

PLANETARY SCIENCE INSTITUTE

NEWSLETTER

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Tucson School Observes Mercury Transit with PSI

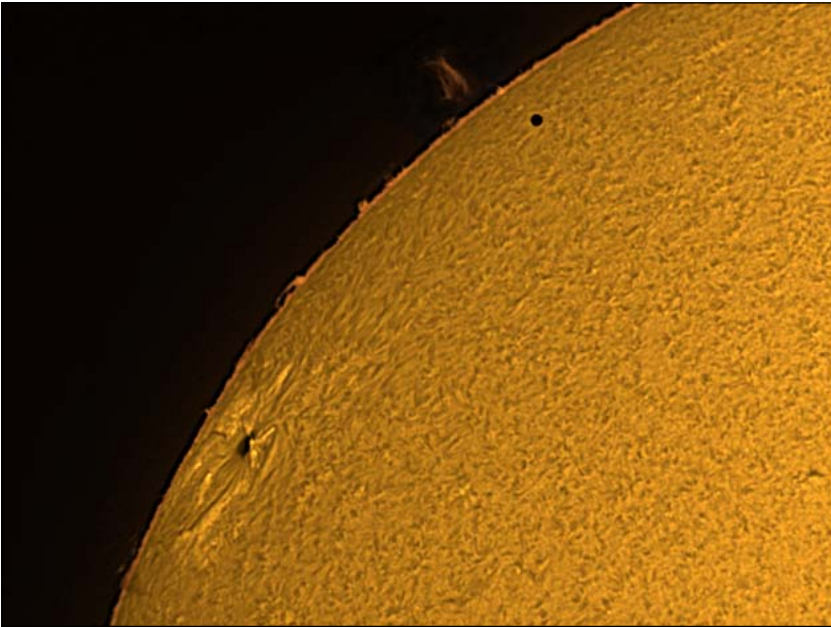


Image of planet Mercury — the small, perfectly round, black dot in the upper third of the photo — ten minutes after it crossed in front of the sun, taken with a specially filtered telescope that isolates the light of hydrogen gas in the upper atmosphere of the sun. A large, dark sunspot can be seen at lower left, and a detached prominence (red flame-like mass shooting off the sun) is visible to the left of Mercury. Since the camera recorded this image in black and white, color has been added after the fact. Photo by PSI Research Assistant Gil Esquerdo.



Using Gil Esquerdo's solar telescope, Mark Everett instructs Presidio Schools' students viewing the Mercury transit.

On November 8, 2006, Mercury slowly passed in front of the sun in an event known as a *transit*. A transit of Mercury is relatively rare, occurring only about 13 times every 100 years. This can happen in May or November; the last two were in 1999 and 2003 and the next Mercury transit will be in 2016.

In an ongoing effort to bring stimulating science to public schools, PSI scientists Don Davis, Bill Hartmann, Steve Kortenkamp and Mark Everett shared this interesting astronomical event with the students at Presidio Schools across the street from PSI. Mark Everett manned the solar telescope for hours (picture below) as curious young people lined up to peer at their first Mercury transit. Although the sun appears orange in the image shown, it is a deep red color through the solar telescope's hydrogen alpha filter.

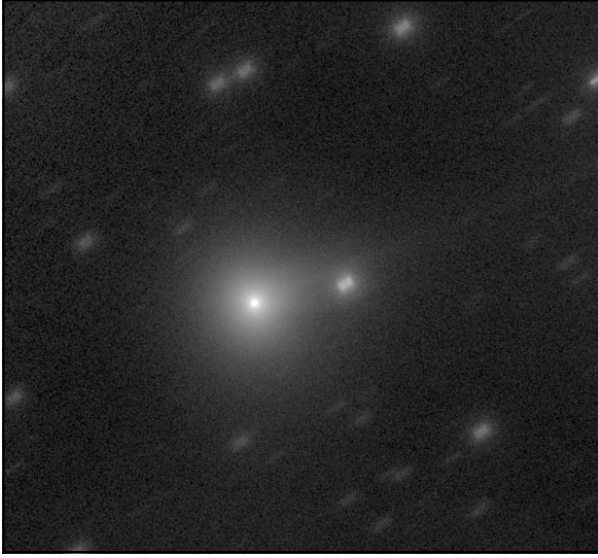
As a follow-up to that exciting day, PSI has extended a science internship to a high school senior from Presidio Schools. Read his report of the students' view of PSI's science visit on the next page.

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David Levy's Latest Discovery!

by Gilbert Esquerdo



PSI Board Chair David Levy made his 22nd comet discovery in October! This image of the comet was taken with the 1.2-m telescope on Mt. Hopkins 48 hours after discovery and less than 24 hours after the announcement. Shot between pesky clouds, a total of 12 images, each 30 seconds long, were taken and combined. A small, bright nucleus can be seen in the center with its narrow, ion tail.

David's discovery is a tribute to his dedication and persistence, having searched for 12 years between comet number 21 and 22. With the large, automated surveys looking for comets and asteroids, the fact that David found this comet visually while it was located close to Saturn is quite remarkable. "It looked like a reflection of Saturn," he said in describing the unlikely area where he located the comet.

Congratulations on your 22nd comet, David!



Baby Boom at PSI!

Eleanor Francis Morrison Kortenkamp, in her father Steve's arms, meeting Arwen Emily Showman, being held by her mother, Lijie Han, at the PSI newborn-baby summit this summer. Both beautiful baby girls were born in late July — one day apart!

PSI Visit from the Students' Perspective

by Thomas Taccone, Presidio High School Senior & PSI Intern

In November, several scientists from PSI, as part of their Education/Public Outreach Program, took the time to come to Presidio Schools and share something spectacular with the students. The event was a transit, which is when a planet, in this case Mercury, passes in front of the sun and is seen from Earth as a small dot against the sun's brilliantly bright backdrop (see front page photo).

While some students were viewing the transit through the solar telescope, others were exploring Mercury's landscape through pictures and activities brought by the PSI scientists. During discussions the scientists answered questions about Mercury posed by enthralled students. The students were shown how projectiles such as comets and meteors shaped craters on Mercury's surface and also heard information about transits. Then they were allowed to witness firsthand this relatively rare and unique event. At least one hundred students and staff took part in the observation, taking turns which lasted from 10-30 seconds at the telescope. Mark Everett described the students as "pretty excited to get up there" and "surprised at how small Mercury was compared to the sun!"

For the students, the visit will last well beyond the few hours the scientists were here. They were given a rare opportunity to view an amazing event they will remember for years to come. Mrs. Joy Barr, from Presidio Schools, stated, "You all touched many students academically and they enjoyed it!"

Bill Hartmann (right) sets up the crater experiment using a pan of flour and cocoa powder for the K-12 students.



Flour/cocoa (left) after it has been "impacted" by dirt clods, representing comets and meteors, dropped on it by the eager students.

Through hands-on experiments (right), Don Davis (in blue) and Bill Hartmann (in white) help the students understand how craters and their rays form on planets.



Student at Presidio Schools reacts to spotting Mercury passing in front of the sun.



Steve Kortenkamp answers student questions about craters on Mercury.

Education/Public Outreach Meeting



NASA Science Education Broker Dr. Cherilynn Morrow (center), Les Bleamaster (left) and Nic Richmond (both PSI) discuss Education/Public Outreach (E/PO) ideas at the one-day meeting held at PSI, November 15, 2006. Dr. Morrow headed the brainstorming session with a group of PSI scientists to identify ways to expand our E/PO efforts to make a greater impact in Tucson and nationally.

Director's Note: PSI Education Always Moving Forward

As this newsletter illustrates, PSI scientists are not only involved in all aspects of solar system exploration, they are deeply interested in sharing their knowledge and enthusiasm with others, too. Our educational and public outreach activities are diverse: from school-based events and lectures and participation in teacher training, to writing children's books, popular books, and giving public talks on current exciting discoveries or controversies. We host student interns and engage university students in cutting-edge research projects. We are now going through an assessment and planning process to see how we can build on these efforts and extend their reach.

This is also the time of year when we ask you to join our *Friends of PSI* and support this institution as we continue to grow, make new discoveries about where we live in the universe, and inspire the public and the next generation — not just scientists and engineers, but everyone. Federal research grants do not cover everything, so your tax-deductible contribution has a real impact.



Best wishes to all for a great new year!

Best wishes to all for a great new year!

Mark V. Sykes
December 2006

Coveted E/PO Award for Pierazzo

PSI Research Scientist Elisabetta Pierazzo has been awarded an institutional Education/Public Outreach grant entitled "Motivating Learning About STEM (Science, Technology, Engineering and Mathematics) Careers, Research, and Content Through the Study of Impact Craters" which was submitted in association with her recently awarded research grants on impact cratering from NASA's Mars Fundamental Research and Planetary Geology and Geophysics programs. Total funding for this E/PO is \$124,991.00.

For this project, Elisabetta has teamed with PSI Research Scientist and Education Specialist Jennifer Grier who serves as the E/PO lead for the institutional award. The E/PO program which involves several other scientists, builds on Elisabetta's previous institutional E/PO grant that developed the "Explorers Guide to Impact Craters" website with virtual tours of impact craters, state-of-the-art computer simulations of impacts, and other tools and resources for educators of middle and high school students and the general public. Visit the website at www.psi.edu/explorecraters/.

An impact crater rock kit was also developed for use with the website and as a stand-alone tool. Each kit contains ten rocks collected from real impact sites around the world.

The new effort focuses on teacher training workshops about impact craters and related science which will be offered in Tucson, Chicago and Maryland for the next two summers. The new E/PO continues the partnership with the Adler Planetarium to develop a demonstration cart centered on the impact rock kits and will be presented by a museum interpreter to school groups as part of their tour of the planetary exhibits. They also expect to present a demonstration of the website and rock kit at the National Science Teacher's Association conference in 2007.

This is the second consecutive institutional E/PO award that PSI has been awarded and speaks very highly of our scientists' commitment to Education and Public Outreach. Bravo, Elisabetta and Jennifer!

PSI In The News ...

PSI Research Scientist **Mary Bourke** was recently featured in an article about Women of Science in *The Irish Times*. To mark National Science Week, the newspaper asked six women scientists about the families, friends, and circumstances that encouraged them to enter the profession.



Mary, with her encouragers — mother, Breda, and father, John —

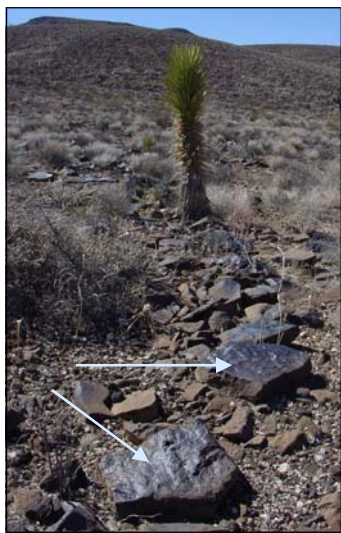
were photographed in the Wicklow Mountains of Ireland for the article since this is where she first fell in love with nature which ultimately led to her career in planetary science.

Shiny Coating on Martian Rocks Could Reveal Past *by Randall S. Perry*

The search for life on Mars always makes exciting news, and recent headlines are particularly compelling. Planetary scientists are transfixed by images returning from the Red Planet, via satellite and surface missions, suggesting that liquid water, and therefore conditions for life, were once widespread.

To transform inferences into concrete information, the European Space Agency is planning the ExoMars mission. It will include a Mars rover for robotic in situ analyses of Martian soil and will target the chemical remains of organisms which may finally confirm that Mars was once a host for alien life.

The ExoMars mission will be a forerunner for ESA's more ambitious adventure, the five-spacecraft Mars Sample Return mission. Scheduled for launch in the next two decades, Mars Sample Return will bring Martian materials back to Earth for analysis by the world's most sensitive instruments.



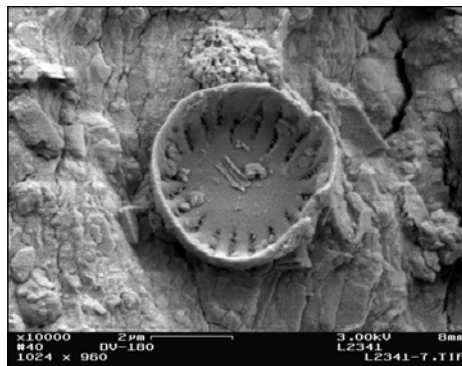
Desert-varnish-coated rocks in Death Valley National Park, west of Panamint Springs, California.

Inevitably there is much discussion about which samples to bring back. Some suggest collecting samples by drilling subsurface Martian soil since it may contain organic matter that has not been destroyed by the oxidizing, radiation-rich surface. However, I prefer a specific type of rock on or near the surface of Mars which would chronicle the history of any nearby life on the planet.

In deserts on Earth, whole mountain ranges are colored black or brown with a paper-thin, shiny coating known as desert varnish. After many years of analyzing desert varnish, I have determined that this coating is similar to opal found in hot springs. At Imperial College, University of London, using a battery of techniques including high-resolution electron microscopy, I have found that silica, rather than the more commonly described clays or metal oxides, is the most important mineral present in desert varnish. These findings, recently published in *Geology* "Baking Black Opal in the Desert Sun: The Importance of Silica in Desert Varnish," indicate that it is formed by a process which begins when moisture is trapped in depressions on rock surfaces. As other components from the environment are added, small amounts of silicic acid may be formed. Evaporation eventually causes concentrations of silicic acid, then condensation produces a gel. During gel formation, surface detrital material and organic materials are incorporated and when the gels are dried these materials are entombed in the shiny rock coating.

The silica preserves both the shapes of microbes and their chemical parts such as amino acids and various other organic compounds. Even the harbinger of life's genetic code, DNA, has been found in these materials. This molecule has been studied and detected in desert varnish by PSI Research Scientist Kim Kuhlman.

Observers have seen rocks on Mars which appear to be covered with a black shiny coating similar to desert varnish on Earth. If Martian desert-varnish-like coatings contain silica, then as on Earth it may contain ancient microbes or chemical signatures of previous life. Moreover, it is possible that on Mars the earliest formed layers may have recorded a wetter, more biologically amenable Martian environment.



Magnification of desert varnish using an electron microscope reveals an apparent diatom fossil in amazing detail! (Diatoms are single-celled algae with silica skeletons.)

Martian desert varnish may be an even better preserver of organic matter than its Earth counterpart as the current Martian environment is much colder and drier. Martian desert varnish records may also extend further back in time as physical and chemical weathering is less aggressive than on Earth. All this indicates that Martian desert varnish would be a sample worth collecting and returning to Earth.

Whichever samples are returned from Mars, they will need to be put into proper context. Here my areas of research will be useful in placing potential Martian indicators of life into the correct setting. These areas include studies of the biogenicity of microfossils in 3.6 billion-year-old sediments in western Australia, organic geochemistry of meteorites, organic chemistry of the Triassic/Jurassic mass extinction, hot-spring silica organic systems in New Zealand, and high altitude rock coatings. In addition, positive results from the Red Planet will feed into more esoteric areas of my research. Specifically, the philosophy of defining life is important for exobiological studies — for if we cannot agree on what life is, how can we be sure if it has been detected?

PSI Research Scientist Randall S. Perry contributed this article from England where he is enjoying a prestigious Royal Society Fellowship at the Impacts and Astromaterials Research Centre, Imperial College, University of London.

Director Sykes at Flag Donation Ceremony



Arizona recently passed a law requiring the display of an American flag in all public school classrooms. Since no funding was provided, PSI joined other Tucson area businesses and organizations donating flags. A presentation ceremony was held on September 11 at Presidio Schools, attended by PSI Director Mark Sykes (left) and Tucson Mayor Bob Walkup.

Nic Richmond Joins Science Staff

Nic Richmond joined PSI as an Associate Research Scientist in August 2006, while working as a Postdoctoral Research Associate at the Lunar and Planetary Laboratory, University of Arizona. Her current research interests include the magnetism of the terrestrial planets and satellites, and the application of mineral physics techniques in planetary sciences.

Nic has a broad range of interests in geology and physics. She received her PhD in Geological Sciences from the University of London, UK, in 2000. Her PhD research used computational mineral physics methods to study the effect of minor elements such as iron, manganese, and aluminum on the properties of the dominant silicate minerals that make up the Earth's mantle. As part of her PhD, Nic spent one year applying the same mineral physics methods to the study of dental materials in a joint project between University College London's Department of Physics and the Eastman Dental Institute, London.

Following a one-year position in 2000 as a Scientific Officer with the Police Scientific Development Branch in the UK, Nic left England to take a post-doctoral position in Tucson working with Dr. Lon Hood on the crustal magnetism of the Moon and Mars. While in Tucson in 2001, Nic caught the planetary magnetism bug, developed a liking for warm, dry weather and met her future husband.

For the last few years, Nic has been working on various applications of planetary magnetism on the Earth, Moon and Mars at both the University of Arizona and Scripps Institution of Oceanography, San Diego. Her current research includes the reprocessing and analysis of the Lunar Prospector magnetometer data set, with the aim of investigating the age, source materials, and origin of lunar crustal magnetic anomalies on a global scale.

Outside of research, Nic's main interest is music. She plays alto saxophone and clarinet in the Tucson Concert Band and the dance band Rhythm Gang. A recently cured arachnophobe, thanks to the London Zoo Spider Program, Nic is seen here (with a lot more hair than she currently has) holding Frieda, one of London Zoo's Mexican Red-Kneed tarantulas.



Bravo, Nic, and welcome to tarantula-free PSI!

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The *Friends of PSI* are people like you — excited by the new worlds revealed in our exploration of the solar system and beyond, seeing the Earth as a planet for the first time, and wanting to participate in the expansion of human presence beyond the Earth. PSI scientists are active participants in this adventure. They travel to remote and dangerous regions on Earth to study processes found on other planets as well. They participate in missions to the Moon, Mars, Saturn, and

asteroids. They model the formation of the solar system and how planets can grow around other stars. They identify the location and nature of space resources to sustain the expansion of permanent human presence on the Moon, Mars, and beyond.

PSI scientists are helping to create the next generation of explorers, and reaching out to the public through lectures, books, and art. Please join us in this adventure by becoming a *Friend of PSI* and renewing your membership annually.

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All of the benefits of *Supporter* plus an autographed multi-color print of an original painting by William K. Hartmann, or a signed copy of *A Traveler's Guide to Mars*, William Hartmann's beautiful and fascinating overview of modern Mars research, illustrated by detailed photographs from the Mars Global Surveyor mission.

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Thank you!

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