Jet Propulsion Laboratory

Universe

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New Mars rover FIDO works like a dog

By MARY HARDIN

It is the ultimate test drive for the newest otherworldly vehicle. A few practice spins around an ancient lake bed in the Mojave Desert late last month with the next-generation Mars rover are helping JPL and NASA scientists and engineers learn more about driving the real thing on Mars.

"It's pretty exciting out here. We want to rack up a lot of miles and see how far this rover can go," said Dr. Raymond Arvidson, a geologist from Washington University in St. Louis and mission director for the 'end-to-end' field tests, which used systems similar to what will be used on Mars. "These test drives will help ensure that we will have a successful Mars rover mission," he said.

Future robotic rovers on Mars—which are being built and tested by JPL—will need to find the best rocks to bring back to Earth, samples that are likely to contain the evidence scientists need to prove that life once existed on the red planet.

To find the best sample, scientists need a good retriever. In late April they tested the work horse, er, dog, named FIDO—Field Integrated Design and Operations—that is helping them figure out how to use the kinds of instruments the next Mars rovers will need to fetch the most scientifically interesting rocks. FIDO is designed to test the advanced technology of the Athena flight rover and science payload that will be launched as part of JPL's Mars sample-return missions in 2003 and 2005.

"No place on Earth is like Mars, but our field site on an ancient lake bed in the Mojave Desert comes close," Arvidson said. "We've been able to use the rover's mini-corer to drill a rock sample and we've used the microscopic camera to look inside the hole. We practiced looking for rocks that contain carbonate minerals. If we find those kinds of rocks on Mars it may tell us if the early planet had a carbon dioxide atmosphere."

"FIDO's advanced technology includes the ability to navigate over distances on its own and avoid natural obstacles without receiving directions from a controller," said Dr. Eric Baumgartner, a robotics engineer at JPL and mission engineer for the desert field tests. "The rover also uses a robot arm to manipulate science instruments and it has a new mini-corer or drill to

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BOB BROWN / JPL PHOTO LAB

Curt Niebur, a graduate student from Washington University in St. Louis, kneels down for a closeup look at the FIDO rover during recent tests in the Mojave Desert. Other members of the FIDO team include, from left, Terry Huntsberger, FIDO system scientist; Fred Serricchio, mini-corer software engineer; and Mike Garrett, FIDO electronics engineer.

Magnetic stripes preserve record of ancient Mars

Mars Global Surveyor has discovered surprising evidence of past movement of the Martian crust, further evidence that ancient Mars was a more dynamic, Earth-like planet than it is today.

Scientists using the JPL-managed spacecraft's magnetometer have discovered banded patterns of magnetic fields on the Martian surface. The adjacent magnetic bands point in opposite directions, giving these invisible stripes a striking similarity to patterns seen in the crust of Earth's sea floors. On the Earth, the sea floor

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MGS back to normal

JPL's Mars Global Surveyor spacecraft returned to normal mapping operations Wednesday night, May 5.

The spacecraft is healthy and all of its science instruments are turned on. A gimbal, or hinge, on the spacecraft's dish-shaped high-gain antenna still has a restriction that limits its range of motion, but this will have no effect on the mission until next February when the Mars-to-Earth geometry will again prevent the antenna from pointing continuously at Earth. Engineers are looking at options for conducting the mission after February so that there will be a minimal impact on how much science data the mission can collect and send to Earth.

On May 7, Global Surveyor fired its

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Special Events Calendar

Ongoing

Alcoholics Anonymous—Meeting at 11:30 a.m. Mondays, Tuesdays, Thursdays (women only) and Fridays. Call Occupational Health Services at ext. 4-3319.

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

Gay, Lesbian and Bisexual Support Group—Meets the first and third Fridays of the month at noon in Building 111-117. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

Parent Support Group—Meets the fourth Tuesday of the month at noon. For location, call Jayne Dutra at ext. 4-6948.

Senior Caregivers Support Group—Meets the second and fourth Wednesdays of the month at 6:30 p.m. at the Senior Care Network, 837 S. Fair Oaks Ave., Pasadena, conference room #1. Call (626) 397-3110.

Friday, May 14

Asian Pacific American Heritage Month Film Festival—A documentary will be shown at 11:45 a.m. in the Building 167 conference room..

JPL Dance Club—Meeting at noon in Building 300-217.

"The Chemistry of Life: Molecular Recognition"—Caltech professors Dennis Dougherty and Peter Dervan will speak at 4 p.m. in the campus' Baxter Lecture Hall. An abstract and list of other seminars are available online at http://www.cco.caltech.edu/~koonin/CCE0_1seminars.html.

Travel Film—Bali and the Spice Islands will be featured in this production at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $9 and $7. For information, call (626) 395-4652.

Fri., May 14–Sat., May 15

Spring Concert—The Caltech Glee Clubs and Caltech Chamber Orchestra will perform a program of spirituals and international music from six continents at 8 p.m. in the campus' Dabney Lounge. Admission is free. Call (626) 395-4652.

Saturday, May 15

Bandorama—This special concert will honor Caltech's band director, William Bing, who will celebrate his 25th year at Caltech this evening. The Caltech Jazz and Concerts Bands will perform a medley of Caltech songs and a Sousa march. At 8 p.m. in the campus' Beckman Auditorium. Admission is free. Call (626) 395-4652.

Sunday, May 16

Cosmic Conversations—As part of the California Science Center's spring series, Dr. Richard Terrile, chief scientist for the Outer Planets/Solar Probe Program, will discuss Solar Probe, Europe Orbiter and Pluto-Kuiper Express. Educator Richard Shope will follow with a kinesthetic activity. To be held at 2 p.m.; tickets are $8 in advance, $10 at the door. The California Science Center is located in Exposition Park in Los Angeles. Call (323) 724-3623.

Tuesday, May 18

Livelink Demo—D.J. Byrne of Section 364 will discuss Livelink, a new Web-based software system that has been added to JPL's array of information management tools. This overview of Livelink's basic capabilities will include a demonstration of how to set up a project workspace from scratch. At noon in the Building 167 conference room.

Tues., May 18–Thurs., May 20

Investment Advice—A TIAA-CREF representative will be available for individual investment and retirement counseling. To schedule an appointment, call (800) 842-2007, ext. 1045.

Wednesday, May 19

Asian Pacific American Heritage Month Film Festival—A feature film will be shown from 5 to 7 p.m. in Building 156-219.

Computer Help—Jeff Sachs of Section 394 will provide an overview of the benefits of using the AFS distributed file system to manage computer files. Learn how to share files, set up group space, access data, publish web pages, obtain online help, change passwords, create protection groups and more. A question-and-answer session will follow. At noon in the Building 167 conference room.

"Freezing Time: The Six Millennia Race to Femto-seconds"—Caltech physics professor Dr. Ahmed Zewail will give this free lecture at 8 p.m. in the campus' Beckman Auditorium. For information, call (626) 395-4652.

JPL Drama Club—Meeting at noon in Building 301-127.

JPL Hiking Club—Meeting at noon in Building 238-543.

Russian Language Workshop—Meets from 7 to 9 p.m. on the Caltech campus. Some knowledge or previous study of the language is essential. For location and further information, call Joyce Wolf at ext. 4-7361.

Thursday, May 20

JPL Astronomy Club—Meeting at noon in Building 198-102.

Von Kármán Lecture Series—Technology and Applications Programs Director Mike Sander will give a lecture titled "Technology of the Future Today: New Technologies Benefit U.S. Industry," at 7 p.m. in von Kármán Auditorium. Open to the public.

Friday, May 21

Asian Pacific American Heritage Month Film Festival—A documentary will be shown at 11:45 a.m. in the Building 167 conference room.

"Evolution in the Test Tube"—Caltech professors Frances Arnold and Richard Roberts will speak at 4 p.m. in the campus' Baxter Lecture Hall. An abstract and list of other seminars are available online at http://www.cco.caltech.edu/~koonin/CCE0_1seminars.html.

JPL Dance Club—Meeting at noon in Building 300-217.

Von Kármán Lecture Series—Technology and Applications Programs Director Mike Sander will give a lecture titled "Technology of the Future Today: New Technologies Benefit U.S. Industry," at 7 p.m. in The Forum at Pasadena City College, 1570 E. Colorado Blvd. Open to the public.

Saturday, May 22

Caltech-Occidental Chamber Orchestra—This free concert will be presented at 8 p.m. in Caltech's Ramo Auditorium. Call (626) 395-4652.

Sat., May 22–Sun., May 23

"Trojan Women"—Presented by Theater Arts at Caltech, this production features JPL staff as well as Caltech students, faculty and staff. To be held 4 p.m. outdoors at the campus' Braun Court Tickets are $15. Call (626) 395-4652.

Sunday, May 23

Cosmic Conversations—As part of the California Science Center's spring series, Dr. Michael Klein, manager of the Deep Space Network Science Office, will speak at 2 p.m. Tickets are $8 in advance, $10 at the door. The California Science Center is located in Exposition Park in Los Angeles. Call(323) 724-3623.

Wednesday, May 26

Asian Pacific American Heritage Month Film Festival—A feature film will be shown from 5 to 7 p.m. in Building 156-219.

JPL Bicycle Club—Meeting at noon in the Building 167 conference room

JPL Drama Club—Meeting at noon in Building 301-127.

JPL Toastmasters Club—Meeting at 5:30 p.m. in the Building 167 conference room. Guests welcome. For more information, contact Mary Sue O'Brien at ext. 4-5090.

Russian Language Workshop—Meets from 7 to 9 p.m. on the Caltech campus. Some knowledge

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Galileo: Old spacecraft learns new tricks

Software patch helps enable Callisto flyby as planned

BY JANE PLATT

Galileo team members are all smiles after the spacecraft proved to be a star pupil by successfully demonstrating specially designed, newly installed software and saving the May 5 flyby of Jupiter's pockmarked moon Callisto.

During previous flybys of Jupiter's moons, a recurring electrical glitch caused the spacecraft computer to reset and enter "safing" mode, shutting down all non-essential functions until ground controllers could restore normal operations.

The Galileo team pooled engineering and problem-solving talents to develop special software, known as a "bus reset patch." The name refers to Galileo's "data bus," which transfers information to various parts of the spacecraft. The software was designed to boost Galileo's I.Q. by teaching it to recognize symptoms of the glitch and correct the problem itself, without entering safing mode.

The spacecraft was put to the test twice on Monday, May 3, when the glitch popped up as Galileo was approaching Callisto. Galileo quickly diagnosed the problem, determined there was no threat to spacecraft health, and decided for itself not to enter safing mode. This allowed all spacecraft and scientific functions to continue uninterrupted, with Galileo snapping pictures and gathering observations from an altitude as close as 1,322 kilometers (821 miles) above Callisto.

"Galileo proved it's an 'A' student," said Project Manager Jim Erickson. "This is an example of our efforts at JPL to make the spacecraft more independent and better able to evaluate and deal with problems without intervention from ground controllers."

"We're so thrilled that our efforts paid off and Galileo performed as we had hoped," said Nagin Cox, who helps oversee the team of current and former Galileo personnel that developed the new software patch.

In an unrelated occurrence during the May 5 Callisto flyby, the pointing control for the scan platform, which aims Galileo toward observation targets, switched on its own from a very accurate gyro-controlled system to a less accurate backup mode that uses the star scanner without gyros.

Nonetheless, the spacecraft continued to record its observations, but observations taken by an instrument called the near infrared mapping spectrometer may be less sharp than planned. Preliminary analysis shows this anomaly occurred just after Galileo's closest approach to Callisto, at 7:56 a.m. Pacific Daylight Time, the time the signal was received on Earth. The Galileo team is investigating this anomaly, and preliminary analysis shows it may be related to previous gyro anomalies.

Galileo has been orbiting Jupiter and its moons since December 1995. Its original, two-year mission ended in December 1997, and the spacecraft is currently more than halfway through a two-year extended tour, called the Galileo Europa Mission. ❑

Star-studded photo album delivered to Internet

By JANE PLATT

A colossal assortment of star-studded, galaxy-filled pictures and information—enough to fill the hard disks on hundreds of home computers—is contained in the first major data release from a telescope sky survey sponsored by NASA and the National Science Foundation.

"We've posted a cornucopia of images on the Internet for average home computer users as well as professional astronomers," said Dr. Michael Skrutskie, principal investigator of the Two-Micron All-Sky Survey (2MASS), designed to catalog 1 million galaxies, 300 million stars, and other celestial objects. The collection includes up-and-comers like T Tauri, an infant star, and stellar has-beens like the Crab Nebula (the remnant of an exploding former star).

"We live inside the Milky Way Galaxy, which is shaped like a flattened disk with embedded gas and dust," explained Dr. Roc Cutri, the 2MASS project scientist, who is affiliated with the JPL/Caltech Infrared Processing and Analysis Center, which combines and processes 2MASS images into usable data. "With visible light, dust limits our view along the flattened disk. But near-infrared light is less affected by dust, exposing many galaxies outside the Milky Way that would otherwise be hidden."

This early data sampling includes 230,000 pictures derived from 3 million raw images, taken by a pair of 1.3-meter (51-inch) telescopes near Tucson, Ariz., and at Cerro Tololo, Chile. This first sample represents just 6 percent of the anticipated final database of the survey. The telescopes study near-infrared wavelengths not visible to the naked eye. By sensing heat, they detect heat-emitting objects like stars and galaxies that hide behind curtains of cold dust throughout our Milky Way galaxy.

"Because the Milky Way is very dusty, we know very little about how it's put together. It's like living in a city where there's a constant dust storm and you have no idea what roads, mountains and buildings are beyond your own house," Skrutskie said. "Our sky survey helps us see through the dust to get a clearer view of the Milky Way."

2MASS, based at the University of Massa-chusetts, where Skrutskie is a physics and astronomy professor, is two years into a three-and-a-half year survey of the entire sky.

One of the survey's most significant findings is the definition of a class of stars called L-dwarfs, the coolest stars known. "It's the first new classification of this type in nearly a century," Cutri said. "We knew L-dwarfs existed, but 2MASS established the category definitively. These may be the most common stars in our galaxy or maybe the universe."

The 2MASS collection includes infant star T Tauri (above) and stellar has-beens like the Crab Nebula, the remnant of an exploding former star.

The raw, unprocessed data contained in this current batch fills more than one terabyte, or 1,000 gigabytes, of computer memory. The average home computer contains less than 10 gigabytes of storage. Thanks to the Internet, people can browse individual pictures without downloading the entire database and gobbling up their computer memory.

Additional releases are planned every six months through the end of 2000. With these images and catalogs, astronomers can pinpoint positions and brightness of stars and other objects, and determine sizes and shapes of galaxies and nebulae. They can then choose specific objects for further study.

"We count the dots, so to speak, to study how galaxies are scattered in the nearby universe," Skrutskie said. "The texture of this distribution echoes how material was hurled about and eventually settled into galaxies and stars after the Big Bang."

2MASS, part of the Origins Program, is funded by NASA's Office of Space Science and the National Science Foundation. 2MASS results will benefit future Origins missions, including Space Infrared Telescope Facility and the Next Generation Space Telescope.

Additional 2MASS information, images and current data releases are available online at http://www.ipac.caltech.edu/2mass . ❑

MGS

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small thrusters for about two minutes in order to fine-tune its orbit around Mars. The mapping orbit was designed so that the spacecraft does not fly over precisely the same swath of Martian landscape, or "ground track," from one week to the next. The spacecraft must fire its thrusters every few months to keep the necessary ground-track separation. This is especially important now since the science team is in the process of an intensive four-week campaign to acquire stereo images of the planet. ❑

Proposals requested for new Grand Challenge initiative

By MARK WHALEN

Proposals that could detect the chemical signatures of life on other worlds are being sought under JPL's Grand Challenge initiative.

Proposals will be selected by a review committee this summer to receive funding for 18 months to conduct basic research that could lead to eventual life-seeking instruments for planetary missions. A total of $1.5 million is available to fund all of the selected proposals.

"The Grand Challenge is in keeping with JPL's tradition of doing what no one else has done, as well as fulfilling the Laboratory's responsibility to generate scientific knowledge," said JPL Chief Scientist Dr. Moustafa Chahine, who is leading the effort.

The Grand Challenge initiative was created last year to encourage JPL scientists and engineers to tackle long-range, big-picture problems and questions in space exploration. In January, Director Dr. Edward Stone announced that the focus of the first Grand Challenge would be to "develop in-situ measurement techniques that are capable of detecting the chemical signatures of life."

Selected proposals will be supported from the Director's Research and Development Fund. NASA supports such a fund at its field centers to stimulate research.

Current mission-development efforts most often have a near-term focus, Chahine said, "but we also need to have long-term challenges." Citing a historical precedent for such forward-looking planning, he recalled what followed the 1984 discovery that the star Beta Pictoris, some 50 light-years from Earth, was found to be surrounded by a disc of dust. That discovery, he said, inspired a vision at the Laboratory that "in part prompted the creation of the Origins Program."

Chahine said Grand Challenge proposals will have a strict limit of 25 pages and use the format of other Director's Research and Develop-ment Fund proposals. Also, because of the multidisciplinary nature of the initiative, the research proposals will be team efforts led by a team leader rather than a principal investigator.

Three critical elements, he said, are necessary for research proposals solicited under this call:

• Identify the chemical signatures indicative of life. This area will be focused on defining the most likely non-Earth-centric signatures of life: those properties that are believed to be universal for living systems, but which are not dependent on specific molecules or peculiar properties of Earth life. The definition of these properties and a strategy for employing them in a systematic search for extraterrestrial life will be the goal of the initial work.

MEETING MONDAY

A meeting to answer questions and provide assistance in forming teams to support Grand Challenge proposals will be held on Monday, May 17, from 2 to 3:30 p.m. in the Building 180-101 conference room.

The term "chemical signature" is not meant to exclude biological signatures, if they can be identified.

• Develop measurement techniques to detect these signatures. The development of measurement techniques and statistical strategies for detecting the signals of life in a background of non-life will be the goal(s) of this project. Coupling a measurement strategy to statistical methods for screening samples, and testing the coupled methods on Earth samples and prepared controls, should allow the method to be fine-tuned.

• Conceptualize the possibilities for miniaturizing in-situ instrumentation. The development of miniaturized instruments for in-situ measurements is clearly the ultimate goal of the JPL Grand Challenge. This task is to show an understanding of how the identified measurement technique, ultimately implemented in-situ, would be sufficient.

The team leader must be a JPL employee, Chahine said. However, JPL team leaders are encouraged to create teams that have members with expertise external to JPL.

The $1.5 million in funding for the initial 18-month phase will support several teams that address the challenge. Pending review of this phase, the funding may continue for approximately four to five years at a level of $1 million per year.

Chahine said teams chosen for the initial funding would not be in competition with each other, but will "build a collaborative effort. The teams will meet frequently, exchange ideas and benefit from each other's experience.

"If we can do it, the Grand Challenge will open a new vista for our exploration beyond regions, planets or bodies from which we can get samples," Chahine added. "It will open the way for new missions and will establish a new paradigm for the search for life."

Eight copies of proposals should be sent to Dr. Katherine Dumas at mail stop 180-904 by end of day Friday, July 9. Each proposal should discuss how the proposed research addresses the Grand Challenge, a task implementation plan and procedure, a budget and a description of team members.

A small committee chaired by JPL Distinguished Visiting Scientist Dr. Wes Huntress will review the proposals. Results will be announced in September 1999. ❑

FIDO

Continued from page 1

extract and cache rock samples. There are also several camera systems onboard that allow the rover to collect science and navigation images by remote-control."

"We've had a fantastic week," said Dr. Steven Squyres, principal investigator for the Athena rover payload from Cornell University, Ithaca, N.Y. "In just a few days, we've shown that we can find good rocks, drill samples out of them, and take the samples back to a lander. That's a huge step forward in preparing to bring the first samples back from Mars."

FIDO is about the size of a coffee table and weighs as much as a St. Bernard, about 70 kilograms (150 pounds). It is approximately 85 centimeters (33 inches) wide, 105 centimeters (41 inches) long, and 55 centimeters (22 inches) high. The rover moves up to 300 meters an hour (less than 1 mph) over smooth terrain, using its onboard stereo vision systems to detect and avoid obstacles as it travels "on-the-fly." During these tests, FIDO is powered by both solar panels that cover the top of the rover and by replaceable, rechargeable batteries.

"FIDO is about six times the size of Mars Pathfinder's Sojourner and is far more capable of performing its job without frequent human help," said Dr. Paul Schenker, who directs FIDO rover development at JPL as part of the NASA Exploration Technology Program. "FIDO navigates continuously using on-board computer vision and autonomous controls, and has similar capabilities for eye-to-hand coordination of its robotic science arm and mast. The rover has six wheels that are all independently steered and can drive forward or backward, allowing FIDO to turn or back up with the use of its rear-mounted cameras."

In addition to testing FIDO, the scientists and engineers are supporting students from four schools around the country in designing and carrying out their own mission with the rover. This is the first time students have been able to remotely operate a NASA/JPL rover. The students—from Los Angeles, Phoenix, St. Louis and Ithaca, N.Y.—form an integrated mission team and are responsible for planning, conducting and archiving a two-day mission using FIDO.

"It is important to excite young people about space exploration and discovery, and these tests provide an excellent educational opportunity," Arvidson said. "We're including high school students in the FIDO tests as a pilot experiment in which the students gain a sense of participation in the field trials by planning their own mission segments and working with us to implement the rover's assignments." ❑

TOPEX CD-ROM released

By DIANE AINSWORTH

Armchair adventurers and educators are invited to explore marine mammals in the Gulf of Mexico, investigate the El Niño phenomenon, or simply discover "what's up" in the world of Earth-orbiting satellites through a new multimedia CD-ROM, "Visit to an Ocean Planet," produced by NASA and the French space agency.

Ocean expeditions, interactive games, teacher resources and classroom activities are featured in an array of educational learning tools, quizzes and global snapshots of ocean circulation patterns based on data obtained by the JPL-managed TOPEX/Poseidon satellite, a joint mission between

See TOPEX, page 6

JPL, Ball Aerospace negotiate on subsystem hardware contract

JPL has selected Ball Aerospace & Technologies Corp., Boulder, Colo., for negotiations for a new contract that will lead to the development of instruments and subsystems for robotic spacecraft used in space exploration and Earth-orbiting missions.

The Flight Instrument and Subsystem Tasks (FIST) contract consists of a 5-year commitment to provide subsystem hardware for JPL projects, and includes two 5-year options. The contract is worth up to approximately $350 million over 15 years.

"With the combination of downsizing at JPL and an increasing workload, we're forging more partnerships with industry to fill the gap, and this contract is an example," said Fred Vescelus, deputy program manager for JPL's Earth Science Flight Experiments Program Office.

"Work performed by the contractor will help us keep up with engineering development of spacecraft subsystems, detailed assembly piece/part work and total system contracting," Vescelus said. The contractor will perform various tasks, including designing, building and testing hardware for JPL programs. Some tasks will require building hardware from existing designs, while other tasks will require new designs.

Negotiation of the contract is expected to conclude by the end of the month. ❑

JPL PHOTO LAB

Lew Allen Award for Excellence winners Dr. Eric Rignot, second from left, Simon Yueh and Dr. Michael Ressler are joined by JPL Chief Scientist Dr. Moustafa Chahine, left, former JPL Director Dr. Lew Allen, second from right, and current Director Dr. Edward Stone.

Three JPLers win Lew Allen Award

Three JPL scientists have received the 1999 Lew Allen Award for Excellence.

The annual awards recognize and encourage significant individual accomplishments or leadership in scientific research or technological innovation by JPL employees during the early years of their professional careers.

The recipients are Dr. Michael Ressler of the Astrophysics Research Element 3231, Dr. Eric Rignot of the Radar and Science Engineering Section 334 and Simon Yueh, also of Section 334.

Ressler received his award in recognition of development of a mid-infrared camera for astronomical observations, its implementation on the Keck telescope and co-discovery of a protoplanetary dust hole in a nearby stellar system, signifying planet formation.

Rignot was recognized for his contributions to the scientific utilization of satellite radar interferometry to study the stability and mass balance of the great polar ice sheets at their junction with ocean waters.

Yueh was cited in recognition of his pioneering research of passive microwave polarimetric remote sensing to Earth science investigations.

The winners received a wall plaque and a grant of $25,000 from the Director's Research and Development Fund, which is used at JPL to enhance the professional efforts of the awardees.

The award was established in 1990 in honor of Allen, who served as JPL's director from 1982–90. ❑

Mars

Continued from page 1

spreads apart slowly at mid-oceanic ridges as new crust flows up from Earth's hot interior. Meanwhile, the direction of Earth's magnetic field reverses occasionally, resulting in alternating stripes in the new crust that carry a fossil record of the past hundreds of millions of years of Earth's magnetic history, a finding that validated the once-controversial theory of plate tectonics.

"The discovery of this pattern on Mars could revolutionize current thinking of the red planet's evolution," said Dr. Jack Connerney of NASA's Goddard Space Flight Center, Greenbelt, Md., an investigator on the Global Surveyor's magnetometer team. "If the bands on Mars are an imprint of crustal spreading, they are a relic of an early era of plate tectonics on Mars. However, unlike on Earth, the implied plate tectonic activity on Mars is most likely extinct."

Alternate explanations for the banded structure may involve the fracturing and breakup of an ancient, uniformly magnetized crust due to volcanic activity or tectonic stresses from the rise and fall of neighboring terrain.

"Imagine a thin coat of dried paint on a balloon, where the paint is the crust of Mars," explained Dr. Mario Acuña of Goddard, principal investigator on the Global Surveyor magnetometer. "If we inflate the balloon further, cracks can develop in the paint, and the edges of the cracks will automatically have opposite polarities, because nature does not allow there to be a positive pole without a negative counterpart."

Peer-reviewed research based on the observations was published in the April 30 issue of the journal Science.

The observations of the so-called magnetic stripes were made possible because of Mars Global Surveyor's special aerobraking orbit. The lowest point of each elliptically shaped orbit curved below the planet's ionosphere, allowing the magnetometer to obtain better-than-planned regional measurements of Mars.

"At its nominal orbit more than 320 kilometers (200 miles) high, the instruments face too much magnetic interference, and they do not have the resolution to detect these features," Acuña noted. "We began with misfortune, and ended up winning the lottery."

The bands of magnetized crust apparently formed in the distant past when Mars had an active dynamo, or hot core of molten metal, which generated a global magnetic field. Mars was geologically active, with molten rock rising from below cooling at the surface and forming new crust. As the new crust solidified, the magnetic field that permeated the rock was "frozen" in the crust. Periodically, conditions in the dynamo changed and the global magnetic field reversed direction. The oppositely directed magnetic field was then frozen into newer crust.

"Like a Martian tape recorder, the crust has preserved a fossil record of the magnetic field directions that prevailed at different times in the ancient past," Connerney said. When the planet's hot core cooled, the dynamo ceased and the global magnetic field of Mars vanished. However, a record of the magnetic field was preserved in the crust and detected by the Global Surveyor instrument.

The mission's map of Martian magnetic regions may help solve another mystery—the origin of a striking difference in appearance between the smooth, sparsely cratered northern lowlands of Mars and the heavily cratered southern highlands. The map reveals that the northern regions are largely free of magnetism, indicating the northern crust formed after the dynamo died.

"The dynamo likely died a few hundred million years after Mars' formation," Acuña said. "One possibility is that later asteroid impacts followed by volcanic activity heated and shocked large areas of the northern crust, obliterating any local magnetic fields and smoothing the terrain. When the crust cooled, there was no longer a global magnetic field in which to become frozen again."

The map also identifies an area in the southern highlands as the oldest surviving unmodified crust on Mars. This area on Mars is

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News Briefs

Wesley Menard has been appointed manager of the Mechanical Systems Engineering and Research Division 350.

Menard had served as deputy manager of the division prior to his appointment. He replaces the recently retired **Brian McGlinchey**.

A JPL employee since 1963, Menard has 25 years of line and project management experience in Divisions 34 and 35. He earned a bachelor's degree in aeronautical engineering from Cal Poly Pomona in 1961 and a master's degree in engineering from UCLA two years later. ❑

Wesley Menard

Members of the public are invited to send their names to the red planet on the Mars 2001 lander.

Names are being collected for a CD-ROM that will be carried on the spacecraft, which is scheduled for launch on April 10, 2001, and will land on Mars on Jan. 22, 2002.

The lander will touch down near the Martian equator, carrying a spare Mars Pathfinder rover, a robotic arm and several other science instruments, including three that will return data in support of eventual human exploration.

A certificate is also available and is provided free of charge by NASA. The agency's goal is to collect several million names. Names can be submitted online at http://spacekids.hq.nasa.gov/2001 . ❑

JPL personnel are invited to the 1999 Award for Excellence ceremony on May 20 at 2 p.m. in the mall. Seating is limited.

The Award for Excellence is the first tier in JPL's three-tier Reward & Recognition Program. It is a cash award that is determined by committee based on employee nominations.

For more information about the award and to see the list of recipients, visit the Reward and Recognition web site at http://eis/sec614/reward.

The winners of JPL's Notable Organizational Value-Added (NOVA) awards for April have been announced:

Section 333: Martha Berg, Bruce Conroy, Reginald Cormier, Theodore Hanson, Patricia Lux, Timothy Sink, John Sosnowski, David Tyner.

Section 351: Steve Fox.

Section 387: John Bousman.

Section 391: Gloria Lang. ❑

JPL is hosting the 33rd Aerospace Mechanisms Symposium May 19–21 at the Pasadena Center. JPL employees are welcome to attend the technical sessions without fee.

The symposium is concerned with the problems of design, fabrication, test and operational use of aerospace mechanisms. Emphasis is on hardware developments. The symposium rotates annually among eight NASA centers and attracts papers and attendees from the centers, international space organizations and industry contractors.

For further information, go online to http://lmms.external.lmco.com/ ams/index.html or contact **Donald Sevilla** at ext. 4-2136 or by e-mail. ❑

Caltech's Center for Neuromorphic Systems Engineering is holding its annual industry conference May 27 from 8 a.m. to 5:30 p.m. in the campus' Beckman Institute Auditorium.

The center, which develops biologically inspired intelligent sensory systems that will enable future machines to see, smell, touch, hear, learn and move, will highlight its research activities to an audience of industry representatives. JPL participants may attend the event without having to pay the conference fee.

The conference, titled "Biometrics and Human Machine Interfaces," will include topics such as vision, robotics, machine learning, reconfigurable computing, interactive robots and olfaction.

Registration information is available on the Internet at www.erc.caltech.edu or by calling **Dean Schonfeld** at (626) 395-2246. ❑

Calendar

Continued from page 2

or previous study of the language is essential. For location and further information, call Joyce Wolf at ext. 4-7361.

Thursday, May 27

Associated Retirees of JPL/ Caltech—Members will begin a two-day overnight trip to Palm Springs. Cost: $152 per person, double occupancy, or $197 per person, single occupancy. For information, call Lila Moore at (818) 790-5893.

Caltech Architectural Tour—The Caltech Women's Club presents this free service, which is open to the public. The tour begins at 11 a.m. and lasts about 1½ hours. Meet at the Athenaeum front hall, 551 S. Hill, Pasadena. For information and reservations, call Susan Lee at (626) 395-6327.

JPL Golf Club—Meeting at noon in Building 306-302.

Social Security—A representative will be on-Lab from 9 to 11 a.m. in the Building 167 cafeteria. Employees can request a "Personal Earnings and Benefits Statement" and ask general questions regarding Social Security benefits.

Friday, May 28

Asian Pacific American Heritage Month Film Festival—A documentary will be shown at 11:45 a.m. in the Building 167 conference room. Schedule and description of feature titles are available online at http://eis/aac.

At the Piano—James Boyk will perform classical pieces at 8 p.m. in Caltech's Dabney Lounge. Admission is free. Call (626) 395-4652.

"Advanced Materials: Bridging the Gap Between Natural and Synthetic Polymers"—Caltech professors David Tirrell, Julia Kornfield and Robert Grubbs will speak at 4 p.m. in the campus' Baxter Lecture Hall.

JPL Dance Club—Meeting at noon in Building 300-217.

Sat., May 29–Sun., May 30

"Trojan Women"—Presented by Theater Arts at Caltech, this production features JPL staff as well as Caltech students, faculty and staff. To be held 4 p.m. outdoors at the campus' Braun Court Tickets are $15. Call (626) 395-4652.

TOPEX

Continued from page 4

NASA and France's Centre National d'Etudes Spatiales (CNES).

More than an hour of digital video, audio, images and text captions describe everything from the impetus for the mission to significant science results obtained during the satellite's three-year primary life span. "Students will be introduced to cutting-edge concepts in science, mathematics and engineering," said Susan Digby, educational outreach representative on the TOPEX/ Poseidon mission at JPL.

This educational tool provides background materials, learning modules, movies, images and classroom activities on three main topics: climate, oceans and life. Targeted primarily for middle-school students, the material is tailored to meet criteria of the National Education Standards office.

One section enables students to learn about the ocean via interactive games that allow them to plan excursions to the nutrient-rich Gulf of Mexico. This region experiences cyclonic eddies, which attract pods of sperm whales and can produce a variety of severe weather patterns. Another section contains a self-guided multimedia tour of the 1997-98 El Niño, which was one of the most severe El Niño conditions in recent history, and provides students interested in oceanography careers with a chance to follow the studies of a group of contemporary oceanographers.

The CD-ROM also includes an easy-to-use Earth-orbiting satellite game, which illustrates how TOPEX/Poseidon, along with other satellites, operates from space.

The CD-ROM can be ordered free of charge via the Internet at http://topex-www.jpl. nasa.gov/education/education.html . ❑

Passings

Arthur Beeman, 85, a retired graphics specialist from Section 655, died of heart failure April 14.

Beeman worked at the Laboratory from 1952–79. He is survived by his wife, Thelma.

Burial was at Forest Lawn Memorial Park in Glendale. ❑

Kenneth LaBau, 78, a retired senior engineering associate from Section 357, died of Alzheimer's disease.

LaBau joined JPL in 1956 and retired in 1986. He is survived by his wife, Mildred, daughter Joann Kennedy and grandchildren Jennifer and Julia Kennedy.

Services were at Rose Hills Memorial Park in Whittier. ❑

Robert A. Gardner, 72, a former senior engineering test assistant in Section 333, died May 2 at Community Hospital of the Monterey Peninsula.

Gardner worked at JPL from 1962–66 and again from 1969–78. He is survived by his companion, Cynthia Parham; sons Robert Jr., David, Chris and Steve; daughters Lisa and Laura; and six grandchildren.

Services were private. Gardner's family requests that memorial contributions be made to the Josephine Kernes Memorial Pool, P.O. Box 2261, Monterey, CA 93942. ❑

Retirees

The following employees retired in May:

Jewel Beckert, 42 years, Section 788; **Ben Wada**, 40 years, Section 354; **Ilene Sharp**, 39 years, Section 314; **Wayne Phillips**, 37 years, Section 346; **Raymond Pickens**, 37 years, Section 352; **Donald McQuarie**, 32 years, Section 506; **Paul Kuhnle**, 28 years, Section 195; **William McLaughlin**, 28 years, Section 311; **George Ottley**, 24 years, Section 393; **Winfried Kuehn**, 22 years, Section 930; **Edward Fortier III**, 21 years, Section 346; **Peter Manuel**, 20 years, Section 223; **Henry Grant**, 17 years, Section 391; **Walter Keryluk**, 13 years, Section 515. ❑

Volunteers sought for open house

The Public Services Office seeks JPL salaried employees willing to volunteer their time staffing the annual open house on June 5 and 6.

Hours of operation each day will be from 9 a.m. to 5 p.m. Volunteers' assistance is needed in the following areas: Tram tour guides, information booth staffing, kids' activity area staffing.

Due to the success and popularity of recent missions, larger community participation is expected this year than in the past. Attendance at the two-day event is likely to exceed 50,000. A large number of JPL employee volunteers are needed to staff essential activities, said Kay Ferrari of the Public Services Office.

Open house showcases JPL and its missions to the local community, she said, and the success of the event relies on volunteer support from within the Laboratory

Contact Public Services at ext. 4-0112 for more details or to sign up. ❑

Mars

Continued from page 5

where the magnetic stripes are most prominent. The bands are about 160 kilometers (100 miles) wide and 965 kilometers (600 miles) long, although the longest band stretches more than 1,930 kilometers (1,200 miles).

"The bands are wider than those on Earth, perhaps for a couple of reasons," Connerney said. "The Martian crust could have been generated at a greater rate, causing a given magnetic field to be imprinted over a wider area before it reversed direction. Second, the Martian magnetic field may have reversed direction less frequently, which would have given more time for any one field direction to imprint itself in the steadily moving crust, resulting in wider bands.

"In order to call this pattern a crustal spreading center like that observed in the mid-oceanic ridges on Earth, we need to find a point of symmetry, where the pattern on one side matches the pattern on the other. We have not yet found evidence of this type of symmetry," Connerney added.

Graphics of the magnetometer data, other supporting material and general information on the Global Surveyor mission may be found on the Internet at http://mpfwww.jpl.nasa.gov/mgs/index.html. ❑

Corrections

Anniversaries—In the April 30 issue of *Universe*, the Anniversaries listing inadvertently omitted Olivia Tyler, who has attained 35 years of service. *Universe* regrets the error. ❑

Retirees—In the April 2 issue, the Retirees listing showed incorrect information on retiree Marc Trummel. He worked at the Laboratory for 41 years. ❑

East gate neighbor raises traffic concerns

JPL personnel who park in the east lot are urged to use care when exiting as they approach Windsor Avenue.

A yield sign leads to that street as traffic exits the parking lot, and a JPL neighbor pointed out that the street parallels the Gabrielino Trail, which is used by many pedestrians and bicyclists. ❑

LETTERS

Thank you to my JPL friends for your support during my mother's recent battle with cancer and subsequent passing. Your love and prayers have helped me so much more than I can ever express to you in words.

Jill Figueroa

❑❑❑

My family and I would like to express our sincere thanks and appreciation to my fellow JPL employees and contractors for their support during the illness and recent passings of my stepfather and father. The flowers and cards have been very encouraging during this time of bereavement.

Janice Ball

FOR SALE

A/C/HEATER package unit, Heil 3-ton, fully charged and working, removed for new construction, $700/obo. 957-2173.

AIR COMPRESSOR, commercial, make offer. 957-2173.

AIRLINE TICKET, Southwest R/T, anywhere S/W flies, must complete travel by June 12, 1999, $125/obo. 626/355-3886.

AUDIO EQUIPMENT, Bang and Olufson (B&O) receiver, speakers, turntable, cassette player, CD player; some components not working properly/ need TLC; $500/obo, all reasonable offers considered. 626/294-1927.

AUDIO EQUIPMENT, Sony CDP-CX100 100-disk CD changer, $125; Sony TC-R503 cassette deck, $85; Hitachi D-W800 dual cassette deck, $85. 790-6959.

BABY ITEMS: cradle with mattress, $40; baby exersauser, $35, assorted items + baby/toddler clothes and shoes, all in good condition. 626/798-6248.

BEDROOM FURNITURE: kids twin bunkbed, blue, metal frame w/1 twin mattress, $200/obo; king size bedroom set w/frame, headboard, 2 nightstands, 9-drawer dresser w/mirror, $250/obo; wood swing set w/2 swings, rope ladder, trapeze, platform w/slide, $100/obo. 909/393-9586.

BOOKCASE / WALL UNIT: Scandinavian design, teak, includes drawers, cabinet & fold-down desk, $100. 626/791-8848, lv. msg., Don or Linda.

BUNK BEDS, children's, white, very strong, excellent condition, w/mattresses, sheets, and comforter, $50, pick up in Pasadena; CHEST FREEZER, good condition. $50, pick up in Pasadena. 952-7624.

CANOE, 13-ft. Royalex Old Town Hunter, $200; AIRBAGS for whitewater, $30. 626/794-4592.

CHINA SET, 60 pieces, $70/obo. 909/592-0780, Ana.

COMFORTERS & QUILTS, king-size +; bedspreads/twin, extra-long; $50 & $30. 626/398-4960.

COMPUTER, Mac II FX, Conner 20 MB HD, 780 kb 3.5" FD, 1.4 MB 3.5 " FD, 20 MB RAM, System 7.5.3, 32-bit addressing, 14" color monitor (16 colors), Global Village Teleport 33.6 fax/modem, Netscape Communicator 4.04, $175. 541-0062.

COMPUTER DESK w/drawer, solid oak: $100/obo. 626/398-4960.

COMPUTER POWER CONTROL CENTER, 5 power switches + 1 master switch, 5 surge-protected outlets + 2 modem/fax/phone jacks, new, $20. 790-3899.

COUCH, blue fabric, pillow back, vg condition, $100; MICROWAVE OVEN, 1500W Amana, $25. 323/257-8640.

CROCK POT square w/Corningware, $13/obo. 626/568-8298.

DIET TAPES, Jenny Craig, set of 14, $50. 790-3899.

DINING ROOM FURNITURE: Queen Anne formal dining room set from Ethan Allen, including oval table (60" x 40" x 29") with 2 leaves (18" ea.), 6 side chairs, server (40" x 21" x 34"), all in cherry, custom table pads, exc. cond., $2,600/obo; unrelated 5-pc. dinette set (table 48" x 36" x 29"), $75. 626/577-8107.

DOGS, American bulldog puppies, ABA registered. 626/299-1213.

FISH, freshwater, large and medium (120-gallon tank for sale when fish gone), price negotiable. 626/794-2758.

FRANCISCANWARE, desert rose pattern, assorted pieces, $5-15. 626/398-4960.

FURNITURE: refinished cherry coffee table, round w/drop leaves, $100/obo; oak table lamp, exc. cond., $85/obo; brass lamp, exc. cond., $80/obo. 368-8160.

GARMENT BAGS, hanging, plastic, w/zippers, 2'-6': $7 each. 626/398-4960.

GUITAR, Fender Mustang electric, 1966 model year, bright red, with original hard shell case, vg condition, $395. 626/351-5485.

JACKET, soft leather, female, never worn, bomber style, med. sz., tan color, orig. $350, sell for $150. 626/798-6248.

JACKETS (2), blue Levi-type, ex. lg. w/thread pic of country star Patsy Cline, mint, $35; red satin-type w/old Budweiser bow tie, mint, $15. 248-5282.

JEWELRY, costume, some vintage, old watches, pins & earrings; various prices. 626/398-4960.

MODEM, Apple Geoport adapter fax/modem, Model M1694 express for power Mac, $25. 541-0062.

MONITOR, Magnavox 14" color for Macintosh; exc. resolution/contrast/condition; yrs. left, $50. 626/441-8572.

ORGAN, Yamaha 415 electronic console w/13

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pedals, 3 keyboards, 144 rhythm patterns, pd. $7,500, sacrifice for $3,000. 790-3899.
PHOTOGRAPHS, 40" x 30", color, framed, 2 tall-ship pictures taken by prof. photog., vg cond.; 1 of Spanish tall ship in SF Bay, 1 of German tall ship taken near Puerto Rico; $70/each, $120 both/obo. 626/568-8298.
PICTURE FRAMES, three made of brass, 22" x 28", $6/each, $15 for all three/obo. 626/568-8296.
POOL COVER WINDER, 24' wide, portable. 909/591-3312.
PRINTER, B&W, HP Deskjet 520, 600 x 300 dpi, $50. 790-4455.
PRINTER, Xerox Diablo 630 with wheels/ribbons, excellent condition, $10/obo. 626/568-8298.
SNOWBOARD BOOTS, size 7-8, clean. 952-8455.
SOFA, lg., off-white, fair cond., $50. 805/259-2201.
SPEAKERS, Advent, good condition, $80/pr. 952-8455.
SPRINKLER VALVE ADAPTERS, Lawn Genie automatic , model 756LG 3/4, New, $10 each. 790-3899.
TABLES: coffee table (approx. 60 x 30); matching end table (approx. 24 x 27); exc. quality and condition; oak with leaded glass inserts; $250/both. 626/296-1537.
TABLES, glass, four 2-shelf tables with brass feet, three make up a coffee table (one round 2.5-ft. dia., two "half-moon"), fourth is round end table (2.5-ft. diameter), $125/obo. 909/592-0780, Ana.
TABLES, oak, 1 coffee & 1 end table, $35 each; DOORS, 3, white, sliding, 36 x 78 each, with all hardware, $75. 362-3358.
TELEVISION, RCA ColorTrak, 25" screen, attractive cabinet, rotates on base, overall dimensions 34" x 19" x 30", good cond., $45; indoor TV antenna (rabbit ears), rotating type, RCA, vg cond., $12. 626/577-8107.
TENNIS RACKET, Prince Magnesium Pro, never been used, w/cover, $40 firm. 626/441-8572.
TOOLS, Craftsman router & table, $20; doweling jig, $5; mitre box & saw, $10; make offer. 805/274-7954.
TV, GE 27" color console, gd. working condition, $175/obo. 626/955-1387, after 7 p.m.
WEDDING DRESS, excellent condition, used once, kept in garment bag; white, straight, long sleeves, bow in the back, $40/obo. 626/568-8298.
WORK BENCHES, 2 ea. 8-ft. and 6-ft. with drawer and top shelf plus component rack, $125/ea./obo. 365-3799, Dave or Lucy.

VEHICLES / ACCESSORIES

'94 ACURA Integra LS, white 2-dr. sport coupe, 5-speed w/6-disc CD changer, alarm, a/c, moonroof, ABS, perfect condition with clean history; no repairs needed, a must-see value, $8,950/obo. 626/792-2180.
CAR COVER made for Lexus ES300, bought from dealer with purchase of the car, $75/obo. 626/568-8298.
'74 CHEVROLET Impala, 2 dr., 80K orig. miles, very well maint. (grandparents' car), clean in/out (few dings), runs great, $1,500/obo. 249-8271, Diana.
'67 CHRYSLER 300, pwr. brakes/windows, exc. body cond. & upholstery, 400 engine needs repair, $2,200/obo. 323/262-7685.
'96 FORD Contour SE, 46,000 miles, black with gray int., 5-spd, CD player, tinted windows, rear defroster, cruise control, keyless entry, power windows/doors; extended warranty available, $10,500. 362-3358.
'95 FORD Escort LX station wagon, auto, a/c, dual airbag, a/m cassette, silver, very clean, exc. cond., $6,000. 323/878-6659.
'94 GEO Prizm, auto, CD changer, A/C, power locks, new timing belt and tires, 76K miles, $6,800/obo. 626/445-0090.
'98 HONDA Accord, 24K miles, clean inside and out, automatic 4-door sedan, champagne color, power windows/locks/steering, alarm, a/c, am/fm cassette, sunroof, $18,000/obo. 323/299-5013.
'93 JEEP Wrangler Sport Utility 2D 4WD, exc. cond., 5-spd. manual, 4.0L inline 6 cyl, soft-top, blue 2-tone paint, running boards, pwr. steering & brakes, tilt whl., AM/FM cass. stereo, prem. sound package & overhead speakers, locking trunk, alarm w/microwave proximity sensor, 55k mi., $9,500/obo. 626/398-6356, mjburns@ix.netcom. com.
'85 JEEP Cherokee Pioneer, 4WD, 6 cyl, gold/tan, power everything, 1-yr.-old engine and carburetor, 2-yr.-old paint & upholstery upgrades, 2d owner, runs great, $3,800. 626/536-4446 or 661/269-0926.
'82 HONDA FT 500 'Ascot' motorcycle, gd. learner bike, needs work, $350. 957-9745.
'88 KAWASAKI Ninja 250, exc. cond., very reliable, red, $2,700/obo. 225-7287, Josh.
'96 LEXUS, white, tan interior, 13,000 miles, CD changer, $23,000. 248-1856, Gordon.
MOTORCYCLE HELMETS, Shoei, pearl white, 7 1/8-7¼ size, exc. cond., hardly used; one is "full face" RF 200 w/clear & smoke face shields; other is "open face" RJ 101V; $200 each / both for $300. 626/335-1816.
'95 NISSAN 200SX SE black coupe, exc. condition with auto, air, cruise control, dual airbags, power door locks, power steering, power windows, tilt steering wheel, AM/FM cassette stereo, 30K miles, $8,900/obo. 790-4703.
'84 NOMAD travel trailer, 4 new tires, 21½ foot, sleeps 6, stove, fridge, a/c and heater, $3,000/obo. 626/798-6248.
'90 SKAMPER pop-up tent trailer, sleeps 5, propane fridge, sink, toilet, electrical wiring for towing included, $2,000. 626/358-1786.
'98 TAHOE trailer by Thor, 24', queen-sz. bed, sofabed, dinette-bed, microwv., awning, air, stereo, all amenities, used 3x, $11,500. 805/533-4255.
'91 TOYOTA Camry sedan, 2.0L, 4 door, auto, 88K, A/C, am/fm/CD, new brakes, PS/PB, alarm, remote entry, crse. ctl., exc. cond., $6,500/obo. 909/624-3181.
'85 VOLVO DL wagon 5D, 4-cyl. 2.1 liter, 5-speed manual, 90,000 miles, air conditioning, power steering; am/fm stereo, $3,500. 790-4455.
'86 VW Golf, 5 spd., well-maintained, exc. gas mileage, $1,700. 626/683-7018.

FREE

CAT, young female, sweet, affectionate, playful, no bad habits, all black, short soft fur, spayed, gd. health, but I'm allergic. 626/797-9009.
HOUSE SITTING, married couple, no kids or pets, available (including watering, lite gardening) on a weekly basis, while you're off enjoying your vacation, Glendale/Pasadena area preferred. 209-586-7323.

WANTED

ENGRS, TECHS, WELDERS: volunteers to upgrade Mt. Wilson 60" telescope into 21st cent.; mech. engr. exp. in electromag braking, var. spd. motor drives; investigate dome trucks problems, others; computer engr., poss Y2K prob.; dome door fab.; repair electronic equip. 626/289-1023; fax 626/576-1550, Earle Bunker, will answer after 5/15.
HOUSE in La Canada, 3-bd., to rent/lease, responsible JPL family. 626/794-2758, Betsy Wilson.
PERSON who was/is collecting Boy Scout accessories. 626/355-2897.
ROOMS OR APARTMENTS: JPL's Educational Affairs Office seeks employees who have accommodations (preferably furnished) available for rent to out-of-state summer interns, approx. 10-12 weeks (May 24–Oct. 12) or for JPL/Caltech Summer Faculty Fellows (June-August); contact Juliet Ellis at ext. 4-0726.
SPACE INFORMATION/memorabilia from U.S. & other countries, past & present. 790-8523, Marc Rayman.
TOOLS for stained glass, e.g., grinder, cutters, etc. 248-4254.
VOLLEYBALL PLAYERS, coed, all levels of play, Tuesday nights 8-10 at Eagle Rock High School, $4/night. 956-1744, Barbara.
WATCHES, old, especially manual wind and automatic wristwatches, in working condition or not. 310/399-4502 or page 310/870-2034.

FOR RENT

ALTADENA house, 2 bd., 1 ba., lg. fenced yd., washer and dryer, fireplace, mountain view; owner working at Kennedy Space Center; $1,200 + plus security deposit. 407/351-7060.
GLENDALE, darling, large 1-bd. apt. with small bonus rm., newly re-decorated, wall-to-wall carpets, air conditioning, dishwasher, $650 incl. water, gas and basic cable. 241-9448.
GLENDALE, lovely 2-bd., 1-ba. home, lg. yd., near park and transportation, no garage, $800. 246-2127.
GLENDALE house, 2 bd., 1 ba., LR, DR, encl. patio/playroom, 15 min./JPL, garage parking for 1 car, water/gardener pd., avail June 15, $850. 249-3602.
GUEST QUARTERS w/private entrance & parking, 1-bd. suites incl. living rooms, full baths, dining rooms, min. kitchen fac., private patios & laundry, cent. a/c, all utilities and cable, no smoking or pets, shared cost $650/$850. 957-2173.
HOUSE to share, across from JPL; wood floors, fireplace, private, nice backyard, $500 + ½ util. 626/798-6302, Michele.
LA CANADA guesthouse w/its own st. address, 1 bd., includes off-st. parking, water, gardeners, shared access to tennis courts, avail. June 1, $840. 952-1304.
SOUTH PASADENA, roommate to share a spacious 2 bd./2 ba. apt., gated entry, covered patio, fireplace, balcony with city view, prefer female roommate, in early-mid 20s, $412.50 + electricity + deposit. 626/441-7338, Zoe.
SOUTH PASADENA, fully furnished studio apt., nice area at 1718 Huntington Dr. between Marengo and Milan Sts., car space, laundry facilities on premises, utilities paid, non-smoker, no pets, $565. 626/792-9053, Marilyn.
TEMPLE CITY, 3 bd., 2 ba., central heat/air, fireplace in liv. rm., dining rm., dishwasher, near shopping area and schools, quiet neighborhood, $1,500. + first and last. 626/445-7228.

REAL ESTATE

BIG BEAR, new cabin 2 blocks from lake, 2 bd., 2 ba., mud/laundry room, $129,000. 909/585-9026.
LA CANADA, 3 bd., 2 ba., 1,650 sq. ft. Spanish style home in uniquely private verdant setting; near Montrose shops, park with tennis ct.; solar water for house and spa; hardwood floors, Berber carpets, Corian kitchen, cul de sac; central heat/air; La Canada schools, $379,000. 249-8088.
MOHAVE VALLEY, ARIZ., 2 bd., 2 ba., spacious mobile home on 50' x 100' lot w/attached storage, private marina, boat/RV parking, property enclosed with gating and many trees for shading, 13 miles from Laughlin, walking distance to Colorado River/marina, great family vacation spot, $43,500. 626/969-5892.
PASADENA, 3-bd., 2-ba. home in Lower Hastings; move-in condition, new roof, new copper plumbing, hardwood floors, cent. air/heat, upgraded kitchen, new paint in/out, lg. fenced yd. in rear, $349,500. 626/446-1140.
SAN DIMAS, in secluded Via Verde area, 4 bd., 3 ba., alarm, 3-car garage, marble floors, large landscaped backyard with automatic sprinkler system, barbecue area, spanish fountain, automatic wireless outdoor lighting, palm trees, covered patio, red brick pathways/walls, built in 1988, $500,000. 626/568-8298.
TEMPLE CITY, 3 bd., 1.75 ba. 2-story home, new CH/A, dishwasher, paint, shutters, newer roof, open floor plan, low-maintenance yards, fireplace, $233,000. 626/462-2424.

VACATION RENTALS

BIG BEAR, 7 mi./slopes; full kitch., f/p, 2 bd., 1 ba., sleeps 6; reasonable rates; 2-nt. min.; no smokers, no pets; exc. hiking, biking, fishing nearby. 909/585-9026, Pat & Mary Ann Carroll.
BIG BEAR cabin, pleasant, quiet area near village, 2 bd., sleeps 8, completely furnished, F/P, TV/VCP, $75/night. 249-8515.
CAMBRIA, ocean front house, exc. view, sleeps up to 4. 248-8853.
HAWAII, Kauai ocean front, 1 bd., 1 ba., condo, sleeps 4, full kitchen, pool, Jacuzzi, BBQ, anytime this year, $100/night, need to reserve by June 30, '99 (timeshare). 213/296-6641.
HAWAII, Kona oceanfront condo on Big Island of Hawaii; 1 bd., 1 ba., sleeps 4, 50 yards from ocean, two pools, private beach, all amenities and good restaurants nearby; week of July 9-16 only (timeshare), $500/week. 790-8069.
HAWAII, Kona, on 166 feet of ocean front on Keauhou Bay, private house and guest house comfortably sleep 6; 3 bd., 2 ba., rustic, relaxing and beautiful; swimming, snorkeling, fishing, spectacular views, near restaurants, golf courses and other attractions; low-season rates begin May 1. 626/584-9632.
LAKE TAHOE, North Shore, 2 bd., 2-1/2 ba., sleeps 6-7, private sandy beach, great location, all amenities, pool, walk to golf course, fishing 150 yards from front door, great hiking, kayaking, river rafting, bike trails, 2 miles/casinos, JPL discount rate. 626/355-3886, Rosemary or Ed.
MAMMOTH condo, studio + loft, 2 ba., fireplace w/wood supplied, Jacuzzi, sauna, game rm., color cbl. TV/VCR, full kitchen w/microwave, terrace, view, amen. 714/870-1872.
MAMMOTH condo in Chamonix, 2 bd., 2 full ba., slps. 6, fully eqpd. elec. kitch., microwv. & extras, frplc./wood, color TV, VCR, FM stereo, o/d Jacz., sauna; gm., rec. & lndry. rms., play & BBQ areas, convenient to shops, lifts, hiking, summer events; daily/weekly rates. 249-8524.
MAZATLAN, week of Oct. 11-18, 1-bd. condo, sleeps 6, on the beach, partial kitchen, airfare not included, $1,050. 626/917-0231.
PACIFIC GROVE house, 3 bd., 2 ba., fp, cable tv/vcr, stereo/CD, well-eqpd. kitch. w/microwv., beaut. furn., close to golf, beaches, 17 Mile Dr., Aquarium, Cannery Row, JPL discount. 626/441-3265.
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.
SOUTH LAKE TAHOE KEYS waterfront vacation home, 4 bd./3 ba. (1 bd. & living room upstairs, handicap access fair), sleeps 12+, fireplace on 2 levels, decks overlooking private dock & ski lifts, gourmet kitchen, bicycles, 20' sail & paddle boats, 3 color TVs, VCR, stereo with tape & disk, assn. indoor & outdoor pools, hot tub & beach; 8 lighted tennis courts. 10 min. to skiing, casinos, golf; 1 hour to Western Sierra wine country, $1,095/week for high season [15 June to 15 Sept; 22 Nov. to 1 March]; $495/week low season, plus $90 cleaning fee, 3-day min. 626/578-1503, Jim Douglas.

NOTICE TO ADVERTISERS

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

Universe

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Mark Whalen

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