage, excite, and educate the public about space science and invest in the development of future generations of explorers.

As we look back with fond memories over the last 40 years, we are filled with a sense of anticipation of what the next years will bring, both for the Institute and the space exploration program as a whole. To all those who have contributed to our success and have joined with us as we have worked toward our common goal, we express our sincere appreciation.

We invite you to celebrate with us by visiting our 40th anniversary historical timeline, available on the LPI's website at [www.lpi.usra.edu/lpi\\_40th/](http://www.lpi.usra.edu/lpi_40th/). Enjoy!

*It is hard to overstate the invaluable role of the LPI Publication Services Department in the editorial production of the current volumes of the Space Science Series. Beginning with Origin of the Earth and Moon (2000), and continuing with Asteroids III (2002), Comets II (2004), Meteorites and the Early Solar System II (2006), Protostars and Planets V (2007), and now The Solar System Beyond Neptune (2008), the LPI has been an essential partner to the quality and success of this series for opening these fields to new students and researchers. What's more, LPI's role in contributing time and effort has been essential toward making these volumes affordable on a graduate student budget. Any editor or author who has contributed their portions can perform the integral and appreciate the enormity of the total effort required to produce each volume at such a high standard. The ultimate beneficiary is the reader and a vibrant future for these fields. Congratulations on your essential role that will continue to promote and enable lunar and planetary sciences for many more decades to come.*

— Richard P. Binzel, General Editor, Space Science Series  
Massachusetts Institute of Technology





# LPI Remembers...

The Lunar and Planetary Institute would like to take this opportunity to pay tribute to these former staff members, now deceased, who have left a lasting legacy among their friends and colleagues.



Bessie Bell, *Security*



Joseph Chamberlain, *Director*



Guy Coleman, *Security*



Carol Davis,  
*Administrative Staff*



Peter Francis, *Scientific Staff*



Lita Holley, *Publications and  
Program Services*



Petr Jakeš, *Scientific Staff*



Bill Johnson, *Security*





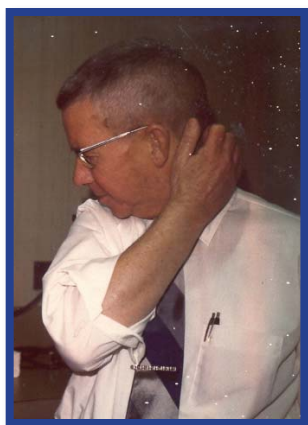
Gus Knight, *Facilities*



Paulette Ledyard,  
*Administrative Staff*



Eleta Malewitz, *Computer Center*



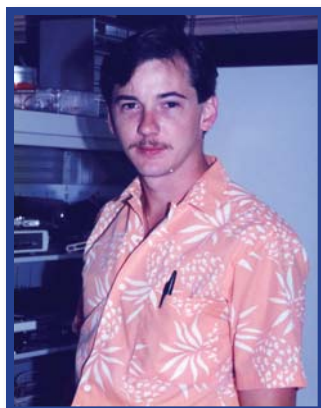
C. M. "Mac" McCollum,  
*Administrative Officer*



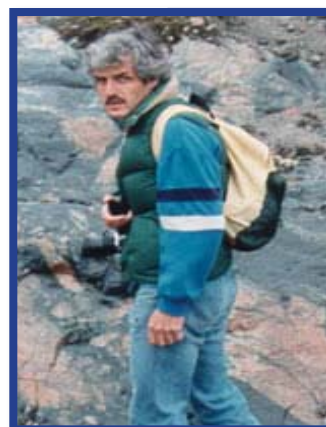
Thomas McGetchin, *Director*



James McKinney, *Facilities*



Dannon Norman, *Computer Center*



Graham Ryder, *Scientific Staff*



William Rubey, *Director*



John "Jack" Sevier, *Associate Director*



Harlan Smith, *Scientific Staff*



Helene Thorson, *Director's Office*



Frances Waranius, *Library*



Robert E. "Bob" Wimberly,  
*Administrative Officer*



## PHOENIX SPACECRAFT LANDS AT MARTIAN ARCTIC SITE

NASA's Phoenix spacecraft landed in the northern polar region of Mars on May 25 to begin three months of examining a site chosen for its likelihood of having frozen water within reach of the lander's robotic arm. Radio signals received at 4:53:44 p.m. Pacific Time (7:53:44 p.m. Eastern Time) confirmed the Phoenix Mars Lander had survived its difficult final descent and touchdown 15 minutes earlier. (The signals took that long to travel from Mars to Earth at the speed of light.)

Mission team members at the Jet Propulsion Laboratory, Lockheed Martin Space Systems in Denver, and the University of Arizona in Tucson cheered confirmation of the landing and eagerly awaited further information from Phoenix. Among those in the JPL control room was NASA Administrator Michael Griffin, who noted this was the first successful Mars landing without airbags since Viking 2 in 1976. "For the first time in 32 years, and only the third time in history, a JPL team has carried out a soft landing on Mars," Griffin said. "I couldn't be happier to be here to witness this incredible achievement."



*This artist's montage shows the Phoenix spacecraft en route to and landing on Mars. Credit: NASA/JPL-Caltech/University of Arizona.*



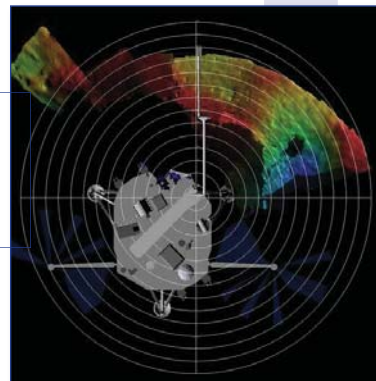
*This approximate color view was obtained on sol 2 (martian day) by the Surface Stereo Imager (SSI) onboard the Phoenix lander. The view is toward the northwest, showing polygonal terrain near the lander and out to the horizon. Credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University.*

During its 422-million-mile flight from Earth to Mars after launching on August 4, 2007, Phoenix relied on electricity from solar panels during the spacecraft's cruise stage. The cruise stage was jettisoned seven minutes before the lander, encased in a protective shell, entered the martian atmosphere. Batteries provided electricity until the lander's own pair of solar arrays spread open. As of May 29, Phoenix was in the midst of the two-day process of deploying its 7.7-foot-long robotic arm, which will be used during future weeks to get samples of soil and ice into laboratory instruments on the lander deck.

Phoenix uses hardware from a spacecraft built for a 2001 launch that was canceled in response to the loss of a similar Mars spacecraft during a 1999 landing attempt. Researchers who proposed the Phoenix mission in 2002 saw the unused spacecraft as a resource for pursuing a new science opportunity. Earlier in 2002, Mars Odyssey discovered that plentiful water ice lies just beneath the surface throughout much of high-latitude Mars. NASA chose the Phoenix proposal over 24 other proposals to become the first endeavor in the Mars Scout program of competitively selected missions.

The Phoenix mission is led by Peter Smith at the University of Arizona with project management at JPL and development partnership at Lockheed Martin, Denver. International contributions come from the Canadian Space Agency; the University of Neuchatel, Switzerland; the Universities of Copenhagen and Aarhus, Denmark; Max Planck Institute, Germany; and the Finnish Meteorological Institute.

*This terrain model of Phoenix's Robotic Arm workspace has been color coded by depth with a lander model for context. The model was derived using images from the depth perception feature from Phoenix's Surface Stereo Imager (SSI). Red indicates low-lying areas that appear to be troughs. Blue indicates higher areas that appear to be polygons. Credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University/NASA Ames.*



For more about Phoenix, visit [www.nasa.gov/phoenix](http://www.nasa.gov/phoenix).

## NASA SATELLITE FINDS INTERIOR OF MARS IS COLDER

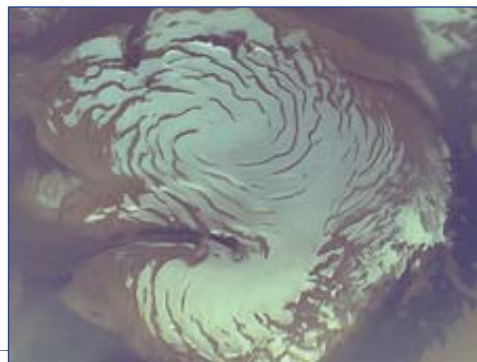
New observations from NASA's Mars Reconnaissance Orbiter (MRO) indicate that the crust and upper mantle of Mars are stiffer and colder than previously thought. The findings suggest any liquid water that might exist below the planet's surface, and any possible organisms living in that water, would be located deeper than scientists had suspected.

"We found that the rocky surface of Mars is not bending under the load of the north polar ice cap," said Roger Phillips of the Southwest Research Institute in Boulder, Colorado. Phillips is the lead author of a new report appearing in the online version of *Science*. "This implies that the planet's interior is more rigid, and thus colder, than we thought before."

The discovery was made using the Shallow Radar (SHARAD) instrument on MRO, which has provided the most detailed pictures to date of the interior layers of ice, sand, and dust that make up the north polar cap on Mars. The radar images reveal long, continuous layers stretching up to 600 miles, or about one-fifth the length of the United States.

The radar pictures also reveal four zones of finely spaced layers of ice and dust separated by thick layers of nearly pure ice. Scientists think this pattern of thick ice-free layers represents cycles of climate change on Mars on a timescale of roughly one million years. Such climate changes are caused by variations in the tilt of the planet's rotational axis and in the eccentricity of its orbit around the Sun. The observations support the idea that the north polar ice cap is geologically active and relatively young, at about 4 million years.

For more detailed information, visit [www.nasa.gov/MRO](http://www.nasa.gov/MRO).



A view of the north polar ice cap on Mars taken by NASA's Mars Reconnaissance Orbiter. Credit: NASA/JPL/Malin Space Science Systems.

## WANDERING POLES LEAVE GIANT SCARS ON EUROPA'S ICY SURFACE



Circles rising on Europa. This view shows what the concentric circles might look like if viewed from a low-orbit spacecraft approaching from the east. The arc-shaped trough in the foreground is roughly 300 meters deep. Image resolution is 1.5 kilometers. Credit: Paul Schenk, Lunar and Planetary Institute.

Global mapping of unusual large circular features on the ice-covered ocean world of Europa has revealed that Jupiter's curious icy moon is even more unstable than previously thought.

In results published in the May 15 issue of *Nature* magazine, a team of scientists led by Dr. Paul Schenk of the Lunar and Planetary Institute of Houston, Texas, and joined by Dr. Isamu Matsuyama of the Carnegie Institution of Washington and Dr. Francis Nimmo of the University of California, Santa Cruz, has discovered that these features form two huge nearly identical circular patterns several thousand kilometers across. These circles are on exactly opposite sides of Europa but are oddly displaced from the equator and the Europa-Jupiter axis, forming one of the most unusual global patterns in the solar system.

Nonsynchronous rotation of the icy shell and daily tidal distortions as high as 30 meters (100 feet) have been proposed as explanations for many of Europa's faults and ridges, but none of these stresses matched the strange circular troughs. A third global stress force, called true polar wander, had also been proposed, although previous efforts to find geologic features that matched this prediction have not met with success. In the polar wander mechanism, proposed by Greg Ojakangas and David Stevenson in 1989, the outer ice shell of Europa can slowly reorient, or "flop over," while the huge rocky core of Europa continues to rotate normally. Cold polar temperatures can thicken the icy shell and drive polar wander.

The findings published in *Nature* are the first direct evidence for polar wander on Europa, a mechanism predicted 18 years earlier. The large reorientation required to explain the observed tectonic pattern is very difficult to achieve if the outer shell is not decoupled from the core by a liquid layer. Geophysical and geologic evidence from Galileo has already indicated the probable existence of a water ocean. This new evidence for polar wander provides an independent confirmation that Europa possesses a water ocean not far beneath its icy shell.



## **SEND YOUR NAME TO THE MOON WITH NEW LUNAR MISSION**

NASA invites people of all ages to join the lunar exploration journey with an opportunity to send their names to the Moon onboard the Lunar Reconnaissance Orbiter (LRO) spacecraft.

The Send Your Name to the Moon website enables everyone to participate in the lunar adventure and place their names in orbit around the Moon for years to come. Participants can submit their information at [lro.jhuapl.edu/NameToMoon/index.php](http://lro.jhuapl.edu/NameToMoon/index.php), print a certificate, and have their name entered into a database. The database will be placed on a microchip that will be integrated onto the spacecraft. The deadline for submitting names is June 27, 2008.

“Everyone who sends their name to the Moon, like I’m doing, becomes part of the next wave of lunar explorers,” said Cathy Peddie, deputy project manager for LRO at NASA’s Goddard Space Flight Center in Greenbelt, Maryland. “The LRO mission is the first step in NASA’s plans to return humans to the Moon by 2020, and your name can reach there first. How cool is that?”

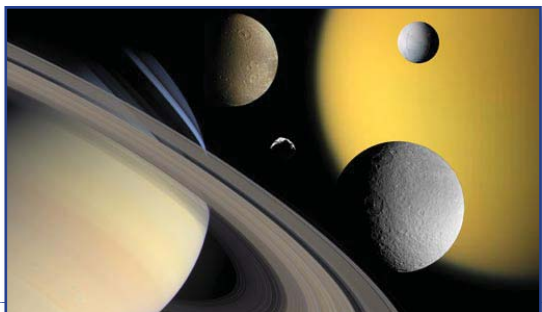
Send Your Name to the Moon is a collaborative effort among NASA, the Planetary Society in Pasadena, California, and the Johns Hopkins Applied Physics Laboratory in Laurel, Maryland.

For more information about the LRO mission, visit [www.nasa.gov/LRO](http://www.nasa.gov/LRO).



*The Lunar Reconnaissance Orbiter mission will conduct investigations that will prepare for and support future human exploration of the Moon. Credit: NASA.*

## **NASA EXTENDS CASSINI’S GRAND TOUR OF SATURN**



*This image collage features Saturn and the moons Titan, Enceladus, Dione, Rhea, and Helene, which will be studied during Cassini’s extended mission. Credit: NASA/JPL/Space Science Institute.*

NASA is extending the international Cassini-Huygens mission by two years. The historic spacecraft’s stunning discoveries and images have revolutionized our knowledge of Saturn and its moons.

Cassini’s mission originally had been scheduled to end in July 2008. The two-year extension will include 60 additional orbits of Saturn and more flybys of its exotic moons. These will include 26 flybys of Titan, seven of Enceladus, and one each of Dione, Rhea, and Helene. The extension also includes studies of Saturn’s rings, its complex magnetosphere, and the planet itself.

“This extension is not only exciting for the science community, but for the world to continue to share in unlocking Saturn’s secrets,” said Jim Green, Director of the Planetary Science Division of NASA Headquarters. “New discoveries are the hallmarks of its success, along with the breathtaking images beamed back to Earth that are simply mesmerizing.”

“When we designed the original tour, we really did not know what we would find, especially at Enceladus and Titan,” said Dennis Matson, the JPL Cassini project scientist. “This extended tour is responding to these new discoveries and giving us a chance to look for more.”

Cassini has returned a daily stream of data from Saturn’s system for almost four years. Its travel scrapbook includes nearly 140,000 images, along with information gathered during 62 revolutions around Saturn, 43 flybys of Titan, and 12 close flybys of the icy moons.

More than 10 years after launch and almost 4 years after entering into orbit around Saturn, Cassini is a healthy and robust spacecraft. Three of its science instruments have minor ailments, but the impact on science gathering is minimal. The spacecraft will have enough propellant left after the extended mission to potentially allow a third phase of operations. Data from the extended mission could lay the groundwork for possible new missions to Titan and Enceladus.

For more information about Cassini, visit [www.nasa.gov/cassini](http://www.nasa.gov/cassini) or [saturn.jpl.nasa.gov](http://saturn.jpl.nasa.gov).

## **STARDUST STARS ON EARTH AS IT DOES IN THE HEAVENS**

While their spacecraft's journeys may have taken it more than halfway to Jupiter, members of the Stardust team have lately been doing some roaming of their own. A great deal of the traveling has been to accept awards and receive the accolades of their aerospace and science-oriented peers. Among the honors the Stardust team has received: the Aviation Week & Space Technology Program Excellence Award; the Popular Mechanics' Breakthrough Award; and the Rotary National Award for Space Achievement. Now, Stardust can add above its mantle the National Air and Space Museum Trophy Award.

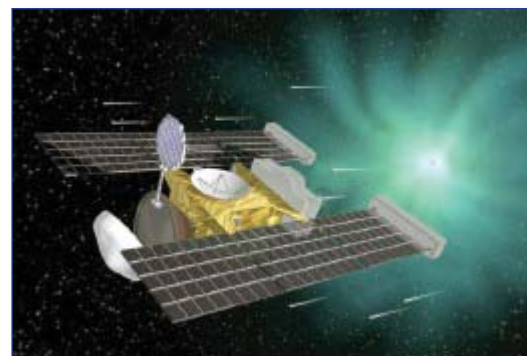
"Stardust came through its historic comet Wild 2 flyby and Earth sample return with resources to spare," said Duxbury. "NASA took a look at what was left in the tanks — of both spacecraft and personnel — and decided Stardust should head on out to explore another comet, Tempel 1."

On July 4, 2005, an impactor deployed by another NASA spacecraft — Deep Impact — was run over by comet Tempel 1 at about six miles a second. Like Stardust, Deep Impact provided great strides for cometary science. Now the plan is for the Stardust spacecraft to revisit the site of Deep Impact's triumph. Called Stardust-NExT, the mission will employ the Stardust spacecraft's camera, cometary dust analyzer, and dust flux monitor during a February 2011 flyby of Tempel 1, where it will observe changes to the surface of the comet since the Deep Impact mission's visit in 2005.

"Tempel 1 made its closest approach to the Sun on July 5, 2005, a day after Deep Impact's visit," said Joe Veverka, a scientist at Cornell University and the principal investigator of Stardust-NExT. "Things happen to comets when they get closest to the Sun and Stardust-NExT is our first opportunity to observe these changes firsthand."

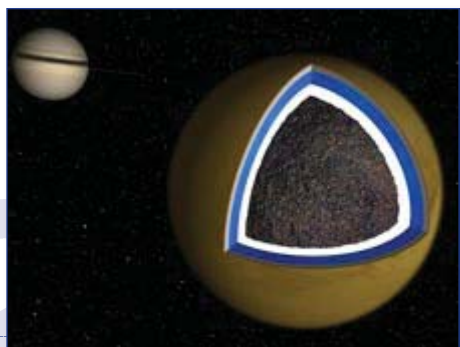
Among the discoveries garnered by Stardust was the finding that comets are a very odd mix of materials that formed at the highest and lowest temperatures that existed in the early solar system. Comets have been cold for billions of years, but their ingredients are remarkable products of both fire and ice. Because the rocky materials in comet Wild 2 formed at such high temperatures, scientists believe that they formed in the hot inner regions of the young solar system and were then transported all the way to beyond the orbit of Neptune.

For more information, visit [stardust.jpl.nasa.gov](http://stardust.jpl.nasa.gov).



*Artist's rendering of the Stardust spacecraft.  
Credit: JPL*

## **CASSINI SPACECRAFT FINDS OCEAN MAY EXIST BENEATH TITAN'S CRUST**



*This graphic depicts a cross-section of the saturnian moon Titan. Credit: NASA/JPL.*

NASA's Cassini spacecraft has discovered evidence that points to the existence of an underground ocean of water and ammonia on Saturn's moon Titan. The findings, made using radar measurements of Titan's rotation, appeared in the March 21 issue of the journal *Science*.

Members of the mission's science team used Cassini's Synthetic Aperture Radar to collect imaging data during 19 separate passes over Titan between October 2005 and May 2007. The radar can see through Titan's dense, methane-rich atmospheric haze, detailing never-before-seen surface features and establishing their locations on the moon's surface.

Using data from the radar's early observations, the scientists and radar engineers established the locations of 50 unique landmarks on Titan's surface. They then searched for these same lakes, canyons, and mountains in the reams of data returned by Cassini in its later flybys of Titan. They found prominent surface features had shifted from their expected positions by up to 30 kilometers (19 miles). A systematic displacement of surface features would be difficult to explain unless the moon's icy crust was decoupled from its core by an internal ocean, making it easier for the crust to move.

"We believe that about 100 kilometers (62 miles) beneath the ice and organic-rich surface is an internal ocean of liquid water mixed with ammonia," said Bryan Stiles of NASA's Jet Propulsion Laboratory. Stiles is a contributing author to the paper.



## **SATURN'S MOON RHEA ALSO MAY HAVE RINGS**

NASA's Cassini spacecraft has found evidence of material orbiting Rhea, Saturn's second largest moon. This is the first time rings may have been found around a moon.

A broad debris disk and at least one ring appear to have been detected by a suite of six instruments on Cassini specifically designed to study the atmospheres and particles around Saturn and its moons.

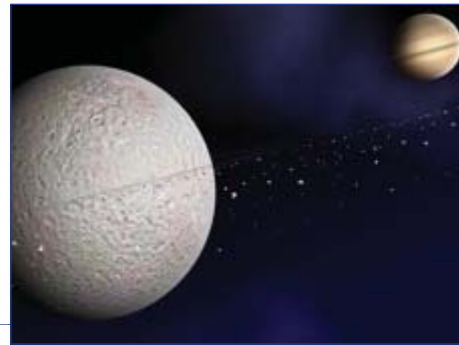
Rhea is roughly 1500 kilometers (950 miles) in diameter. The apparent debris disk measures several thousand miles from end to end. The particles that make up the disk and any embedded rings probably range from the size of small pebbles to boulders. An additional dust cloud may extend up to 5900 kilometers (3000 miles) from the moon's center, almost eight times the radius of Rhea.

The discovery was a result of a Cassini close flyby of Rhea in November 2005, when instruments on the spacecraft observed the environment around the moon. Three instruments sampled dust directly. The existence of some debris was expected because a rain of dust constantly hits Saturn's moons, including Rhea, knocking particles into space around them. Other instruments' observations showed how the moon was interacting with Saturn's magnetosphere, and ruled out the possibility of an atmosphere.

Evidence for a debris disk in addition to this tenuous dust cloud came from a gradual drop on either side of Rhea in the number of electrons detected by two of Cassini's instruments. Material near Rhea appeared to be shielding Cassini from the usual rain of electrons. Cassini's Magnetospheric Imaging Instrument detected sharp, brief drops in electrons on both sides of the moon, suggesting the presence of rings within the disk of debris. The rings of Uranus were found in a similar fashion, by NASA's Kuiper Airborne Observatory in 1977, when light from a star blinked on and off as it passed behind Uranus' rings.

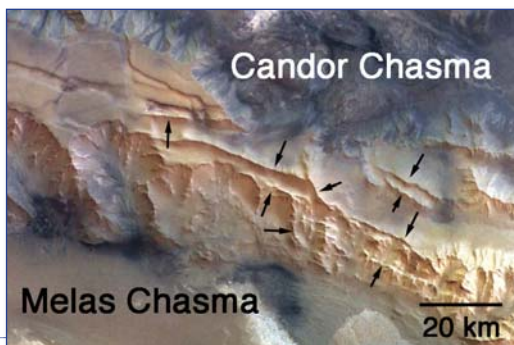
"Seeing almost the same signatures on either side of Rhea was the clincher," added Jones. "After ruling out many other possibilities, we said these are most likely rings. No one was expecting rings around a moon."

One possible explanation for these rings is that they are remnants from an asteroid or comet collision in Rhea's distant past. Such a collision may have pitched large quantities of gas and solid particles around Rhea. Once the gas dissipated, all that remained were the ring particles. Other moons of Saturn, such as Mimas, show evidence of a catastrophic collision that almost tore the moon apart.



*Artist's concept of the ring of debris that may orbit Saturn's second-largest moon, Rhea.  
Credit: NASA/JPL/JHUAPL.*

## **ANCIENT GROUNDWATER FLOW ON MARS**



*Fault lines and fault-trace ridges (FTR) between the canyons Melas Chasma and Candor Chasma in the Valles Marineris. Credit: European Space Agency.*

Water on Mars is important for understanding its climate, geology, and potential for life, and spacecraft orbiters and landers continue to provide evidence about water near Mars' surface and in its atmosphere. The missing part of Mars' water cycle is underground — its groundwater. To see the effects of groundwater, one has to excavate or use natural excavations. That is what Dr. Allan Treiman reported recently, using the Valles Marineris Canyon system as a way to see the effects of ancient groundwater deep inside Mars.

Treiman, Senior Staff Scientist at the Lunar and Planetary Institute, published his recent findings in the February 24 issue of *Nature Geoscience*. Treiman explains that the fault trace ridges between Melas Chasma and Candor Chasma in Valles Marineris, which are over 100 kilometers long, are the major terrain boundaries between the canyons. Usually, fault lines appear as valleys (not ridges) because the fault motions and earthquakes break up the rock. For

fault zones to appear to resist erosion, and appear as ridges, their broken rock must be cemented together. On Earth, the cements are usually minerals (like silica and calcite) deposited by flowing groundwater.

The length of the fault trace ridges (up to and over 100 kilometers) and their depth (over 5 kilometers) suggest that the faults acted as “pipes” for huge volumes of water. The flow was probably west-to-east, from the Tharsis volcanos and eventually downward toward Mars’ northern lowlands. The fault trace ridges appear up to the surface of the nearby high plateaus, which suggests that liquid water was stable at or near the martian surface when the fault zones were cemented; liquid water is not stable now at Mars’ surface.

### ***SATURN IMAGES SHOWCASED IN NEW YORK CITY***

A selection of the best images from Saturn and its rings and moons are appearing in an exhibition that opened on April 26 at the American Museum of Natural History in New York City.

The show, called “Saturn: Images from the Cassini-Huygens Mission,” will run through March 29, 2009. It features dramatic, up-close-and-personal images in small individual views and super-large mosaics. Roughly 50 images taken by the Cassini-Huygens mission in visible light, infrared, and radar have been hand-picked by a team of Cassini scientists.

“The images show the Saturn system as we had never seen it before. They perfectly blend exploration, science and beauty,” said Joe Burns, the exhibit’s guest co-curator and a Cassini imaging scientist at Cornell University. “We are excited to have the opportunity to show these breathtaking photographs to the broader public in one of the world’s greatest science museums.” Burns, along with colleagues at Cornell University and on the Cassini project, has been collaborating with museum curators for the past year on the image selection, scientific captions, and exhibit design.

For exhibition information, visit [www.amnh.org/exhibitions/photo/saturn/](http://www.amnh.org/exhibitions/photo/saturn/).

### ***Solicitation for Contributions***

Contributions to the **Lunar and Planetary Information Bulletin (LPIB)** are solicited from the planetary community and beyond. Articles exploring issues related to planetary science and exploration are welcome. Of special interest are articles describing web-based research and educational tools, meeting highlights and summaries, and descriptions of new space missions that may be of interest to our readers. Peer-reviewed research articles, however, are not appropriate for publication in the LPIB. The LPIB is published quarterly and serves the planetary research community, science libraries, educators, students, and lay readers interested in space-science-related research. Suggested topics can be e-mailed to the editors, who will provide guidelines for formatting and content.

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Graphic Design: Leanne Woolley

The Bulletin welcomes articles dealing with issues related to lunar and planetary science and exploration. The copy deadline for the next issue is July 11, 2008. Articles or announcements should be submitted via e-mail to [lpibed@lpi.usra.edu](mailto:lpibed@lpi.usra.edu).

To be added to the list to receive notification by e-mail of future issues, please send your e-mail address to [lpibed@lpi.usra.edu](mailto:lpibed@lpi.usra.edu).

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*“Spotlight on Education” highlights events and programs that provide opportunities for planetary scientists to become involved in education and public outreach and to engage science educators and the community. If you know of space science educational programs or events that should be included, please contact the Lunar and Planetary Institute’s Education Department at [shupla@lpi.usra.edu](mailto:shupla@lpi.usra.edu).*

## **MARS PHOENIX MISSION LANDING**

The landing of the Phoenix Mission and its subsequent investigations on Mars mark the opportunity to engage the public this summer. Planetary scientists interested in conducting outreach should consider contacting their local schools, colleges, museums, and planetariums to see if they can participate in any local educational events. Video and podcasts are available for download at [www.jpl.nasa.gov/news/phoenix/main.php](http://www.jpl.nasa.gov/news/phoenix/main.php), explaining the entry, descent, and landing events for the Phoenix Mars Lander on May 25, 2008.



## **JOIN NASA’S OUTREACH DURING THE 2009 INTERNATIONAL YEAR OF ASTRONOMY!**

In 2009 we celebrate the 400th anniversary of Galileo’s first observations of the universe through a telescope. In honor of this early event, the International Astronomical Union (IAU) and the United Nations have proclaimed 2009 as the International Year of Astronomy to spread awareness of astronomy’s contributions to society and culture, stimulate young people’s interest in science, portray astronomy as a global peaceful endeavor, and nourish a scientific outlook in society.

NASA invites you to join us in the celebration of IYA 2009. The NASA IYA website ([astronomy2009.nasa.gov](http://astronomy2009.nasa.gov)) will be your portal to exciting NASA resources, events, and opportunities for involvement as we develop our program of regional and national IYA activities for students, teachers, and the public.

## **EDUCATIONAL ACTIVITIES AT THE AGU JOINT CONFERENCE**



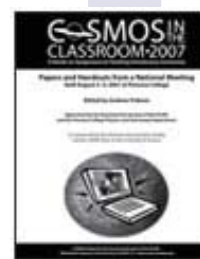
The Meeting of the Americas 2008 Joint Assembly was held May 27–30, 2008, and several educational activities occurred as part of the conference, including the *Geophysical Information for Teachers (GIFT) Workshop: Hurricanes and Atmospheric Science and Classroom Toolkit* (May 29–30); the *Family Science Event* (May 26) (a four-hour open house for local families, teachers and kids); and a *Rock and Paleomagnetism Short Course* for Earth science students and professionals (May 26). More information is available at [www.agu.org/meetings/ja08/?content=outreach](http://www.agu.org/meetings/ja08/?content=outreach) and at [www.agu.org/meetings/os08/?content=outreach](http://www.agu.org/meetings/os08/?content=outreach).

## **SCHOLARSHIP FOR WOMEN IN PHYSICS RESEARCH CAREERS**

Scholarships are being offered to enable early-career women to return to physics research following career interruptions due to family reasons. The scholarship consists of a one-year award of up to \$45,000 (applicants can apply in a subsequent year for one additional year of support). Allowed expenses include dependent care, salary, travel, equipment, and tuition and fees. Applicants must have an affiliation with a research-active educational institution or national lab. For more information, visit [www.aps.org/programs/women/scholarships/blewett/index.cfm](http://www.aps.org/programs/women/scholarships/blewett/index.cfm).

## **COSMOS IN THE CLASSROOM 2007 PAPERS AND HANDOUTS AVAILABLE**

Designed for university, college, and high-school faculty who teach beginning astronomy, the 2008 volume of *Cosmos in the Classroom* is full of practical advice, reviews of instructional tools, curriculum guides, and class activities. The Astronomical Society of the Pacific assembled the papers, handouts, and resource guides from a



national conference held in August 2007 on the most effective ways of teaching the introductory astronomy course for non-science majors. For the full Table of Contents, visit [www.astrosociety.org/events/cosmos/cosmos07/cosmos07toc.pdf](http://www.astrosociety.org/events/cosmos/cosmos07/cosmos07toc.pdf), or to order online, go to the Society's AstroShop at [www.astrosociety.org/online-store/scstore/p-BO366.html](http://www.astrosociety.org/online-store/scstore/p-BO366.html).

### **NASA LAUNCHES NEW SCIENCE WEBSITE**

NASA's Science Mission Directorate has launched a new website that provides enhanced and engaging information about NASA's vast scope of scientific endeavors and achievements, which scientists can share with the public. The site provides coverage of NASA's past, present, and future science missions with features that include:

- Interactive tables that the public can use to search for specific Earth, heliophysics, planetary, and astrophysics missions
- Insight written for the average adult into dark matter and dark energy, planets around other stars, climate change, Mars, and space weather
- A citizen-scientist page with access to resources that equip the public to engage in scientific investigation
- Expanded "For Educators" and "For Kids" pages to provide access to a broader range of resources for learning the science behind NASA missions

Visit the new NASA science website at [nasascience.nasa.gov](http://nasascience.nasa.gov).

### **SIMPLE EFFECTIVE EDUCATION AND DISSEMINATION (SEED) GRANTS FOR ASTRONOMY RESEARCHERS**

The ASP SEED Grant program supports the ASP's mission to improve the understanding, appreciation, and enjoyment of astronomy by encouraging active researchers to engage in public outreach, K–14 formal education, or informal education programs or activities. The maximum grant is \$2500. Funds may be used to purchase equipment related to the proposed EPO activity, or to defray expenses associated with carrying out the activity. The application, funding, and reporting processes have been made as simple and easy as possible in order to minimize the "personal overhead" associated with obtaining and fulfilling the obligations of these grants. For more information, visit [www.astrosociety.org/education/grants/grants.html](http://www.astrosociety.org/education/grants/grants.html).



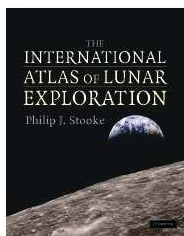
### **FUNDING OPPORTUNITY FOR NASA UNIVERSITY RESEARCH CENTERS AT MINORITY SERVING INSTITUTIONS**

The NASA Office of Education invites proposals for advancing the research capacity and infrastructure at Minority Serving Institutions in NASA-related areas. This Cooperative Agreement Notice will lead to the establishment of multi-disciplinary scientific, engineering, and/or commercial research centers at the host universities. U.S. colleges and universities designated and listed as Postsecondary Minority Institutions by the Department of Education are encouraged to apply. In addition, applying institutions must offer graduate degrees in engineering, mathematics, or science disciplines. For more information about this opportunity, visit [nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={C2129545-4629-21BA-67C4-7F22D275E3AD}&path=open](http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={C2129545-4629-21BA-67C4-7F22D275E3AD}&path=open).



## BOOKS

***The International Atlas of Lunar Exploration.*** Philip J. Stooke. Cambridge University Press, 2008. 464 pp., Hardcover, \$190.00. [www.cambridge.org](http://www.cambridge.org)



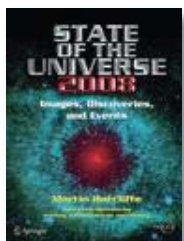
Bringing together a wealth of information from many sources, including some material never before published, this atlas is a comprehensive reference on lunar exploration. It tells the story of every spacecraft mission to the Moon since the dawn of the space age, illustrating each account with a unique combination of maps and annotated photographs. Many of the illustrations were created especially for this atlas, including panoramic photographs from every lunar mission. The missions are listed in chronological order, providing readers with an easy-to-follow history of lunar missions. Special attention has been given to describing the processes involved in choosing landing sites for Apollo and its precursors. The atlas also includes missions that were planned but never flown, before looking ahead to future missions as the world's space agencies prepare for a new phase of lunar exploration.

***We Came in Peace for All Mankind: The Untold Story of the Apollo 11 Silicon Disc.*** Tahir Rahman. Leathers Publishing, 2007. 304 pp., Hardcover, \$39.50. [www.silicondisc.com](http://www.silicondisc.com)

The story of the Apollo 11 trip to the Moon is one that has been told in every language and in every country. But there is an untold story that is now revealed in a beautifully illustrated book. The story focuses on a silicon disc that traveled with the astronauts on that most historic moment. And the messages it contained were meant for worlds beyond the Earth. This book tells the amazing story behind a disc smaller than a poker chip that was intended to carry the most inspiring words from Earth to the rest of the universe.



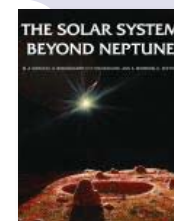
***State of the Universe 2008: Images, Discoveries, and Events.*** Martin Ratcliffe. Springer, 2008. 184 pp., Paperback, \$29.95. [www.springer.com](http://www.springer.com)



The aim of the *State of the Universe* annuals is to provide an annual astronomy review suitable for the popular science-level reader. The 2008 annual covers all major astronomical news on topics beyond the solar system, placing them in the context of the longer-term goals of astronomers and astrophysicists around the world. This book captures the excitement and vibrancy of modern astronomical research. This section also includes web links for all major news stories, providing a bridge between the public news stories and the actual research websites.

***The Solar System Beyond Neptune.*** Edited by M. A. Barucci, H. Boehnhardt, D. P. Cruikshank, and A. Morbidelli. University of Arizona Press, 2008. 592 pp., Hardcover, \$70.00. [www.uapress.arizona.edu](http://www.uapress.arizona.edu)

A new frontier in our solar system opened with the discovery of the Kuiper belt and the extensive population of icy bodies orbiting beyond Neptune. Today the study of all these bodies, collectively referred to as transneptunian objects, reveals them to be frozen time capsules from the earliest epochs of solar system formation. This new volume in the Space Science Series, with more than 100 contributing authors, offers the most detailed and up-to-date picture of our solar system's farthest frontier. Our understanding of transneptunian objects is rapidly evolving and currently constitutes one of the most active research fields in planetary sciences. *The Solar System Beyond Neptune* brings the reader to the forefront of our current understanding and points the way to further advancement in the field, making it an indispensable resource for researchers and students in planetary science.

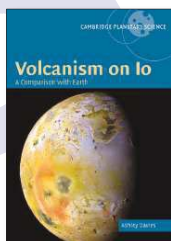


**Why the Sky is Blue: Discovering the Color of Life.** Götz Hoeppe. Princeton University Press, 2007. 368 pp., Paperback, \$29.95. [press.princeton.edu](http://press.princeton.edu)

*Why the Sky Is Blue* answers an ancient and surprisingly complex question in an entertaining and accessible way. Hoeppe takes the reader on a historical and scientific journey to show the various ways people in different times and places have explained why the sky looks blue. The illustrated story begins with ancient myths and philosophy and ends with the cutting-edge science of optics, statistical physics, and ozone depletion. Most importantly, it is the story of how scientists discovered that the sky's blue depends on life on Earth and the makeup of our planet's ozone layer. *Why the Sky Is Blue* shows that skylight can be viewed from a surprising variety of vantage points. We learn how our physiology and cognitive capacities govern our perception of the sky's color, and we discover why this everyday experience has been such a source of fascination and controversy over the centuries. This book shows how the attempt to answer this age-old and deceptively simple question only enhances the magic of the blue sky we see above us.



**Volcanism on Io: A Comparison with Earth.** Ashley Davies. Cambridge University Press, 2007. 376 pp., Hardcover, \$133.00. [www.cambridge.org](http://www.cambridge.org)



This illustrated book is the first dedicated to volcanism on Io. It describes and explains the different styles and scales of volcanic activity on this fascinating moon, and compares Io's diverse volcanos with their contemporaries on Earth. It also provides background as to why Io and Earth are volcanically active, and describes how remote-sensing data from spacecraft and telescopes are analyzed to reveal the underlying volcanic processes. Containing the latest results from the Galileo mission, this book is a fascinating reference for advanced undergraduates, graduate students, and researchers in planetary science, volcanology, remote-sensing and geology.

## CD-ROM

**Geoscience Animation Library CD-ROM, 4th edition.** From Pearson Education, 2008, one disc. \$27.60. [www.pearsonhighered.com](http://www.pearsonhighered.com)

The fourth edition of this animation library has been resequenced in alphabetical order by title so it is easier to find specific animations. This edition contains five new oceanography topics, and a variety of animations have been revised or updated including "Atmospheric Stability," "Convergent Margins: India-Asia Collision," and "Earth-Sun Relations."



## DVD

**Planetary Defense.** Produced by Space Viz Productions, 2008, 48 minutes, one disc. \$49.99. [www.amazon.com](http://www.amazon.com)



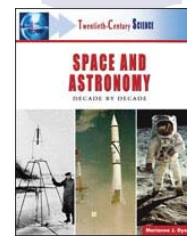
Scientists and the military have only recently awakened to the notion that impacts with Earth do happen. *Planetary Defense* meets with both the scientific and military communities to study our options to mitigate an impact. This documentary addresses efforts that are underway to detect and mitigate an impact with Earth from asteroids and comets, collectively known as NEOs (Near Earth Objects). *Planetary Defense* features Sir Arthur C. Clarke, Freeman J. Dyson, David H. Levy, and Rusty Schweickart, among other experts in the field. Nominated for a 2008 Sir Arthur Clarke Award in the category of Best Presentation in Film.



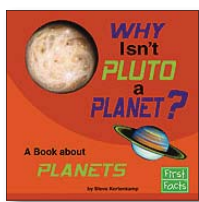
## FOR KIDS!!!

**Space and Astronomy.** Marianne J. Dyson. Facts on File, 2007. 304 pp., Hardcover, \$49.50.  
[www.factsonfile.com](http://www.factsonfile.com)

For thousands of years, humans have scanned the sky and charted the movement of celestial bodies. The daily and seasonal patterns of the Sun, Moon, and stars guided sailors home, dictated the timing of planting and harvesting, and became an inspiration for festivals, celebrations, and holidays. The appearance of novae, comets, and storms of “shooting stars” lighting up the predawn hours were interpreted as lucky signs, dire omens, or special messages from the gods. These practical and spiritual connections of astronomy with human activity motivated and inspired improvements in observations and technology, which led to a deeper interest in exploring what lies beyond the outskirts of this galaxy and the next. *Space and Astronomy: Decade by Decade* reveals how the astronomers unravel the mysteries of how the Sun shines, how stars collapse into black holes, and how the universe expands. It is the story of dreamers who designed rockets to bring back knowledge of other worlds and other galaxies. This volume describes the progress of astronomy and the development of spaceflight from 1901 to 2000. For grades 6–12.



**Why Isn't Pluto a Planet? A Book about Planets.** Steve Kortenkamp. Capstone Press, 2007. 24 pp., Hardcover, \$15.95. [www.capstonepress.com](http://www.capstonepress.com)



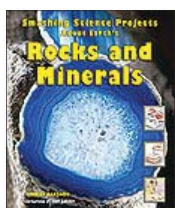
What is a planet anyway? How come Pluto isn't one? Are there any more planets? Scientists are learning more about these questions every day. This book helps the reader discover more about the mysteries of the planets in our solar system. For grades 1–2.

**From the Earth to the Moon: Astronaut on the Moon Model.** From World Space Museum. \$9.95.  
[www.world-space-museum.com](http://www.world-space-museum.com)

Astronaut Neil Armstrong climbed down Eagle's ladder and stepped onto the surface of the Moon on July 20, 1969. This kit commemorating that event includes a snap-together plastic model (no glue needed to assemble); a two-sided, full-color, illustrated educational information sheet and assembly instructions; and 11 collectible trading cards of famous astronauts, scientists, equipment, and events. Seven other models are available in this series.



**Smashing Science Projects about Earth's Rocks and Minerals.** Robert Gardner, 2007. 48 pp., Hardcover. \$23.93. [www.enslow.com](http://www.enslow.com)



What is in soil? Can you make a crystal? What is the difference between sedimentary rock and igneous rock? The exciting experiments in this book will unlock the secrets of rocks and minerals. Some will even give you ideas for your own science fair. All you need are some simple materials, most of which can be found around your home, school, or neighborhood. So get started and discover that Earth science rocks! For grades 3–4.

## JUNE

- 1 **SOFIA Early Science Workshop II**, St. Louis, Missouri.  
<http://www.sofia.usra.edu/Science/AASworkshops/workshops.html>
- 1–5 **American Astronomical Society 212th Meeting**, St. Louis, Missouri. <http://www.aas.org/meetings/>
- 1–6 **Solar Variability, Earth's Climate and the Space Environment**, Bozeman, Montana.  
<http://solar.physics.montana.edu/SVECSE2008/>
- 3–5 **Outer Planet Flagship Mission Instrument Workshop**, Monrovia, California.  
<http://opfm.jpl.nasa.gov/InstrumentWorkshop/>
- 3–6 **Chaotic Modeling and Simulation International Conference (CHAOS2008)**, Chania, Greece.  
<http://www.asmda.net/chaos2008/>
- 8–11 **Fifth Annual Planetary and Terrestrial Mining Sciences Symposium (PTMSS)**, Montreal, Quebec.  
<http://www.ptmss.com/>
- 9–11 **Mars Express MARSIS and MaRS Data Workshop**, Madrid, Spain.  
[http://www.rssd.esa.int/index.php?project=TOP&page=3rd\\_mexdw\\_08](http://www.rssd.esa.int/index.php?project=TOP&page=3rd_mexdw_08)
- 9–12 **2008 RASC-AL Forum**, Cape Canaveral, Florida.  
<http://www.lpi.usra.edu/rascal/>
- 11–13 **Geoinformatics 2008: Data to Knowledge**, Potsdam, Germany.  
<http://www.geosociety.org/meetings/08geolInfo/index.htm>
- 16–18 **Extra-Solar Super-Earths**, Nantes, France.  
<http://www.sciences.univ-nantes.fr/geol/SuperEarths2008/>
- 16–19 **ASTRONET Infrastructure Roadmap Symposium: Towards a Strategic Plan for European Astronomy**, Liverpool, United Kingdom.  
<http://www.astro.livjm.ac.uk/~airs2008/index.html>
- 16–20 **Asia Oceania Geosciences Society**, Busan, Korea.  
<http://www.asiaoceania.org/aogs2008/>
- 23–27 **Sixth International Planetary Probe Workshop**, Atlanta, Georgia. <http://www.planetaryprobe.org/>
- 26–28 **International Conference on 100 Years Since the Tunguska Phenomenon: Past, Present, and Future**, Moscow, Russia. <http://tunguska.sai.msu.ru/>
- 29–Jul 3 **Ninth International Conference on Permafrost**, Fairbanks, Alaska. <http://nicop.org>
- 7–11 **Symposium on Titan After Cassini-Huygens**, Corpus Christi, Texas. <http://titanaftercassini.com/>
- 8–11 **Polar Research: Arctic and Antarctic Perspectives in the International Polar Year**, St. Petersburg, Russia.  
<http://www.scar-iasc-ipy2008.org/>
- 13–18 **Goldschmidt 2008: From Sea to Sky**, Vancouver, Canada.  
<http://www.goldschmidt2008.org/>
- 13–20 **37th COSPAR Scientific Assembly**, Montreal, Canada.  
<http://www.cospar-assembly.org/>
- 14–18 **Asteroids, Comets, Meteors 2008**, Baltimore, Maryland.  
<http://acm2008.jhuapl.edu/>
- 20–23 **NLSI Lunar Science Conference**, Moffett Field, California.  
<http://www.lpi.usra.edu/meetings/nlsc2008/>
- 20–24 **Australian Earth Sciences Convention 2008**, Perth, Western Australia. <http://www.iceaustralia.com/aesc2008/>
- 20–26 **International Symposium on Topical Problems of Nonlinear Wave Physics (NWP-2008)**, Nizhny Novgorod, Russia. <http://www.nwp.sci-nnov.ru/>
- 26–27 **Workshop on Antarctic Meteorites: Search, Recovery, and Classification**, Matsue City, Japan.  
<http://www.metsoc2008.jp/workshop/>
- 27–Aug 2 **Dynamics of Solar System Bodies**, Tomsk, Russia.  
<http://sibeclipse2008.nxt.ru>
- 28–Aug 1 **Symposium on Saturn After Cassini-Huygens**, London, United Kingdom. <http://www.saturnaftercassini.org>
- 28–Aug 1 **71st Annual Meeting of the Meteoritical Society (MetSoc 2008)**, Matsue, Japan.  
<http://www.lpi.usra.edu/meetings/metsoc2008/>
- 29–Aug 1 **2008 Western Pacific Geophysics Meeting**, Cairns, Australia. <http://www.agu.org/meetings/wp08/>

## AUGUST

- 3–8 **International Radiation Symposium (IRS2008)**, Iguassu Falls, Brazil. <http://www.irs2008.org.br>
- 6–14 **33rd International Geological Congress**, Oslo, Norway.  
<http://www.33igc.org>
- 10–14 **Symposium at IGC33: Environments and Consequences of Impacts of Asteroids and Comets**, Oslo, Norway.  
<http://www.33igc.org/>
- 10–14 **The N-Body Problem: Numerical Methods and Applications**, Turku, Finland.  
<http://www.astro.utu.fi/conf/NBody2008/>
- 11–16 **Sixth International Conference on Case Histories in Geotechnical Engineering**, Arlington, Virginia.  
<http://campus.mst.edu/6icchg/>

## JULY

- 6–11 **Astronomical Polarimetry 2008: Science from Small to Large Telescopes**, Quebec, Canada.  
<http://www.astro.umontreal.ca/astropol2008/>



- 14–16 The Great Planet Debate: Science as Process (A Scientific Conference and Educator Workshop), Laurel, Maryland. <http://gpd.jhuapl.edu>
- 15–18 The Sloan Digital Sky Survey: From Asteroids to Cosmology, Chicago, Illinois. <http://sdss2008.uchicago.edu/>
- 17–21 Large Meteorite Impacts and Planetary Evolution IV, Vredefort Dome, South Africa. <http://www.lpi.usra.edu/meetings/lmi2008/>
- 17–23 Surface and Interface Processes at the Molecular Level, Il Ciocco, Barga, Italy. <http://www.chem.ucl.ac.uk/astrosurf/SIPML.html>
- 24–29 XV International Conference on the Origin of Life, Florence, Italy. <http://www.dbag.unifi.it/issol2008/>
- 25–29 Extrasolar Planets in Multi-Body Systems: Theory and Observations, Torun, Poland. <http://www.astr.uni.torun.pl/~workshop/>

## SEPTEMBER

- 1–5 IMPRS Summer School 2008: The Art and Craft of Astronomical Instrumentation — From Optical to Infrared, Heidelberg, Germany. <http://www.mpia.de/imprs-hd/SummerSchools/2008/>
- 7–12 Eleventh Electromagnetic and Light Scattering Conference (ELS-XI), Hatfield, United Kingdom. <http://www.els-xi-08.org/>
- 8–11 Grand Challenges in Computational Astrophysics, Vienna, Austria. <http://www.obs.univ-lyon1.fr/js7/>
- 8–12 Cosmic Dust — Near & Far, Heidelberg, Germany. <http://www.mpia-hd.mpg.de/DNF08/>
- 8–12 Future Ground Based Solar System Research: Synergies with Space Probes and Space Telescope, Portoferraio, Italy. <http://www.arcetri.astro.it/~elba2008/>
- 15–17 Thermal Models for Planetary Science, Beaulieu sur Mer, France. <http://www.oce.eu/thermops/>
- 15–17 Workshop on the Early Solar System Impact Bombardment, Houston, Texas. <http://www.lpi.usra.edu/meetings/bombardment2008>
- 18–21 International Meteor Conference 2008, Sachticka, Slovakia. <http://www.imo.net/imc2008/>
- 22–26 European Planetary Science Congress 2008, Münster, Germany. <http://meetings.copernicus.org/epsc2008/>
- 29–Oct 2 Eleventh Mars Crater Consortium Meeting and GIS Training Workshop, Flagstaff, Arizona. <http://www.marscraterconsortium.nau.edu/>
- 29–Oct 3 59th International Astronautical Congress, Glasgow, Scotland. <http://www.iafastro.com/index.php?id=78>

## OCTOBER

- 5–9 2008 Joint Meeting of the Geological Society of America: Celebrating the International Year of Planet Earth, Houston, Texas. <http://www.geosociety.org/meetings/2008/index.htm>
- 5–10 IAGA International Symposium: Space Weather and Its Effects on Spacecraft, Cairo, Egypt. <http://laga.cu.edu.eg/>
- 6–10 International Young Astronomers School on CoRoT Astrophysics: The Star and Its Planetary System in the Wake of CoRoT Advances, Observatoire de Paris-Meudon, France. <http://ecole-doctorale.obspm.fr/rubrique163.html>
- 6–10 Sixth IRAM Millimeter Interferometry School, Grenoble, France. <http://www.iram.fr/IRAMFR/IS/school.htm>
- 10–15 40th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society, Ithaca, New York. <http://www.aas.org/dps/meetings.html>
- 14–17 Classification and Discovery with Large Astronomical Surveys, Ringberg Castle, Germany. <http://www.mpia.de/class2008/>
- 19–24 Second Workshop on Mars Valley Networks, Moab, Utah. <mailto:workshops@si.edu>
- 21–23 Workshop on Martian Phyllosilicates: Recorders of Aqueous Processes?, Paris, France. [http://www.ias.u-psud.fr/Mars\\_Phyllsilicates/main\\_1st.php](http://www.ias.u-psud.fr/Mars_Phyllsilicates/main_1st.php)
- 26–30 New Light on Young Stars: Spitzer's View of Circumstellar Disks, Pasadena, California. <http://www.ipac.caltech.edu/spitzer2008/>
- 26–31 2008 Huntsville Workshop: The Physical Processes for Energy and Plasma Transport Across Magnetic Boundaries, Huntsville, Alabama. <http://hsvworkshop.cspar.uah.edu/hsvworkshop/>
- 28–31 Joint Annual Meeting of LEAG-ICEUM-SSR, Cape Canaveral, Florida. <http://www.lpi.usra.edu/meetings/leagilewg2008/>

## NOVEMBER

- 3–7 Cosmic Magnetic Fields: From Planets, to Stars and Galaxies (IAU Symposium 259), Puerto Santiago, Tenerife, Spain. <http://www.aip.de/IAUS259/>
- 10–13 Third International Workshop on the Mars Atmosphere: Modeling and Observations, Williamsburg, Virginia. <http://www.lpi.usra.edu/meetings/modeling2008>
- 10–14 Cosmic Cataclysms and Life (ESLAB 08), Frascati, Italy. <http://www.congex.nl/08C16/>

## DECEMBER

- 15–19 2008 Fall AGU Meeting, San Francisco, California. <http://www.agu.org/meetings>