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Inside

Spirit nears Mars

Rover landing set for evening of Jan. 3

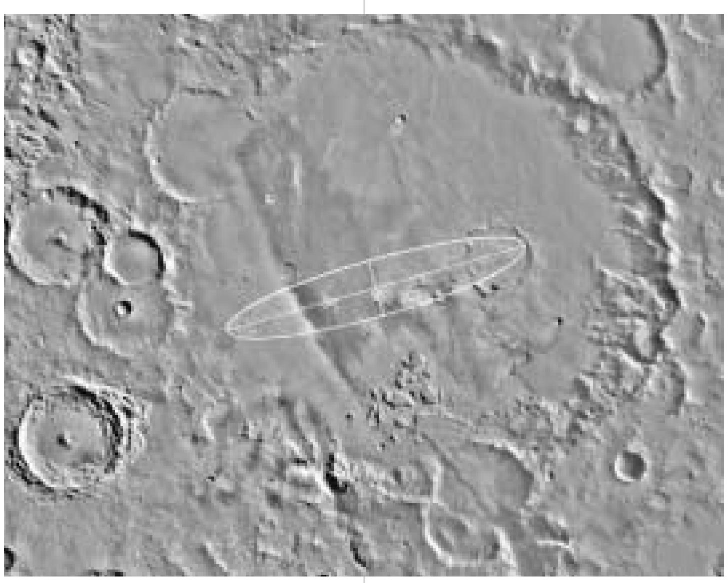
By Guy Webster

NASA'S ROBOTIC MARS GEOLOGIST, SPIRIT, EMBODYING AMERICA'S ENTHUSIASM FOR EXPLORATION, must run a grueling gantlet of challenges before it can start examining the Red Planet. Spirit's twin Mars Exploration Rover, Opportunity, also faces tough Martian challenges.

"The risk is real, but so is the potential reward of using these advanced rovers to improve our understanding of how planets work," said Dr. Ed Weiler, NASA's associate administrator for space science.

Spirit is the first of two golf cart–sized rovers headed for Mars landings in January. The rovers will seek evidence about whether the environment in two regions might once have been capable of supporting life. Engineers at JPL have navigated Spirit to arrive during the evening (in U.S. time zones) of Jan. 3.

Spirit will land near the center of Gusev Crater, a bowl bigger than Connecticut which may have once held a lake. Three weeks later, Opportunity will reach the Meridiani Planum, a region containing exposed deposits of a mineral that usually forms under watery conditions.



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Gusev Crater, the site of Spirit's Jan. 3 landing.

"We've cleared two of the big hurdles, building both spacecraft and launching them," said Mars Exploration Rover Project Manager Peter Theisinger. "Now we're coming up on a third, getting them safely onto the ground."

Since their launches on June 10 and July 7 respectively, each rover has been flying tucked inside a folded-up lander. The lander is wrapped in deflated airbags, cocooned within a protective aeroshell and attached to a cruise stage that provides solar panels, antennas and steering for the approximately seven-month journey.

Referring to Spirit, the first of the twin rovers to reach Mars, Theisinger said, "The spacecraft's performance has been excellent; the navigation has been superb."

Spirit will cast off its cruise stage 15 minutes before hitting the top of the Martian atmosphere at 5,400 meters per second (12,000 mph). Atmospheric friction during the next four minutes will heat part of the aeroshell to about 1,400 C (2,600 F) and slow the descent to about 430 meters per second (960 mph). Less than two minutes before landing, the spacecraft will open its parachute.

Twenty seconds later, it will jettison the bottom half of its aeroshell, exposing the lander. The top half of the shell, still riding the parachute, will lower the lander on a tether. In the final six seconds, airbags will inflate, retro rockets on the upper shell will fire, and the tether will be cut about 15 meters (49 feet) above the ground.

Several bounces and rolls could take the airbag-cushioned lander about a kilometer (0.6 mile) from where it initially lands. If any of the initial few bounces hits a big rock that's too sharp, or if the spacecraft doesn't complete each task at just the right point during the descent, the mission could be over. More than half of all the missions launched to Mars have failed.

"Can we guarantee success? Of course not," said JPL Director Dr. Charles Elachi. "But on the other hand, the team deserves it, because we have done everything we know that could be humanly done to ensure success. We have conducted more testing and external reviews for the Mars Exploration Rovers than for any previous interplanetary mission."

Landing safely is the first step for three months of Mars exploration by each rover. Before rolling off its lander, each rover will spend a week or more unfolding itself, rising to full height, and scanning surroundings. At approximately 174 kilograms (384 pounds), Spirit and Opportunity each weigh about 17 times as much as the Sojourner rover of the 1997 Mars Pathfinder mission. They are big enough to roll right over obstacles nearly as tall as Sojourner.

"Think of Spirit and Opportunity as robotic field geologists," said Dr. Steve Squyres of Cornell University, principal investigator for the rovers' identical sets of science instruments. "They look around with a stereo, color camera and with an infrared instrument that can classify rock types from a distance. They go to the rocks that seem most interesting. When they get to one, they reach out with a robotic arm that has a handful of tools, a microscope, two instruments for identifying what the rock is made of, and a grinder for getting to a fresh, unweathered surface inside the rock."

To coordinate their work with the rovers, flight team engineers and scientists operating the rovers from JPL will be living on "Martian time" as well.

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Stardust's big day also approaches

Flyby, sample collection on Jan. 2

By D.C. Agle

FORTY-NINE DAYS BEFORE ITS HISTORIC RENDEZVOUS WITH A COMET, JPL'S STARDUST spacecraft successfully photographed its quarry, comet Wild 2 (pronounced Vilt-2), from 25 million kilometers (15.5 million miles) away. The image, the first of many comet portraits it will take over the first four weeks of December, will aid Stardust's navigators and scientists as they plot their final trajectory toward a Jan. 2 flyby and collection of samples from Wild 2.

"Christmas came early this year," said Project Manager Tom Duxbury. "Our job is to aim a 5-meter-long (16-foot) spacecraft at a 5.4-kilometer wide (3.3 mile) comet that is closing on it at six times the speed of a bullet. We plan to 'miss the comet' by all of 300 kilometers (188 miles), and all this will be happening 389 million kilometers (242 million miles) away from home. By finding the comet as early and as far away as we did, the complexity of our operations leading up to encounter just dropped drastically."

The ball of dirty ice and rock, about as big as three Brooklyn Bridges laid end-to-end, was detected on Nov. 13 by the spacecraft's optical navigation camera on the very first attempt. The set of images was stored in Stardust's onboard computer and downloaded the next day where mission navigator Dr. Shyam Bhaskaran processed them and noticed a white blob of light bisecting the base of a triangle made by three stars Stardust uses for deep space navigation.

"When I first looked at the picture I didn't believe it," said Bhaskaran. "We were not expecting to observe the comet for at least another two weeks. But there it was, very close to where we thought it would be."

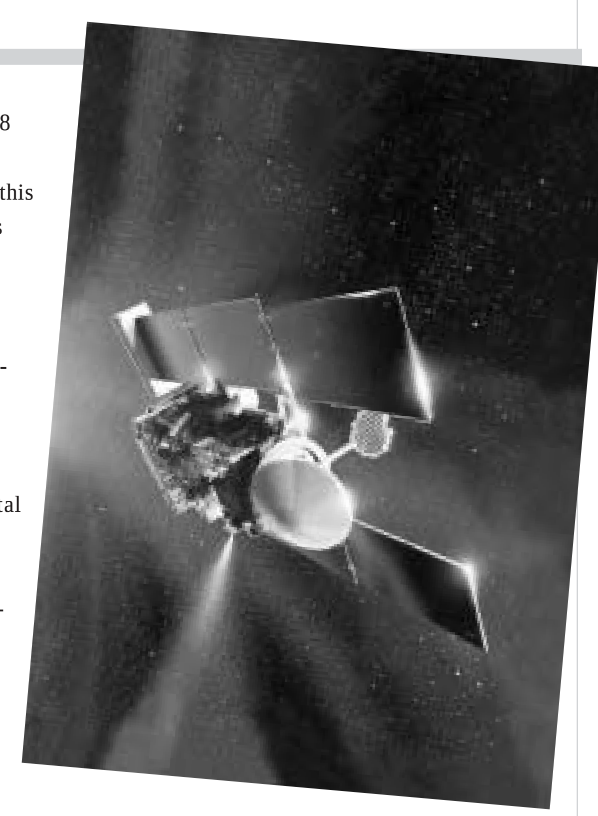
The Wild 2 sighting was verified on Nov. 18 using the second set of optical navigation images downloaded from Stardust. To make this detection, the spacecraft's camera saw stars as dim as 11th visual magnitude, more than 1,500 times dimmer than a human can see on a clear night.

The early detection of Wild 2 provides mission navigators critical information on the comet's position and orbital path. Future optical navigation images will allow them to do more fine-tuning. In turn, these new orbital plots will be used to plan the spacecraft's approach trajectory correction maneuver.

A trajectory correction maneuver successfully executed on Dec. 3 placed Stardust on a trajectory that is a little inside the 300 kilometer flyby distance planned for Comet Wild 2. Three more such maneuvers are planned during the next month.

Unlike other orbiting bodies, the paths of comets cannot be precisely predicted because their orbits about the Sun are not solely determined by gravity. The escape of gas, dust and rock from comets provides a "rocket effect" that causes them to stray from a predictable orbital path. The actual orbital path cannot be precisely determined from Earth-based telescopes because the comet is shrouded in a cloud of escaping gas and dust. What is seen from Earth is not the actual 5.4 kilometer–wide (3.3 mile) body composed of rock and ice, but the cloud of debris and gas that envelops it.

"With these images we anticipate we will flyby comet Wild 2 at an altitude of 300 kilometers, give or take about 16 kilometers," added



Bhaskaran. "Without them, we wouldn't be able to safely get any closer to the comet than several thousand kilometers."

Stardust will return to Earth in January 2006 to make a soft landing at the U.S. Air Force Utah Test and Training Range. Its sample return capsule, holding microscopic particles of comet and interstellar dust, will be taken to the planetary material curatorial facility at Johnson Space Center, where the samples will be carefully stored and examined.

Stardust's cometary and interstellar dust samples will help provide answers to fundamental questions about the origins of the solar system. For more information on the mission, visit *http://stardust.jpl.nasa.gov*.

News Briefs

Lab's small-business efforts lauded

JPL has received honors from NASA and the U.S. Small Business Administration for its work with small, small disadvantaged and women-owned businesses.

Stan Jankowski (left)

Fred McNutt (right)

SBA Administrator HECTOR BARRETO recently presented the annual Dwight D. Eisenhower Award for Excellence to STAN JANKOWSKI, manager of JPL's Acquisition Division, at the SBA's National Entrepreneurial Conference and Award Luncheon in Washington, D.C. The award recognized JPL for its outstanding work in the Research and Development category for 2002-03.

The award is named after the former president in recognition of his support of small business and establishment of the SBA in 1953. JPL was selected from prime contractors nationwide and commended for its program and services in the utilization of small business as suppliers and subcontractors to JPL and to its programs in support of NASA.

TOM MAY, manager of the Business Opportunities Office, directs JPL's Small Business Program. He expressed thanks to the hundreds of JPL technical and acquisition personnel and to Business Opportunities staff who contributed to JPL's success in this area.

And NASA's Office of Small and Disadvantaged Business Utilization has bestowed its annual achievement award to JPL for fiscal year 2003. JPL was one of four NASA centers to be recognized for meeting its small, small disadvantaged and women-owned business goals for FY 2003. JPL Associate Director and Chief Financial Officer FRED MCNUTT received the award from NASA Deputy Administrator FRED GREGORY in an awards ceremony at the NASA Minority Business and Advocates Conference.

JPL goals for socio-economic business participation from small business are established annually by JPL under the NASA prime contract. The Lab has met or exceeded these goals for the last six fiscal years.

Three named IEEE Fellows

Tom Cwik

Harold Kirkham

Richard Murray

Three JPLers have been elected Fellows of the Institute of Electrical and Electronics Engineers (IEEE).

DR. TOM CWIK, manager of Earth Science Instruments and Technology (Section 834) and manager of Advanced Instruments (832), received his honor for contributions to computational techniques in large-scale e lectromagnetic modeling and analysis. He joined the Lab in 1988.

DR. HAROLD KIRKHAM, a Principal in the Power Systems Group, Power and Precision Conversion Systems and Technology Section 346, was recognized for his leadership in developing optical measurements for power systems. He has worked at JPL since 1979.

DR. RICHARD MURRAY, a consultant to the Office of the Chief Technologist (130) and chairman of Caltech's Division of Engineering and Applied Science, was cited for contributions to the theory of nonlinear control and its applications to robotics, flight control and fluid systems.

Force on asteroids detected

NASA scientists have for the first time detected a tiny but theoretically important force acting on asteroids by measuring an extremely subtle change in a near-Earth asteroid's orbital path. This force, called the Yarkovsky Effect, is produced by the way an asteroid absorbs energy from the sun and re-radiates it into space as heat. The research will impact how scientists understand and track asteroids in the future.

Asteroid 6489 "Golevka" is relatively inconspicuous by near-Earth asteroid standards. It is only one half-kilometer (.33 mile) across, although it weighs in at about 210 billion kilograms (460 billion pounds). But it is also relatively well characterized, having been observed via radar in 1991, 1995, 1999 and this past May. An international team of astronomers, including researchers from JPL, have used this comprehensive data set to make a detailed analysis of the asteroid's orbital path. The team's report appears in the Dec. 5 issue of Science.

"For the first time we have proven that asteroids can literally propel themselves through space, albeit very slowly," said JPL's DR. STEVEN CHESLEY, leader of the study.

The idea behind the Yarkovsky Effect is the simple notion that an asteroid's surface is heated by the sun during the day and then cools off during the night. Because of this the asteroid tends to emit more heat from its afternoon side, just as the evening twilight on Earth is warmer than the morning twilight. This unbalanced thermal radiation produces a tiny acceleration that has until now gone unmeasured.

"The amount of force exerted by the Yarkovsky Effect, about an ounce in the case of Golevka, is incredibly small, especially considering the asteroid's overall mass," Chesley said. "But over the 12 years that Golevka has been observed, that small force has caused a shift of 15 kilometers (9.4 miles). Apply that same force over tens of millions of years and it can have a huge effect on an asteroid's orbit. Asteroids that orbit the Sun between Mars and Jupiter can actually become near-Earth asteroids."

The Yarkovsky Effect has become an essential tool for understanding several aspects of asteroid dynamics.

Michael Pelletier

Pelletier receives honors

MICHAEL PELLETIER of the Intelligent Instruments and Technology Group (3847) was recently honored at the annual conference of the Federation of Analytical Chemistry and Spectroscopy Societies. He received the Charles Mann Award for "achievements in the field of applied Raman spectroscopy and dedication to the advancement of Raman spectroscopy."

Pelletier joined JPL July 2002 and has worked on the Non-Invasive Glucose Analysis Project and on the Mars Organic Detector Project.

Honorary doctorate awarded

Rob Green

DR. ROBERT GREEN, experiment scientist for the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS), has been awarded an honorary doctorate by Universidad Extremadura, Caceres, Spain, for scientific contributions to the field of imaging spectroscopy.

Green has pursued imaging spectroscopy research at JPL since 1988.

New map for atmosphere created

NASA scientists have opened a new window for understanding atmospheric water vapor, its implications for climate change, and ozone depletion.

The scientists have created the first detailed map of water containing heavy hydrogen and heavy oxygen atoms in and out of clouds, from the surface of Earth to some 25 miles upward, to better understand the dynamics of how water gets into the stratosphere.

"For the first time, we have water isotope content mapped in incredible detail," said JPL senior research scientist DR. CHRISTOPHER WEBSTER, principal author of a scientific paper announcing the new findings in the journal Science.

Only small amounts of water reach the arid stratosphere, 10 to 50 kilometers (6 to 25 miles) above Earth, so any increase in the water content could potentially lead to destruction of some ozone-shielding capability in this part of the atmosphere. This could produce larger ozone depletions over the North and South Poles as well as at mid-latitudes.

Heavy water is more readily condensed or frozen out from its vapor, causing the nature of its distribution to differ somewhat from the usual isotopic form of water. A measurement of the isotopic make-up of water vapor enables scientists to determine how water gets into the stratosphere.

Measuring water isotopes is extremely challenging, because they represent only a small fraction, less than 1 percent, of the total water in the atmosphere. Detailed measurements were made using an Aircraft laser infrared absorption spectrometer (Alias) flying aboard NASA's WB-57F high-altitude jet aircraft in July 2002. This new laser technique enables mapping of water isotopes with sufficient resolution to help researchers understand both water transport and the detailed microphysics of clouds, key parameters for understanding atmospheric composition, storm development and weather prediction.

"The laser technique gives us the ability to measure the different types of isotopes found in all water," Webster said. "With the isotopic fingerprint, we discovered the ice particles found under the stratosphere were lofted from below, and some were grown there in place."

The data help explain how the water content of air entering the stratosphere is reduced, and show that gradual ascent and rapid upward motion associated with tall cloud systems (convective lofting) both play roles in establishing the dryness of the stratosphere.

Wishing you & your family a joyous holiday season

Courtesy of Henry Kline

Special Events Calendar

Ongoing Support Groups

Alcoholics Anonymous—Meetings are available. Call the Employee Assistance Program at ext. 4-3680 for time and location.

Caregivers Support Group—Meets the first Thursday of the month at noon in Building 167-111 (the Wellness Place). For more information, call the Employee Assistance Program at ext. 4-3680.

Codependents Anonymous—Meeting at noon every Wednesday. Call Occupational Health Services at ext. 4-3319.

Gay, Lesbian and Bisexual Group—Meets the first Friday and third Thursday of the month at noon in Building 111-117. Call the Employee Assistance Program at ext. 4-3680 or Randy Herrera at ext. 3-0664.

Parents Group for Children With Special Needs—Meets the second Thursday of the month at noon in Building 167-111 (the Wellness Place).

Working Parents Support Group—Meets the third Thursday of the month at noon in Building 167-111. For more information, call the Employee Assistance Program at ext. 4-3680.

Friday, December 12

TIAA/CREF Enrollment Meeting—This noon workshop in Trailer 1720-137 will assist employees newly eligible for the Caltech/JPL retirement plan with selection of investment options and completion of enrollment forms.

Von Kármán Lecture Series—Dr. John Trauger, JPL senior research scientist, Division of Earth and Space Science, will present "Pointing the Way to Exoplanetary Systems: New Initiatives in Space Astronomy and the Legacy of the Hubble Space Telescope" at 7 p.m. in Pasadena City College's Vosloh Forum, 1570 E. Colorado Blvd. For more information, visit *http://www.jpl.nasa.gov/events/lectures/dec03.html.*

Saturday, December 13

Children's Holiday Party—The Caltech Women's Club sponsors this potluck, held from 11a.m. to 2 p.m. at Caltech's Winnett Lounge. Bring your family and your favorite dish to share; the club will provide the paper products and beverages. The event also includes holiday crafts for children and storytelling.

Sunday, December 14

"Upright: The Evolutionary Key to Becoming Human"—Dr. Craig Stanford, co-director of the Goodall Primate Research Center and professor of biological anthropology at USC, will speak at this Skeptics Society–sponsored lecture held at 2 p.m. in Caltech's Baxter Lecture Hall. Free for Caltech/JPL community. For more information, call (626) 794-3119.

Mon., Dec. 15–Wed., Dec. 23

JPL Store Hours—The store will expand its hours of operation to 8:30 a.m. to 5:30 p.m.

Friday, December 19

Salary Reduction Agreements—Today is the deadline to submit deferral amounts for 2004 Tax-Deferred Annuities. For more information, call the Benefits Office at ext. 4-3760.

Saturday, December 20

Folk Music—Cyntia Smith and the Lilies, with special guest Joellen Lapidus, will perform a Winter Solstice Wassail Concert at 8 p.m. in Caltech's Beckman Institute Auditorium. The group performs an eclectic blend of folk, archaic, ethnic, pop, flamenco, and original music. Tickets are $15 for adults, $5 for children under 12. For more information, call (626) 395-4652 or check the Folk Music Society website at *http://www.folkmusic.caltech.edu.*

Wednesday, December 31

Volunteer Professionals for Medical Advancement—Meeting at 10:30 a.m. at the Caltech Credit Union, 528 Foothill Blvd., La Cañada.

Tuesday, January 6

JPL Gamers Club—Meeting at noon in Building 301-227.

JPL Genealogy Club—Meeting at noon in Building 301-271.

Wednesday, January 7

Associated Retirees of JPL/Caltech—Meeting at 10 a.m. at the Caltech Credit Union, 528 Foothill Blvd., La Cañada.

Thursday, January 8

JPL Gun Club—Meeting at noon in Building 183-328.

Space leaders meet

Dr. Conrado Varotto (right), director of the Argentine Space Agency, chats with JPL Deputy Director Gene Tattini during a November visit to the Lab. Varotto also met with Dr. Diane Evans, Earth scientists, and other members of the Earth Science and Technology Directorate. Past (SAC-C), current (Aquarius), and potential future collaborations between Argentina and JPL were discussed, and Varotto was given a tour of the Mars Yard and Solar System Visualization.

NASA aids European Mars mission

A EUROPEAN SPACE AGENCY MISSION that will arrive at Mars this month has American participants, and Europeans are team members for two NASA spacecraft that will reach Mars in January.

The European Space Agency's Mars Express and NASA's twin Mars Exploration Rovers will examine the red planet in quite different and complementary ways. "Together, these missions can provide a range of new information about Mars that neither could provide alone," said Dave Lavery, NASA Headquarters program executive for the Mars Exploration Rovers and for NASA's participation in Mars Express. "Historically, there have been only three successful landings on Mars. In the span of only one month, we may double that number, and our knowledge of Mars may increase even more."

Mars Express is expected to release part of its payload, the Beagle 2 lander, on Dec. 19. On Christmas Eve (in U.S. time zones), Beagle 2 will parachute to the Martian surface, and Mars Express will enter orbit around the planet. Beagle 2 will use analytical tests and a robotic arm to search for evidence of past or present life at its landing site. The orbiter will use seven instruments to study Mars' atmosphere, structure and geology. The science teams for Beagle 2, and for every instrument on Mars Express, include U.S. researchers. Two instruments on Mars Express have components from U.S. partners in the mission.

The Beagle 2 team plans to use JPL's Mars Odyssey orbiter to relay communications to Earth on the lander's arrival day and in subsequent weeks.

The U.S. role in Mars Express includes navigational support and software developed at JPL and communications support from the JPL-managed Deep Space Network. One of the Mars Express instruments, with U.S. components, will use radar to seek evidence of underground water, either frozen or liquid.

"This will be the first attempt to study layers far below Mars' surface," said JPL's Dr. William Johnson, manager for the instrument, which was built under the leadership of Dr. Giovanni Picardi, University of Rome, La Sapienza. The instrument, the Mars Advanced Radar for Subsurface and Ionosphere Sounding, is designed to discern boundaries between layers as deep as 5 kilometers (3 miles) under the surface. It will also examine the structure and variability of the Martian ionosphere, the top layer of the atmosphere. The University of Iowa built the transmitter for the radar instrument. JPL built the receiver. Astro Aerospace of Carpinteria, Calif., built the 40-meter (131-foot) antenna. Italy provided the instrument's digital processing system and software and integrated the parts.

The other Mars Express instrument with key NASA-funded components is the Analyzer of Space Plasma and Energetic Atoms. It will examine interactions between the Martian atmosphere and the solar wind of charged particles speeding away from the Sun. Southwest Research Institute, San Antonio, Texas, built two sensors for it, an electron spectrometer and an ion mass analyzer.

Europe provided important tools on the Mars Exploration Rovers. The German Space Agency and the Max Planck Institute for Chemistry, Mainz, Germany, supplied each rover's alpha particle X-ray spectrometer instrument. The German Space Agency and the University of Mainz supplied the Mossbauer spectrometer. The Neils Bohr Institute, Copenhagen, Denmark, supplied the magnet array for observation by rover cameras. Plans call for Mars Express to relay signals from a NASA rover at least once. In addition, Europeans make up about one-sixth of the members of the rovers' science team.

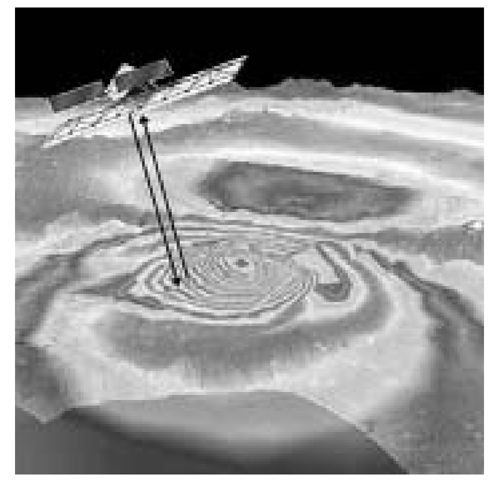
For information about Mars Express, visit *http://sci.esa.int/home/marsexpress;* about its radar experiment, visit *http://www.marsis.com*

Progress, promise in space-based quake research

By Alan Buis

NEARLY 10 YEARS AFTER LOS ANGELES was shaken by the devastating, magnitude 6.7 Northridge earthquake, scientists at NASA and other institutions say maturing space-based technologies, new ground-based techniques and more complex computer models are rapidly advancing our understanding of earthquakes and earthquake processes.

Dr. Andrea Donnellan, a geophysicist and deputy manager of JPL's Earth and Space Sciences Division, says the past decade has seen substantial progress in space-based earthquake research. "We've confirmed through space observation the Earth's surface is constantly moving, periodically resulting in earthquakes, and we can measure both the seismically quiet motions before and after earthquakes, as well as the earthquakes themselves. These technologies are allowing us to pursue lines of data and research we didn't know existed only a few years ago."



Radar image shows ground deformation after an earthquake.

Two months before the Northridge earthquake, Donnellan and university colleagues published a paper in the journal Nature on ground deformation north of Los Angeles' San Fernando Valley. Six years of Global Positioning System (GPS) data showed the area's faults were active and building up strain, and indicated the size and style of a potential earthquake there. Following the earthquake, the data made it possible to rapidly determine where the fault ruptured and to measure how the earthquake had deformed Earth's surface.

Space-based instruments can image Earth movements to within fractions of an inch, measuring the slow buildup of deformation along faults, and mapping ground deformation after an earthquake. Two primary tools are the space-based GPS navigation system and Interferometric Synthetic Aperture Radar (InSAR). The latter compares satellite radar images of Earth taken at different times to detect ground movement.

InSAR complements surface measurements because it lets us look at whole regions in a spatial context. An InSAR mission is also a key component of EarthScope, a jointly led initiative by the National Science Foundation, NASA and the U.S. Geological Survey.

EarthScope studies the North American continent's structure and evolution, and the physical processes that control earthquakes and volcanic eruptions, according to Dr. James Whitcomb, section head for Special Projects, Earth Sciences Division, National Science Foundation, Arlington, Va.

Precise Earth surface-movement data measure strain and provide a first approximation of where earthquakes are likely to occur, notes Dr. Brad Hager, a Massachusetts Institute of Technology professor and co-author of the 1993 Nature paper. "In California, patterns of ground deformation are complicated by the complex interactions between fault systems. Interpreting this data requires computer models that can estimate how much deformation has accumulated and identify regions where strain should be released, but hasn't been."

University of California, Davis, researcher Dr. John Rundle says the complexity of earthquakes requires they be studied as part of the full Earth system. "Most natural events result from interrelated Earth processes over various lengths and times. These processes have variables that can't be readily observed, so understanding them requires computers."

NASA's QuakeSim project is developing a similar forecasting methodology. Its tools simulate earthquake processes, and manage and model the increasing quantities of data available. "We're focusing on observing and understanding earthquakes in space and time, and developing methods that use patterns of small earthquakes to forecast larger ones," Rundle explains. "New simulations of earthquakes on California's active faults are providing considerable insight, showing earthquakes tend to "cluster" in space and time due to their interactions. That is, an earthquake on one fault section can turn on or off earthquake activity on nearby fault sections, depending on the relative orientation of the faults. Simulations have led researchers to conclude that fault system geometry determines earthquake activity patterns."

A NASA/Department of Energy–funded research team reports promising results from an experiment to forecast earthquakes in southern and central California from 2000 to 2010. It uses mathematical methods to forecast likely locations of earthquakes above magnitude 5 by processing data on earthquakes of about magnitude 3 from the past decade. The high-risk regions identified in the forecast are refined from those already identified by the government as susceptible to large earthquakes. Five earthquakes greater than magnitude 5 have occurred since the research was completed, all in those high-risk regions.

Dr. Wayne Thatcher, a senior research geophysicist at the U.S. Geological Survey, Menlo Park, Calif., says as these technologies are validated they will be transferred to end users. "Such data and models improve understanding of earthquake and volcanic processes, substantially refining seismic hazard maps and resulting in more appropriate, earthquake-resistant construction codes and more targeted retrofitting strategies."

Spirit

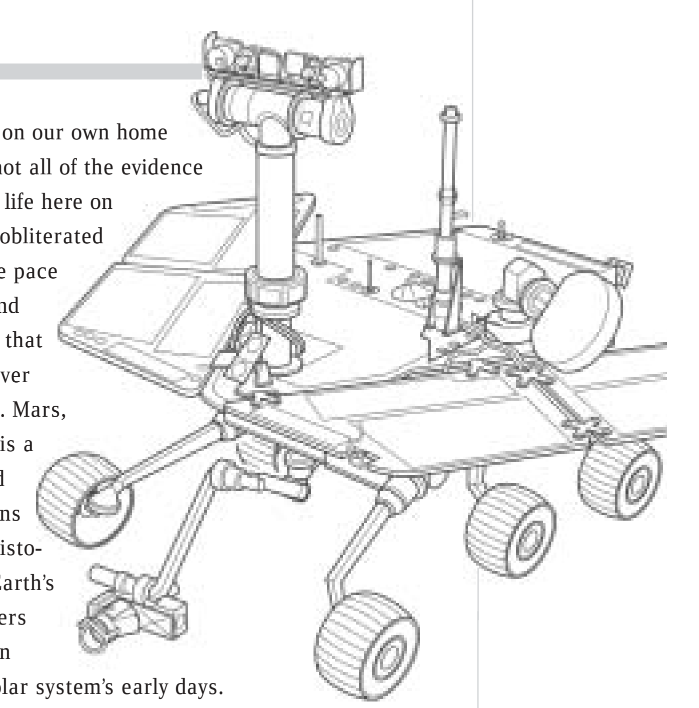
Continued from page 1

The 39 1/2–minute difference from Earth's day length means that, by about two weeks after the rovers land on Mars, team members' wake-up times and meal times will have shifted by about 9 hours.

Added Weiler: "One of NASA's three prime goals is the search for life; on Earth, water is the key to life. Where there is water on Earth, we find life, wherever that water is. Mars Odyssey has shown us that there's lots of frozen water on Mars, especially above 60 degrees north latitude and below 60 degrees south latitude.

"But life can't just exist in water; water has to persevere for a length of time so life can have a chance to come into being and hopefully evolve. These rovers will look for clues of the perseverance of water in the past. They will answer questions about whether the surface was once suitable for life, and if successful, Spirit and Opportunity will help humans take a giant leap forward in our understanding of Mars' potential as a site for past or current life."

Even if we ultimately learn that Mars never harbored life as we know it here on Earth, scientific exploration of the Red Planet can assist in understanding the history and evolution of life on our own home world. Much if not all of the evidence for the origin of life here on Earth has been obliterated by the incredible pace of weathering and global tectonics that have operated over billions of years. Mars, by comparison, is a composite world with some regions that may have histories similar to Earth's crust, while others serve as a frozen gallery of the solar system's early days.



Thus, even if life never developed on Mars—something that we cannot answer today—scientific exploration of the planet may yield critical information unobtainable by any other means about the pre-biotic chemistry that led to life on Earth. Mars as a fossil graveyard of the chemical conditions that fostered life on Earth is an intriguing possibility.

Passings

ART LANDSGAARD, 72, retired safety tower operator at JPL's Edwards Air Force Base facility, died Nov. 4.

Hired in 1968, Landsgaard also worked at JPL in Pasadena. He is survived by his wife, Marion, their 11 children and their families.

Services were held at Good Shepherd Cemetery in Quartz Hill. In lieu of flowers, tax-deductible donations designated for cancer research or academic scholarships can be made to the Rosamond Rotary Foundation.

FRED GERBRACHT, 77, a retired engineer from the former Design Engineering Services Section 356, died Nov. 15 in Covina.

Gerbracht, who designed rocket engines, joined the Lab in 1957 and retired in 1989.

He is survived by his wife, Rosemarie; sons Kirk and Mark; daughter Carrie Baugus; and six grandchildren.

Services were scheduled for Nov. 21 at Forest Lawn in Covina Hills.

RICHARD HAGA, 66, retired technical group supervisor in Section 341, died Nov. 20.

Haga joined JPL in 1969 and had been on long-term disability since 1996. He retired in 2002. He is survived by his wife, Sharon, sons Roger and Gregory, daughter Christy and four grandchildren.

Services were private.

Letters

The strength we have gathered through everyone's support has helped each of us make it through a difficult time. Our family, Larry, Linda, Tim, Tiffany and Jenifer, thank each of you for your thoughts and prayers as we bid adieu to our son, brother, and husband: 1LT Todd J. Bryant. The wreath you sent was especially bright and cheery, just as we will always remember Todd. Thank you.

Larry Bryant

On behalf of my family and myself, I would like to express my deep appreciation to my friends in Section 312 and elsewhere in JPL for their thoughts, flowers and hospice contributions following the recent illness and passing of my mother.

Dennis Byrnes

My family and I would like to thank all my friends and coworkers for their kind and caring thoughts after the recent passing of my dad. The plant you sent will be a wonderful living memorial. Your support was greatly appreciated.

Glenn Tsuyuki, Section 353

Retirees

The following JPL employees retired in December:

Dominick Panzarello, 35 years, Section 252; Charles Porter, 31 years, Section 353; Ronald Hellings, 25 years, Section 312; B.C. Lathrop-Pino, 23 years, Section 211.

Classifieds

For Sale

BABY CRIB, maple, Sears mattress, new, used 5 times, $50; hi-chair, folds-up, exc. cond., $10; $55 for both. 626/864-4194.

BABY CRIB + CHANGING TABLE, w/mattress, pad + bumper pad, light oak finish, exc. cond., $185. 626/446-1140.

BABY ITEMS: crib, wood, made in Italy, incl. mattress, height adjustable, exc. cond., $150/obo; car seat, front-facing, up to 40 lbs., made by Century, gd. cond., $25/obo. 626/791-6101.

BASKETBALL HOOP, portable, $65. 626/289-8799.

BED, antique, called "Trailing Vine," brass and iron, ca. 1885, made by Indiana Iron Foundry, bed has recently been repainted and brass re-polished, would make a terrific child's bed or a wonderful Christmas present, $1,500/obo. 249-0453, between 5-9, or jkbonner@gte.net.

BEDROOM FURNITURE: full- to queen-size headboard, 6-drawer dresser with tall mirror, 2-drawer nightstand, walnut-colored oak, excellent condition, $200/obo. 626/798-4821.

BOOK CASE, mahogany, solid wood, 4 shelves, 72"x 36", $45. 970-8456, Steve.

BOOKS: WWII collector's technical "Applied Electronics" by MIT staff, publisher John Wiley, $12; have other technical books; "Big Band Almanac" w/profuse pictures + descriptions of all Big Bands, musicians and singers from the '30s thru the '60s, vg cond., $10. 626/793-1895.

BOOTS, leather, size 6, blk., worn once, paid $129, sell for $50. 626/487-2663.

BUNK BEDS, twin on top, queen bottom, cobalt blue metal frame, exc. cond., $200, great for kids. 626/289-8799.

CARD SHUFFLER, Johnson, collectible item, all-metal construction w/exception of friction wheels which drive the cards & the carved-wood dowel handles, stands 6" handle-high & 9" by 6", flanges & handle inclusive, $35; DIET TAPES, Jenny Craig, set of 14, $50. 790-3899.

CLOTHES, men's; down-filled jacket, ski or cold weather, clean, gd. cond., size 40 long, $100 value, $25/obo; dinner jacket, burgundy, like new, for any formal occasion, size 40 long, $25/obo. 626/793-1895.

COMPUTER, HP Pavilion, 333 MHz, 15" monitor, standard built-ins, $195. 952-8455.

COMPUTER ARMOIRE, cherry wood, like new, $575/obo. 247-4505.

COMPUTER DESK/CART, mobile, cherry veneer, O'Sullivan, model 61925, exc. cond., bought for $120, sell for best offer. 626/449-0997.

CUPBOARD, antique, 18th century vitrine, dark oak, recently appraised at $3,000, best offer; pictures: http://www.e-neighborhood.net/neighborhood/vitrine. 626/568-9890, Tracy.

DINING ROOM SET, marble table top, china cabinet, blk. laquor, exc. cond., like new, $300. 241-6801.

DRUM SET w/double peddle base, $250/obo. 626/447-4734.

FURNITURE: sofa, new, blk., leather, $500; din. rm. cabinet, 10' long, 30" height, custom, cherry, $300; wall unit, redwood, contains locking cabinets & shelves, $150; coffee table, glass and chrome, $80. 661/286-1038.

FURNITURE: desk, hand carved, oak, + 2 matching bookcases, $570; library desk, mission, $375; office furn.: Techline, white, 6 pc., $350; hall table, drop leaf, $200; mirror, tall, wood-framed, $25; rug, Spanish, hand- made, exc. cond., 7 x 9, $250; Nordic Track, orig., $30. 626/584-0860 or 626/794-3144, Donna.

FUTON, highest quality, qn.-size, mission style, w/southwest design cover, purchased for $1,200+, gd. to vg cond., pictures at http://www.ginkoleaf.net/futon, $300. 626/798-4265.

FUTON CHAIR, w/frame + ottoman, 39" wide, gd. cond., pictures available, $150/obo. 323/656-8602, Randy.

GUITAR BOOK, Oregon Catholic Press, for mass, Christian service, Vol. I and II, with binder, barely used, purchased this year, $40/obo. 626/840-0955.

HOCKEY TICKETS (2), Kings season ticket holder selling individual games, $100 for 2 tickets in the lower bowl. 626/852-0821.

LEAF BLOWER, gas, Echo PB1000, $80. 246-2319, leave message.

MISC: air cleaner, Sears, Hepa, like new, $60; carving knife, electric, $5; stepstool, $5. 626/355-6923.

MISC: red wig, shoulder length, $20; tablecloths, 2, slate blue, oval, 18 matching napkins and rings, $10; car creeper, Huffy, $10; shovels, $2 ea; hoe, $5; punch bowl set, 18 pc., $10; mailbox, oversized, green, $20; sytch, cuts tall grass, pd $54 in 1970, sell $10. 626/357-8210.

MISC: ski boots, ladies, rear entry, Rossingol, size 8, $40; gas grill, CharBroil Master Flame, $75; Nokia 5190 w/hands-free speaker/charger and Body Glove cover, no house charger, $30; ring, ladies, 10K, diamond chip, gift box incl., $90. 897-1203.

MONITOR, Philips 15," new cond., and/or HP 3200C scanner, $60 for both/obo. 626/836-6667, Leo.

MOVING SALE: Meticulous owner moving to NYC: 2 JVC 13" color TVs, 18.7 cu. ft. side-by-side GE refrigerator, Pentax 35mm camera, stuffed chair, ironing board, Ikea TV stand, Ikea floor lamp, cloth covered desk chair, Eureka Whirlwind Hepa upright vacuum, floral dish set, Braun hand held mixer/combo, metal clothes drying rack, inflatable mattr., baseball glove. thobedk@hotmail.com for pics/prices.

PIANO, Yamaha C3, grand, 6 ft., polished ebony, exc. cond., MSRP $32,495, sacrifice, $11,000; PORT REPLICATOR for IBM Thinkpad, works with T20, T21, A20, A21, or X, R series, like new, $85. 790-3899.

RUG, oriental, barely used, 8x4, dark blue with white and pink floral patterns, $50/obo. 626/840-0955, msg.

SKI RACK, used once, $25; SKI BOOTS, men's, 1 pair, used once, $25, exc., cond. 626/449-6799, Bob.

SKIS/BOOTS/POLES for child, cross-country, skis are about 60" tall, boots are about size 1, exc. cond., $23. 952-8455.

SOFA/LOVESEAT, Rattan, 2 yrs. old, like new, bright floral pattern, paid $800, sell $500/obo. 707-2356.

SOFA BED, very comfortable both as couch and bed, bed hardly used, you remove, $200. 626/577-6638, Suzanne.

TOY TRAIN: Thomas Tank Engine, mining set, Sodor, wooden, with toy box, #09777, www.learningcurve.com, brand new, never opened, incl. coal station, water tower, arched viaduct, single stone tunnel; trains: Thomas, Percy, James w/coal car, Rickety, handcar, Wilbert and Sodor China clay cars; $200/obo. 720-8455.

TOOLS (25) for home shop, $200 value for $65, may be bought individually. 626/793-1895.

TREES, red banana plant, 5' tall, $60/obo; fish tail, 6' tall, $80/obo; ficus, 10' tall, braided, in 30" plastic pot, $250/obo; CERAMIC BOWL, gray, 2' diameter with planted geraniums, $40/obo. 626/791-6101.

TV, 20", stereo, color, w/remote & manual, vg cond., San Gabriel area, $60. 626/287-6148.

TELEVISIONS (3), Sony Trinitron; two 26" with cabinet stands, one white 17," $50 each; COMPUTER, Compaq Pentium 2 with Sony 17" monitor, $100; COMPUTER TABLE, triangular corner unit, $20. 626/836-9577, before 9 p.m.

Vehicles / Accessories

'97 BMW 328i, 6 cyl., 2.8 L, auto, 56K mi., 4 dr., sports pkg., leather, pwr. everything, sunroof, CD changer, $14,500/obo. 626/862-3744.

'66 CADILLAC Fleetwood, great restoration vehicle, has all its parts, $1,200/obo. 626/705-1312, Saitiel.

'95 FORD Explorer XLT 4W dr., pwr. steering/windows/locks/seats, multi-CD/cass., front & rear air, tilt whl., cruise cont., 99K mi., $7,500/obo. 626/794-8731 eve., 818/426-6371 day.

'03 HONDA Accord, loaded, exc. cond., gold, metallic, 20K mi., $18,000. 667-5569.

'00 HONDA Insight, 22,000 miles, 5-spd., 55-60 mpg, 6-disc CD changer, extra speakers; with the money I saved on gas in the last few years I can now afford a sport car, you too can do the same, $10,500. 653-8204, Buck.

'97 HONDA Valkyrie motorcycle, exc. cond., many extra chrome parts, garage kept, 23K mi., leather bags, studded seats, purple/white, showroom cond., $7,500/obo. 957-2852.

'89 HONDA Accord Coupe LXI, original owner, 213K mi., good cond., new a/c, manual transmission, roof needs some paint work, pictures available, $1,300/obo. 323/656-8602, Randy.

'67 JEEPSTER Commando, exc. cond., new front end, tires and disc brakes, forest green, 3 spd., manual, removable hardtop, $7,200. 951-1979, Steve.

'90 LINCOLN Mark VII, 5.0, V8, loaded, electric everything, keyless entry, silver with gray leather interior, runs very well, looks great, always garaged, oil changed every 3,000 mi., 106,700 mi., needs a/c work & parking brake sometimes sticks; http://home.comcast.net/~imsteve/wsb/html/view.cgi-photos.html-.html for pictures, $2,600/obo. 429-5506.

'99 MAZDA Miata MX-5, convertible, 2 dr., 4 cyl., 1.8 L, automatic, loaded with a/c, power steering, tilt wheel, cruise, am/fm/CD, dual front airbags, in pristine cond., blk. exterior and tan leather interior, only 28K mi., but must sacrifice at $12.5K/obo. 249-9437, eves.

'87 MERCEDES 300E Autobahn Special, new front tires, brakes, muffler, rebuilt transmission, new shocks, injectors, cap, rotor, wires, battery, alternator, water pump, radiator, etc., $5,185. 626/484-9257.

'71 OLDSMOBILE Cutlass Supreme, fresh 350 with cam/intake/carb/exhaust, new transmission, B&M floor shifter, mag wheels, clean, $10,000/obo. 636-7323, Mike.

'95 SATURN SC2 sporty coupe, red, auto, a/c, cruise, leather interior, hatchback, fold-down back seats, 1 owner, great shape, 100K mi., $2,800, 3KDZ017. 353-4242.

'93 SATURN SW2 station wagon, blue, 71K miles, good cond., must sell, $2,600 obo. 626/584-1164.

'89 SHELBY CXS turbo, #192 of 500, high performance, collector's car, 53K easy mi., exotic red w/gray interior, gold Fiberide wheels, Recaro seats, 2.2 L, 175HP, Viper alarm, garage kept, all orig. equip. and owner, very clean and well-maint., 0.88g, 0-60 in 6.8 sec., fun to drive, pictures at http://home1.gte.net/res0v57d, $7,000. 909/447-4676, Grant.

SNOW CHAINS for 15"or 16" wheels, heavy duty, $12. 626/793-1895.

TIRES & RIMS, '03 Lexus ES 300, brand new, $400. 626/355-1949.

TIRES (4), Goodyear Eagle (P285 60 R16) w/American Racing rims, 6-lug, $400. 897-1203.

'02 TOYOTA Highlander Ltd, V6, 30K mi., sunroof, roof rack, loaded, 6-CD changer, auto, dark blue, exc. cond., $19,750. 909/599-3230.

'93 TOYOTA Camry LE, V6, 4 dr., only 110K mi., drives Toyota-new, dark green, everything automatic, clean title, non-smoker, $4,550. 423-5901, Brian.

Free

DOG, lab mix, some pit & rott, 5 yrs. old, sweet disposition, great companion & watchdog, spayed, shots, needs yd & love. 957-0743, Karen.

FILL DIRT, clean, 14 cu. yds. avail., haul as much as you like, near Los Robles/Jackson, Pas. 626/791-3103, dtrask6@its.caltech.edu.

FURNITURE: moving out of state; exc. cond.: solid oak entert'nm't ctr., 35"x 57"x 20," very attractive, blk., 10-pc. sectional couch, 5-drawer chest, 42" round kitchen table expands to 63" w/6 chairs, all wood, photos avail. 240-2147.

KITTEN: Rocky, a beautiful gray-striped short-haired male, loves to play outdoors, neighbors moved away and left him, 2 yrs. old, neutered, extr. loving & friendly, deserves happy home. vlieding@caltech.edu for more info, pictures.

LAMPS (3), globular, pendant; CEILING FIXTURE, mounted. 246-2319, leave message.

THOUSAND TRAILS MEMBERSHIP, take over yearly membership dues. 626/963-5484.

Wanted

LP RECORDS from '50s through '80s, interested in jazz, blues and Big Bands. 661/297-2988 or whartford@sbcglobal.net, Wayne.

PARKING: In trouble, need space for venerable WWII Dodge ambulance, my retirement dream vehicle. jalonso11@earthlink.net.

RENTAL, 1- or 2-bdrm. townhome or mobile home w/garden area pref.; Santa Clarita or San Fernando Valleys pref.; single cat OK required, must be away from busy st. 661/297-0219.

SPACE INFORMATION/memorabilia from U.S. & other countries, past & present, for personal use. 790-8523, Marc Rayman.

TYPEWRITER, IBM, Selectric II, in good working order. 790-0828.

VOLLEYBALL PLAYERS, coed, no beginners please, Tues. 8 to 10 p.m. at Eagle Rock High School, $4/nt. 956-1744, Barbara.

Lost & Found

Found: Sunglasses, Friday, 11/21, in the Arroyo parking lot. Ext. 4-1954, Ronni.

For Rent

ALTADENA room, guest bd. + ba., 4-bdrm. home built in 1998, very close to JPL, pool, street parking, $875. 653-9613.

ARCADIA condo, 2 bd., 2 ba., partially furn., a/c, secured complex, pool and washing facility, $1,700 + util. + $1,500 security deposit, 1200 E. Huntington Drive at Michillinda. 626/794-6606, Sandy Harlan.

CRYSTAL VIEW guesthouse, small 1 bd., on secure and private 3/4 acre, 15 min./JPL, has storage, W/D, rose garden, patio, fruit trees, carport; $875 incl. utilities. 952-7980, Ann.

EAST PASADENA, beautifully decorated room in nice home in Daisy Villa area, furnished, util. incl., shared ba./kitchen/laundry, near bus & parks, DSL Internet to room, no pets, non-smokers only, $545 + $200 security deposit. 626/298-4977 or 626/449-5191, Linda.

LA CANADA, 2 bd., 1 ba., large patio, great view, covered parking, 1 block to JPL shuttle, avail. Jan. 1, $1,450; 1 bd., 1 ba., also available for $1,050. 957-1009, A.J.

LA CRESCENTA, Spanish house, 2 bd., 1 ba., charming, terra cotta floors, skylights, fireplace and canyon view, Briggs area, gardener and trash paid, $1,700. 248-8217.

PASADENA, spacious 1-bd., 1-ba. condo, walking distance to CIT, close to 210 fwy., near CIT and Gold's Gym, $975. 790-0308.

PASADENA apt., unfurnished, 2 bd., 1.5 ba., 2 story; dishwasher, central a/c, new carpet & floors, refrig & stove, laundry room, large patio, parking; close to Caltech & JPL, $1,150 + utilities; furn. 2 bd., 1.5 ba., apt. available, $1,175. 626/577-3060, ext. 14, Dennis.

PASADENA apt. to share, furnished, 3 bd., 3 ba., town home-style, with patio, central a/c, laundry, close to Caltech & JPL, $625 + 1/3 utilities, great for co-ops. 626/429-3677 or bettyrs@earthlink.net.

PASADENA townhouse, large, 3 bd., 2.5 ba., central air and heat, washer/dryer hookups, fireplace, walk to Goldline station, new paint, carpet, linoleum, stove, covered secure parking, no smoking or pets, $1,800, water and trash included. 626/394-5946.

SUNLAND home, 2 bd., 1 ba., one bd. for rent, 300 sq. ft. of storage in garage, roomie shares driveway, laundry, kitchen, bathroom, linen closet, pets OK, quarter-acre lot, utilities included, phone separate, non-smoker, house completely remodeled, $600. 951-9744 or 653-2575, Shannon, or itsypoo@yahoo.com.

Real Estate

ALTADENA condo, 2 bd., 1 3/4 ba., fireplace, upgraded kitchen, custom closets, patio w/Jacuzzi and oriental garden, c/a&h, community pool, parking, and storage, built in 1981, very close to JPL, must see, 2660 N. Lake Ave. #1, $265,000. 626/398-1988.

BIG BEAR cabin, 900 sq. ft., open floor plan, kitchen with large bar, living room, dining room, 2 bd., 1 ba., fully furnished, owner must sell 2/3 interest, appraised at $140K, near Moonridge ski slope. 626/359-7668, Stan.

DUARTE home, 2,300 sq. ft., brick/stucco, 10,000 sq. ft. lot, on a quiet cul-de-sac with mountain access, open floor plan, kitchen, living room with fireplace, dining room, 3 bd., 2 ba., covered patio, 3-car garage + workshop, large second floor home office, private entrance, sundeck with mountain view, lots of storage, walk-in attic, $525,000, by owner. 626/359-7668, Stan.

GLENDALE condo, modern, near Maple Park, 3 bd., 2.5 ba., 1,755 sq. ft., in center of complex, little street noise, large living/dining room, bright modern kitchen with pantry, 2 big balconies, fireplace, central a/c, laminate floors in living and bedrooms, new carpet and paint, attached 2-car garage, 15-minute drive to JPL, $382,000. 240-2802, Paul.

N.E. ALTADENA home, prime area north of New York Dr.; 2 bd., 1.5 ba, den, formal dining room, fireplace; French doors in den and dining room lead out to large yd; newly painted, in and out; refinished wood floors and new tile floors; new 500 sq. ft. bonus room with lots of storage; $549,000. 952-6007.

PASADENA, beautiful Madison Heights townhouse, 249 Alpine St., 1 bd., 1 ba., 3 floors, end unit, vaulted ceiling, beautiful landscaping, Pergo floors, 1-car garage, a lot of light, great association reserves, 2-block walk to Gold Line Fillmore stop, $275,000. 626/297-7129, Donald.

Vacation Rentals

BIG BEAR LAKEFRONT luxury town home, 2 decks, tennis, pool/spa, beautiful master bd., suite, slps. 6. 949/786-6548.

CABO SAN LUCAS, Valentine's wk. getaway, junior suite at Pueblo Bonito Resort, sleeps 4, balcony w/panoramic view of Sea of Cortez, kitchenette, a/c, satellite TV, on white sand beach, lg freeform pool w/island & waterfall, fitness center, 2 restaurants, deli, beauty shop, maid service, bilingual staff, www.pueblobonito.com, 80F ocean temp, $800 for week of 2/9/04. 626/296-8633.

CAMBRIA, ocean front, sleeps 4-6. 956-0014.

HAWAII, Maui coast, ocean front view, 25 ft. fr. surf, 1 bd. w/loft, compl. furn., phone, color TV, VCR, microwave, d/w, pool, priv. lanai, slps. 4, laundry fac., low season rate $105/nite/2, high season rate $120/nite/2, $15/nite/add'l person. 949/348-8047, or jackandrandy@cox.net.

HAWAII, Kauai condo, Pona-Kai, on the beach in Kapaa, 1 bd., full kitchen, a/c, balcony, pool, hot tub, laundry on-site. 626/676-1408.

MAMMOTH, Snowcreek, 2 bd., 2 ba., + loft, slps. 6-8, fully equip'd kitchen incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. vw., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL disc'nt. 626/798-9222, 626/794-0455 or valeriee@caltech.edu.

OCEANSIDE condo, on the sand, charming, 1 bd., panoramic view, walk to pier & harbor, pool/spa, game room, slps. 4. 949/786-6548.

OCEANSIDE condo, fully furnished 2 bd., 2 ba., fireplace, full kitchen, quiet, relaxing, in beautiful setting, located at beachside, with barbeque, pool, spa, game room, and great ocean view, easy walk to pier and restaurants, slps. 8, available weekly or monthly. 909/981-7492, Darlene or dfhauge@yahoo.com.

OCEANSIDE deluxe condo, 2 bd., 2 ba., slps. 6+, great ocean views, newly decorated, fully furn., full kitchen, fireplace; restful beachside setting, easy walk to pier/harbor/restaurants; BBQ, pool, spa, game rm, tropical landscaping, gated garage/grounds; weekly or monthly. www.beachvisitors.com, Ginger 831/425-5114 or Grace 760/433-4459.

OCEANSIDE deluxe condo, 1 bd., 1 ba., slps. 4, garden view; newly decorated, fully furn., full kitchen, fireplace; restful beachside setting close to many attractions, easy walk to pier/harbor/restaurants; amenities incl.: BBQ, pool, spa, game room, tropical landscaping, gated garage & grounds; weekly or monthly. www.beachvisitors.com, Ginger 831/425-5114 or Grace 760/433-4459.

ROSARITO BEACH condo, 2 bd., 2 ba., ocean view, pool, tennis, short walk to beach on priv. rd., 18-hole golf course 6 mi. away, priv., secure parking. 626/794-3906.

Next Universe

January 9, 2004

Due to JPL holidays coming up at year's end, as well as the Mars Exploration Rovers' landings, this issue of Universe will be the last one published in 2003.

The deadline to submit classified ads for the Jan. 9 issue is Monday, Dec. 22.

For on-Lab news, log on to

http://dailyplanet

View this and previous issues of Universe online

http://universe.jpl.nasa.gov

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Notice to Advertisers

Advertising is available for JPL and Caltech employees, contractors and retirees and their families. No more than two ads of up to 60 words each will be published for each advertiser. Items may be combined within one submission. Ads must be submitted via e-mail to universe@jpl.nasa.gov *and are due at 2 p.m. on the Monday after publication for the following issue.*

All housing and vehicle advertisements require that the qualifying person(s) placing the ad be listed as an owner on the ownership documents.