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1997—The year of Mars Pathfinder

Mission captivates the world while setting new standards in planetary exploration

By DIANE AINSWORTH

Of all the headline news in 1997, Mars Pathfinder's remarkable landing and performance on the surface of frozen, nearly airless Mars stole the show. Pathfinder became a landmark mission and a catalyst for new and affordable ways of exploring other worlds.

Pathfinder's landing marked America's return to the red planet after more than 20 years. In addition to a swift, seven-month cruise to the planet, Pathfinder dived directly into the Martian atmosphere and landed with the aid of a parachute and giant cocoon of airbags. This novel entry technique had never been demonstrated before.

Nor had any spacecraft before Pathfinder

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UNIVERSE PHOTO

Memories of the Pathfinder mission will live on with a new stamp issued by the U.S. Postal Service, which shows the first image received from the spacecraft after its July 4 landing. Presiding at the Dec. 10 "first day off issue" ceremony are, from left, Project Manager Brian Muirhead, Postal Service Board of Governors Chairman Tirso del Junco and JPL Deputy Director Larry Dumas.

Reconfigured MGS ready for mission based on new orbit

By DIANE AINSWORTH

1997 saw the arrival of two spacecraft at Mars and the beginning of an extended program of Mars exploration. Two months after Pathfinder's landing, NASA's Mars Global Surveyor was captured in orbit on Sept. 12, after a 10-month journey through deep space.

Global Surveyor was designed to replace Mars Observer, which was lost in August 1993. Ingenuity, teamwork and an exceptionally dedicated group of engineers and scientists quickly went to work to develop and launch the spacecraft within a

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Cassini well *on its way* to Saturn

By MARY BETH MURRILL

After years of diligent work to design, build and test the Cassini spacecraft, its instruments and ground systems, the mission team was rewarded this year with a dramatic predawn launch on Oct. 15 from Cape Canaveral, Fla. as Cassini began its long voyage to Saturn.

Cassini team members from across the U.S. joined fellow mission contributors from the European Space Agency and the Italian Space Agency to watch the Air Force Titan IV/Centaur launch vehicle lift Cassini into a moonlit sky studded with silvery clouds.

Since then, the spacecraft has remained in excellent health as it travels toward its first mission milestone—a swingby of Venus on April 26, 1998.

"Everyone who contributed to the program, and their families too, can take pride in the perfect launch and Cassini's superb performance now that the mission is under way," said Cassini Program Manager Richard Spehalski. "Designing, building and launching Cassini was an incredible effort by the best people in the business," he said.

"Many of the people who worked on Cassini are moving on to other projects now, and those projects will benefit from the commitment to excellence and mission success that permeated every aspect of Cassini's development."

After a complete systems health check, the spacecraft team, which built Cassini, formally turned over control of the spacecraft to the operations team that will fly Cassini and conduct day-to-day operations throughout the rest of the mission.

The last of NASA's flagship planetary exploration missions, Cassini will perform an intensive, detailed study of the Saturnian system, including the ring system, the planet, its magnetic environment, and moons, espe-

See Cassini, page 2

Galileo starts two-year extended Europa mission

By JANE PLATT

After yielding a rich harvest of science results in 1997, NASA's Galileo spacecraft wrapped up its primary mission on Dec. 7 and began a two-year follow-on journey, known as the Galileo Europa mission.

The transition from primary to extended mission brought a change in management. Bob Mitchell, who served as mission director for the last year of Galileo's primary mission, was appointed project manager for the Galileo Europa Mission, taking over from Bill O'Neil, who served as Galileo project manager for the flight to Jupiter and the two-year primary mission at Jupiter. O'Neil will serve as a consultant on the senior staff of JPL's Telecommunications and Mission Operations Directorate pending his next assignment at the Laboratory.

"A great bounty of Jupiter system science has been obtained and the continuing study of these data will surely add many more important discoveries," O'Neil said of the mission. "I've been involved with the Galileo mission since its beginning in 1977, and have been at the helm since 1990 for the flight to Jupiter, the first-ever outer planet entry and orbit insertion, and throughout the two-year primary mission tour of the Jovian system. I feel extraordinarily fortunate to have had this priceless, truly unique experience. But it is time for new challenges. I am delighted to turn the reins over to Bob Mitchell. Having worked closely with Bob for more than 25 years, I know that he will do

See Galileo, page 6

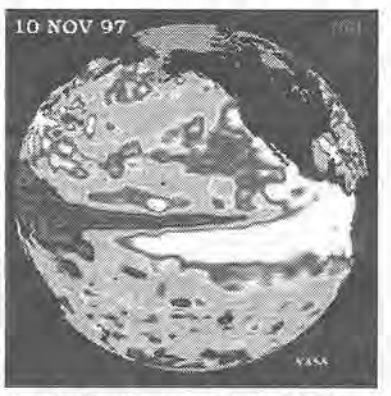
JPL makes big splash with El Niño observations

By MARY HARDIN

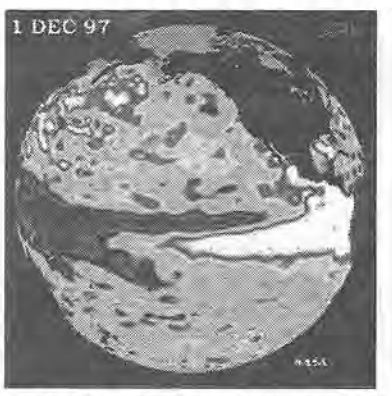
JPL has been riding the wave of early El Niño forecasting in 1997 as three Lab-managed instruments where used by meteorologists to confirm that the ocean warming phenomenon is back in the Pacific.

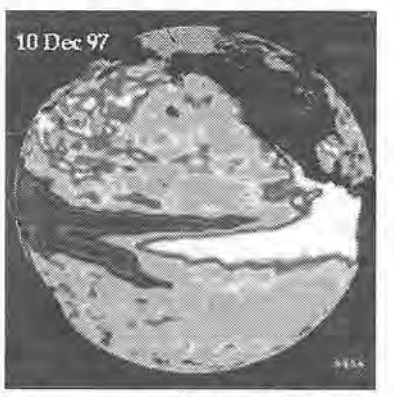
And while the El Niño predictions have resulted in stories of panicked sandbagging and TV weather forecaster hyperbole, JPL scientists say their data show this El Niño is the real thing. JPL's TOPEX/Poseidon radar altimeter, the NASA Scatterometer (NSCAT) and the Microwave Limb Sounder (MLS) have all contributed to tracking the current El Niño condition in the Pacific.

"The sea surface height data that we have collected all year confirm what the National Oceanographic and Atmospheric Administration has predicted—a full-blown El Niño condition is established in the Pacific," said Dr. Lee-Lueng Fu, project scientist for the U.S./French TOPEX/Poseidon satellite at JPL. The five years of global ocean topography observations made by TOPEX/Poseidon have been a boon for El Niño researchers, who have been able to track three El Niño events since the satellite's launch in August 1992.



In July, the white area of high sea level in the Pacific exceeded 1 1/2 times the area of the continental U.S., and the volume of associated warmer-than-average water equaled 30 times the volume of all the Great Lakes combined. This is because for each inch that sea level was raised above normal, the amount of warm water below had increased by 200 inches (it is like an iceberg, where the exposed tip is only a small fraction of the total volume). Early November was marked by a large increase in the areal extent of above-average sea level, especially off the west coast of North America. At this time, sea level "peaked" at about 35 centimeters above average (similar to July) in the eastern Pacific, near the Galapagos Islands.





The beginning of December was marked by a temporary sea level low in the eastern Pacific warm pool (shown as white). By Dec. 10, the volume and area of the warm water pool related to El Niño had increased. Oceanographers believe the recent increases and decreases in the size of the warm water pool at the equator are part of the natural rhythm of El Niño and that the warm pool is occasionally pumped up by wind bursts blowing from the western and central Pacific Ocean.

For more comparative images, go to the Web at http://www.jpl.nasa.gov/elnino

NOAA issued its first advisory regarding the presence of El Niño conditions in May 1997. A number of El Niño forecast activities supported by NOAA indicated the likelihood of a moderate or strong El Niño this winter. The forecast model operated at NOAA's National Centers for Environmental Prediction used data collected by the TOPEX/Poseidon satellite.

An El Niño is thought to be triggered when steady westward blowing trade winds weaken and even reverse direction. This change in the winds allows the large mass of warm water that is normally located near Australia

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Cassini

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cially the big moon Titan. The European Space Agency's Huygens Probe will parachute a science package through Titan's atmosphere and to its surface after Cassini reaches Saturn in 2004. The Cassini orbiter itself, built at JPL, will orbit Saturn for at least four years. Taken together, the scientific information gathered by the 18 instruments on the Cassini orbiter and Huygens probe will provide a comprehensive understanding of the Saturnian system.

Hundreds of supportive e-mail messages of encouragement were received by the JPL home page and the Cassini Web page both before and after Cassini's successful launch. This message came from an Arkansas-based contractor where Cassini work was performed: "Congratulations to you and your fantastic team of people. Everybody at LaBarge is very stoked at the part they have played in the launch. You must have mixed emotions watching Cassini fly away into space. Well, here's to 11 years of great science and the elation you've earned for a job well done (even though it's not over yet)."

More words of support and interest in the mission came from across the U.S. and around the world, even as misinformation about the mission's nuclear safety and radioisotope thermoelectric generators (RTGs) received wide circulation through the news media and the Internet.

PHOTO BY TOM WYNNE / JPL PHOTO LAB

'We're a group of loyal Saturn owners, and they're going to our planet!'

—Trina Ray, Cassini radio science operations engineer

At a Cassini all-hands meeting in November, Trina Ray, left, presents Program Manager Richard Spehalski with a picture showing a gathering of 24 JPL employees who own Saturn cars. Each signed the picture, which has an inscription that says, 'Cassini, there's Saturn in your future.' Looking on is Peter Doms, Cassini mission and science operations manager.

One message from Phoenix was typical: "Believe me, you have many supporters like myself and my friends that are in awe of the information you are gathering about our universe and I look forward to the wonders you will unlock on this mission. Good luck."

A telescope operator at Griffith Observatory weighed in with this reality check: "I have been showing Saturn to the public every night that I work. I have been talking about the Cassini project for the last month, it seems that unfortunately most people are unaware that we are about to embark on this most exciting endeavor, and none that I have spoken to have even heard of RTGs, so that controversy is overblown. The best of luck on launch day and throughout the mission, I know that many wonders await us at Saturn. All I can say is a big THANK YOU for all that JPL's explorations have added to my life."

Cassini's flight through the inner solar system over the next two years will be highlighted by planetary gravity assist flybys of Venus and Earth. The first of Cassini's four such flybys will occur April 21, 1998 when the spacecraft swings around Venus at a closest-approach altitude of 336 kilometers. On Dec. 3, 1998, the spacecraft is scheduled to perform a "deep space maneuver" that will adjust the trajectory to achieve the optimum geometry for the next Venus flyby on June 24, 1999 at 623 kilometers (387 miles) altitude. Cassini's flyby of the Earth will follow on Aug. 18, 1999 at an altitude of 1,157 kilometers (719 miles). ❑

STRV mission will validate spaceborne technologies

In 1998, JPL will manage a validation mission for demonstration of advanced spaceborne technologies that is funded by the Department of Defense's Ballistic Missile Defense Organization.

The Earth-orbiting Space Technology Research Vehicle-2 project, also known as STRV-2, is scheduled to launch Nov. 1, 1998 from Vandenberg Air Force Base.

STRV-2's key test is the use of high modulus graphite fibers and cyanate ester resin composite materials for the three-piece, 14-kilogram (31-pound) spacecraft structure.

Several other of its experiments are designed to gather primary data about radiation, micrometeorites and debris in a high-radiation zone at approximately 1,800 kilometers (1,120 miles) above Earth. This high altitude is desirable for military and commercial satellites which, until now, have typically remained at lower altitudes pending further studies about risks in this zone.

STRV-2 experiments include:

• The Space Active Modular Materials Experiment (SAMMES), featuring four components measuring radiation and solar energy;

• An electronic testbed featuring the investigation both of micrometeorite particles and the use of advanced instruments in a radiation environment;

• A midwave-length imager system for detection of non-afterburning targets from space;

• A satellite-to-ground station laser communications test, encompassing the first-ever demonstration of lasers for space communications; and

• A vibration isolation system testing use of sensitive instruments on vibrating spacecraft.

JPL's contributions cover such areas as configuration control, payload integration, environmental testing and support to mission operations.

Jim Kenny is STRV-2 project manager. ❑

Award for Excellence committee named; nominations under way

A selection committee has been named to review nominations and select award recipients for the upcoming Award for Excellence. The 11-member committee consists of at least one delegate from each directorate and represents the diverse Laboratory population. The committee members were selected based on nominated candidates whose names were recently submitted by each directorate.

The committee includes Katherine Dumas (100), Tania Geddes (190), Marilyn Miller (215), Frank Wright (320), Carl Ruoff Jr. (340), Peter Theisinger (490), James Arnett (505), Michael Nieto (642), Karla Clark (742), Terrance Mason (891) and Fred McLaughlin (920).

The Award for Excellence is an employee-owned program which promotes nominations from any JPL employee. The call for nominations for this cash award began Jan. 5 and will continue until Jan. 23. During the call, JPL employees can nominate any other Laboratory employee for an award in one of four categories: technical excellence, business operations excellence, exceptional quality and exceptional leadership. The award ceremony will be held in April 1998.

Reward & Recognition Administrator Monica Garcia said all employees should have received notification about the program during the first week of January.

Hard-copy nomination forms can be obtained at the ERC, the JPL Library or the Reward & Recognition Program Office at Building 291-205. Microsoft Word versions of the nomination form can be downloaded through the R&R Home Page at http://eis/sec614/reward/excel. htm .

For more information, call Garcia at ext. 4-3825. ❑

Special Events Calendar

Ongoing

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

Codependents Anonymous—Meeting at noon every Wednesday. For more information, 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. For more information, call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

HIV Support Group—Meets quarterly. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 for more information.

Overeaters Anonymous—Meets Mondays at noon. For more information, call Occupational Health Services at ext. 4-3319.

Parent Support Group—Meets the fourth Tuesday of the month at noon. For location, call Jayne Dutra at ext. 4-6400.

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 #11. For more information, call (626) 397-3110.

Friday, January 9

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

Saturday, January 10

California Philharmonic Orchestra—*Serenade for Strings* will be performed at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $40, $35 and $30. For information, call (626) 395-4652.

Sunday, January 11

Chamber Music—Pianist David Koerner and cellist Tom Lloyd will perform a free concert at Caltech's Dabney Lounge at 3:30 p.m. For information, call (626) 395-4652.

Tuesday, January 13

JPL Scuba Club—Meeting at noon in Building 168-427/

Wednesday, January 14

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

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

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

JPL Toastmasters Club—Meeting at 5:30 p.m. in the Building 167 conference room.

"The World of Our Grandchildren: Visualizing Alternative Futures With the World Wide Web"—Caltech professor Dr. Bruce Murray will speak at 8 p.m. in Beckman Auditorium. Admission is free. Call (626) 395-4652.

Thursday, January 15

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

JPL Writers Club—Meeting at noon in Building301-127.

Von Kármán Lecture Series—"Forecasting an El Niño: TOPEX/Poseidon Brings News of Wet Winter" will be presented by Annette deCharon, outreach leader for JPL's Earth science flight projects. At 7 p.m. in von Kármán Auditorium.

Friday, January 16

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

Saturday, January 17

Reduced Shakespeare Company—*The Complete History of America (abridged)* will be presented by this comedy troupe at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $29, $26 and $23. Call (626) 395-4688.

Sunday, January 18

Chamber Music—Classical pieces will be performed by New York Philomusica at 3:30 p.m. in Caltech's Beckman Auditorium. Tickets are $25, $21, $17 and $13. For information, call (626) 395-4652.

Wednesday, January 21

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

JPL Hiking Club—Meeting at noon in Building 303-209.

Thursday, January 22

JPL Atari Club—Meeting at noon in Building 238-544.

JPL Dance Club—Clogging class will be held at noon in Building 300-217.

Friday, January 23

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

Travel Film—Lecturer Bob Willis will present his film *Ukraine* at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $9 and $7. For information, call (626) 395-4652.

Saturday, January 24

Caltech Jazz Bands—The groups will perform a free concert titled "A Little Bit of Gershwin and A Whole Lot of Swing" at 8 p.m. in Caltech's Beckman Auditorium. For information, call (626) 395-4652.

For the record

In the Dec. 12 issue of *Universe*, an incorrect job title was shown for Bernard Cuthbert in the Passings column. He was a mechanical engineer. ❑

New Millennium Program prepares for full plate of missions

By JOHN G. WATSON

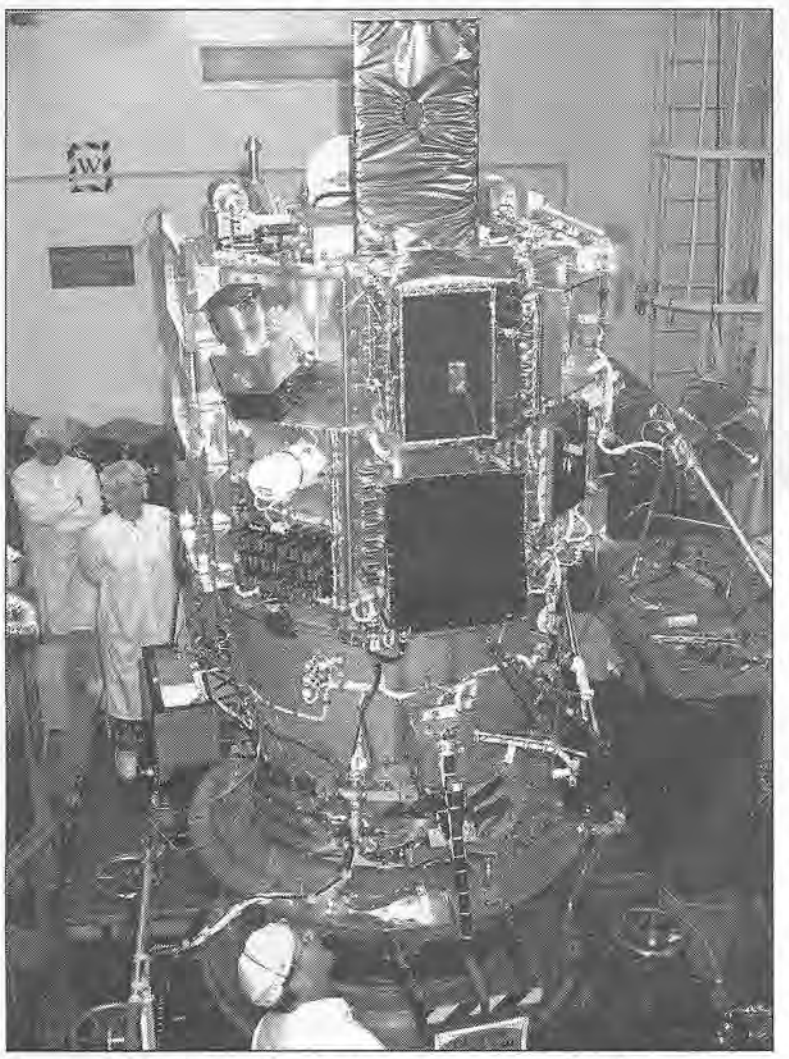
The adventurous New Millennium Program made great strides in 1997 in its preparations for a series of missions launching from 1998 to 2003, with many more in the pipeline.

The program is a flagship NASA venture whose goal is the development and testing of revolutionary technologies in space flight so that they may be confidently used in science missions of the future. Through a series of deep space and Earth-orbiting missions, the New Millennium Program will validate the essential technologies and capabilities required for challenging, new types of missions to be flown in the next century.

In November, Dr. Fuk Li was named program manager, after serving as acting program manager for several weeks following the retirement of veteran JPL manager Kane Casani. Li, a remote sensing expert who most recently served as manager of JPL's Earth Science Program office, has the challenging task of overseeing a wide variety of "faster, better, cheaper" missions whose key technologies typically have never been used in space flight before.

A key element of the New Millennium Program is the teaming of government with industry and academia to improve America's technological infrastructure. For this purpose, a series of Integrated Product Development Teams composed of private firms, universities and research labs are now working to identify, design and deliver technologies needed to enable future science missions so that they can be tested through upcoming New Millennium missions.

Those missions begin this summer with Deep Space 1, whose launch period starts July 1. Flying by asteroid McAuliffe, then by Mars and finally by comet West-Kohoutek-Ikemura, *DS1 will be the first spacecraft* ever to rely on solar electric propulsion rather than conventional propellant-based systems for its main source of thrust.



Spacecraft test engineer Tom Shain, foreground, checks out Deep Space 1 during recent vibration tests in Building 144. The lower of the two dark boxes is the integrated electronics module, while the upper box contains the miniature imaging camera and spectrometer.

Solar electric propulsion is but one of 12 advanced technologies to be demonstrated on this high-risk mission. Others include new telecommunications equipment; autonomous optical navigation; advanced solar arrays; a miniature integrated ion and electron spectrometer; microelectronic devices; and a miniaturized camera and imaging spectrometer that will take pictures and make chemical maps of the target asteroid and comet.

Late this summer, the DS1 bus arrived at JPL from the Arizona facilities of DS1's industry partner, Spectrum Astro, and the spacecraft has since been almost fully assembled. It is now preparing for testing in the 25-foot space simulator in Building 150 in preparation for its delivery to the Cape in early spring.

Deep Space 2 will send two small probes weighing two kilograms (4.5 pounds) each aboard the 1998 Mars Surveyor lander to study Mars' soil and atmosphere. In-situ instrument technologies for making direct measurements of the Martian surface will include a meteorological pressure sensor, temperature sensors for measuring the thermal properties of the Martian soil, and a subsurface soil collection and analysis instrument.

1997 saw many crucial tests of the probe and instrumentation design, nearly all taking place at the New Mexico Institute of Mining Technology's Energetic Materials Research and Test Center in Socorro, N.M. A critical test took place on Oct. 29, when two of the most sensitive subsystems, a battery assembly and a tiny motor and drill assembly for extracting a subterranean soil sample, were successfully qualified. Fully integrated systems testing will take place in 1998 in preparation for DS2's January 1999 launch.

An advanced, lightweight scientific instrument designed to produce visible and short-wave infrared images of Earth's land surfaces was selected as the New Millennium Program's first Earth-observing mission. Launching in May 1999, Earth Orbiter 1 is managed by NASA's Goddard Space Flight Center in Greenbelt, Md. Like DS1, it too will validate 12 technologies.

The mission will serve multiple purposes, including providing remote-sensing measurements of Earth that are consistent with data collected since 1972 by the Landsat series of satellites, which is used by farmers, foresters, geologists and city planners. In addition, it will acquire data with finer spectral resolution, a capability long sought by many scientists studying Earth and its environs, and it will lay the technological groundwork for inexpensive, more compact imaging instruments in the future.

In 1997, a successful EO-1 critical design was conducted. Focal plane and telescope elements are on schedule to be delivered to MIT's Lincoln Laboratory, the instrument integrator, in the first half of 1998. All of the major structural elements of the bus are fabricated, and the mechanical assembly and flight electrical harness are now in process. Spacecraft bus-level integration will begin this spring, and the instrument is due for bus integration at the end of 1998.

In mid-November, NASA announced that Earth Orbiter 2 will encompass the Space-Readiness Coherent Lidar Experiment (Sparcle), flying in the cargo bay of the space shuttle. Scheduled to launch in 2001, its goal is to determine whether a space-based sensor can accurately measure global winds within Earth's atmosphere from just above the surface to a height of about 16 kilometers (10 miles).

Among the many candidate New Millennium Program launches are Deep Space 3, an interferometry mission encompassing three spacecraft orbiting the sun in formation, and Deep Space 4/Champollion, the first landing of a science payload on the nucleus of an active comet.

Landing in 2005, DS4 will analyze the nucleus; conduct an atomic, molecular and mineralogical composition assessment down to a depth of one meter; assess such physical properties as thermal conductivity; send back both standard and stereographic images; and attempt to return a nucleus sample to Earth by 2010.

1997's DS4 activities have included developing detailed designs of the lander and carrier spacecraft, testing of spacecraft anchoring systems at the China Lake Naval Weapons Testing Center in Ridgecrest, Calif., and the construction of a lab at JPL dedicated to the creation of cometary simulant materials that replicate the possible properties of a comet nucleus for further spacecraft anchor and drilling tests. ❑

Origins advances its study of star, galaxy and life formation

By JANE PLATT

1997 was a busy year for the Origins program, an ambitious and intriguing series of missions to teach us more about star and galaxy formation and extend the search for life beyond our solar system.

For the first of the Origins missions, the Space Infrared Telescope Facility (SIRTF), the year was spent with planning and design during the project's Phase B. SIRTF passed its preliminary design review and non-advocate review in late September, and will undergo its critical design review in the fall of 1998. The development of SIRTF's large, sensitive infrared detector arrays was completed and construction of the flight detectors was initiated. SIRTF will enter Phase C/D in April 1998.

With a planned launch in 2001, SIRTF will explore galaxy evolution and star formation in other galaxies, and will probe the distant reaches of the observable universe to study some of the most luminous galaxies known. Within our own galaxy, SIRTF will search for brown dwarfs, and will detect and characterize extra-solar disks that may represent new solar systems forming.

SIRTF will complete NASA's Great Observatories Program, a suite of observatories designed to study the universe at all wavelengths. The other observatories in this family are the Hubble Space Telescope, the Advanced X-ray Astrophysics Facility, and The Compton Gamma Ray Observatory.

NASA has selected the Infrared Processing and Analysis Center (IPAC), which is operated jointly by Caltech and JPL, to be the home institution for the SIRTF science center.

Dr. Tom Soifer of Caltech has been named director of the center, which will be responsible for operating SIRTF and processing its data. The SIRTF mission is managed by JPL for NASA's Office of Space Science.

Another in the series of Origins missions, the Space Interferometry Mission, entered Phase A in October 1997. Chris Jones, the former Cassini spacecraft development manager, was appointed project manager for SIM, which will have an unprecedented ability to pinpoint stars and determine with high accuracy ages and distances in the universe. Within the Milky Way galaxy, SIM will search for signs of planet formation in disks of material orbiting other stars. The spacecraft will look for the wobble of stars that are caused by planets orbiting around them.

As the world's first long baseline optical space interferometer, SIM will serve as a technological stepping stone for the Terrestrial Planet Finder, a future Origins mission designed to capture a "family portrait" of other planetary systems. The Planet Finder would characterize the atmospheres of newly-discovered "Earthlike" planets to determine which of them might be habitable.

The planned Keck interferometer successfully completed its preliminary design review in September, with a critical design review scheduled next summer. The Keck project will link the two 10-meter (393-inch) telescopes at Hawaii's Keck Observatory on Mauna Kea into one interferometer, later adding four 2-meter (79-inch) outrigger telescopes to complete the six element imaging array. The project has begun the process of applying to Hawaii's conservation district for permits to install the outriggers. The linking of the two main telescopes is scheduled for completion in 2000, with 2002 set as the target date for the outriggers to begin operations.

The Keck interferometer will survey 500 nearby stars, using astrometry for extra-solar planet detection. It will look for the wobble caused by planets of a mass as low as Uranus out to a distance of 10 parsecs. The so-called "warm Jupiters," the type of planets currently being detected indirectly, will be seen directly using the six-element interferometer.

In addition, the Keck interferometer will determine the extent of the zodiacal dust clouds believed to shroud other solar systems, gathering information that will affect the design of the Terrestrial Planet Finder.

New images of various celestial objects were captured by the 2-Micron All-Sky Survey (2MASS), which began operations in 1997 using the first of a pair of twin telescopes. The two 1.3 meter (51-inch) telescopes will peer through the Milky Way galaxy's curtain of interstellar dust to conduct a near-infrared survey of the entire celestial sky. Operations began in 1997 at the Smithsonian Astrophysical Observatory site atop Mount Hopkins near Tucson, Ariz., while the other 2MASS telescope, at a National Optical Astronomy Observatories site in Cerro Tololo, Chile, will begin operating in February of 1998. 2MASS, which is primarily funded by NASA, is based at the University of Massachusetts, Amherst. IPAC is processing the 2MASS data.

The survey is designed to catalogue 300 million stars and 1 million galaxies in the local universe, along with such exotic targets as quasars, black holes and brown dwarfs. It will also observe many known asteroids and possibly some comets.

It's expected that 2MASS will discover new infrared sources that may form the basis for future space observatories, like the Advanced X-Ray Facility (AXAF), the Space Infrared Telescope Facility and the Next Generation Space Telescope.

Another project supported by Caltech's IPAC is the Wide-Field Infrared Explorer (WIRE), which has a mission to discover how galaxies change through time and to detect the birth of new galaxies, called proto-galaxies.

Within weeks of the September 1998 launch of the WIRE spacecraft into low Earth orbit, this small telescope will detect tens of thousands of starburst galaxies—galaxies where stars are forming at a much higher rate than usual—as well as an unknown number of proto-galaxies. ❑

Ice and Fire: 3 missions rolled into 1

By JANE PLATT

1997 brought new names and greater budget certainty to the three missions of the Ice and Fire Preprojects. Rob Staehle, formerly preproject manager of Pluto Express, was appointed to manage the preproject work for all three Ice and Fire missions—Europa Orbiter, Solar Probe and the renamed Pluto-Kuiper Express.

Pluto-Kuiper Express underwent a name change to reflect its new designation as an extended mission after the Pluto flyby, to visit one or more objects in the Kuiper disk.

Perhaps the most dramatic change for the Ice and Fire Preprojects came with the budgetary separation of the technology development from the missions. The technology budget received a new start in FY '98 as the Advanced Flight Systems (X2000) Program, under the leadership of JPL's Anthony Spear. The Ice and Fire Preprojects are the primary users of X2000 technology. The Outer Planets/Solar Probe Program, which is to carry out the Ice and Fire missions, is slated for its new start in FY2000.

Although the preprojects' three missions are diverse, they were combined because of the potential for using the same electronics, software, mission operations systems and, perhaps, even the same mission operations teams for all three. The technology of X2000 may enable such a high level of efficiency that the Ice and Fire spacecraft cost could be lower than that of the Mars Pathfinder spacecraft.

Ice and Fire got a big boost in 1997 from various new and intriguing science discoveries. Interest in the Europa Orbiter, for instance, was heightened by the return of fascinating new Galileo pictures showing more evidence that the icy moon may have had liquid oceans at some point in its history, perhaps even today. This premise was boosted by the images of volcanic ice flows and chunky "rafting" features resembling icebergs on Earth.

The science community watched with interest new images from the Solar and Heliospheric Observatory, which showed newly-discovered polar plumes in the Sun's corona. The Solar Probe mission, which is now a serious candidate for a 2004 launch, will fly through those plumes and make in-situ measurements.

The discovery of more objects in the Kuiper disk inspired the broadening of the Pluto-Kuiper Express mission scope, as more questions arise about the farthest reaches of the solar system. ❑

Pathfinder

Continued from page 1

carried a roving vehicle the size of a small microwave oven to the surface of another planet. Pathfinder's companion rover, named "Sojourner" after Sojourner Truth, a female abolitionist who lived during the American Civil War, was the first robotic vehicle ever to make direct measurements of rocks and soil on Mars.

Over the course of three months—which was three times the design lifetime of the spacecraft—Mars Pathfinder returned about 2.6 gigabits of data, which included more than 16,000 images of the Martian landscape from the lander camera, 550 images from the rover and about 8.5 million temperature, pressure and wind measurements. All science objectives had been fulfilled when the mission ended, 83 days after a nearly perfect landing on July 4. The only remaining objective was to complete a high-resolution 360-degree image of the landing site called the "Super Pan," of which 83 percent had been received. The last successful data transmission cycle from Pathfinder was completed at 3:23 a.m. Pacific Daylight Time on Sept. 27, 1997.

Sojourner, built to last seven days, wound up roaming the floor of an ancient flood basin and exploring about 250 square meters (820 square feet) of the Martian surface. In all, the rover traveled a total of about 100 meters (328 feet) in 230 commanded maneuvers, performed more than 16 in-situ chemical analyses of rocks and soil, and carried out numerous soil mechanics and technology experiments.

"The mission demonstrated a reliable and low-cost system for placing science payloads on the surface of Mars," said Project Manager Brian Muirhead. "We've validated NASA's commitment to low-cost planetary exploration, shown the usefulness of sending microrovers to explore Mars, and obtained significant science data to help understand the structure and meteorology of the Martian atmosphere and to understand the composition of the Martian rocks and soil."

"Pathfinder was an unequivocal success and has given us phenomenal insights into how to operate future landers and rovers on the surface of Mars," added Dr. Wesley Huntress, associate administrator for science at NASA Headquarters, when the mission was officially declared over. "I congratulate the entire Pathfinder team on their accomplishment, which is a lofty but wonderful standard for future missions to attempt to exceed."

Part of NASA's Discovery program of low-cost planetary missions with highly focused science goals, the spacecraft used an innovative method of directly entering the Martian atmosphere. Assisted by an 11-meter (36-foot) diameter parachute, the spacecraft descended to the surface of Mars and landed, using airbags to cushion the impact.

This innovative method of diving into the Martian atmosphere worked like a charm. "Every event during the entry, descent and landing (EDL) went almost perfectly," said Mission Manager Richard Cook. "The sequences were executed right on time and well within our margins."

Pathfinder's descent through the Martian atmosphere was nearly flawless. After being suspended from a 20-meter (65-foot) bridle and firing its retro rockets, the spacecraft released a 5.8-meter (19-foot) diameter cluster of airbags intended to soften the landing. The entry, descent and landing sequence marked the first time this airbag technique had been used. Pathfinder hit the ground at a speed of about 18 meters per second (40 mph) and bounced about 16 times across the landscape before coming to a halt, Dr. Tim Parker of JPL later reported. The airbag sustained little damage. To top it off, the spacecraft landed on its base petal, consequently allowing a thumb-sized auxiliary antenna to communicate the successful landing just three minutes after impact.

Once safely on the surface, Pathfinder opened its solar-powered petals and unveiled the small, 10.5-kilogram (23-pound) rover and science instruments to their new home. Science operations got under way within a day of landing, after the rover had exited the lander using one of two exit ramps.

PHOTOS COURTESY OF DONALD FUHRMAN

Pathfinder proved to be one of the most popular and inspirational events of 1997, finding its way into many national publications such as Vanity Fair, Glamour and Self magazine. Celebrity photographer Annie Leibovitz, whose portraits of stars, athletes, business tycoons, politicians and average people have captured some of the most dramatic moments in recent history, met with the Pathfinder team in late September to shoot for a spread in Vanity Fair's December 1997 issue. Linda Robeck, mechanical engineer for spacecraft assembly, poses with Leibovitz (inset). Robeck's husband, Donald Fuhrman, who works in Section 351, caught Leibovitz, right, and her crew as they gathered in JPL's Mars Yard. From left are Tam Nguyen, Matt Wallace, Richard Cook, Brian Cooper, Al Nakata, Donna Shirley (standing), Robeck (kneeling), Kendra Short, Rob Manning, Jennifer Harris and Jake Matijevic.

As the rover ventured out into unexplored territory, the lander's camera began to image the surroundings, often taking shots of the rover so that scientists and engineers could monitor the vehicle's progress. A new portrait of the Martian environment began to emerge as the spacecraft started to record weather patterns, atmospheric opacity, winds and a variety of other Martian conditions. The rover's alpha proton X-ray spectrometer began studying rocks and making direct measurements of their chemical compositions, another first in this mission.

Some of the rocks near the landing site were rich in silica, or quartz, and some were identified as possible conglomerates, reported Project Scientist Dr. Matthew Golombek and his colleagues. Conglomerates are usually formed by running water, which smoothes and rounds pebbles and cobbles found in the conglomerate. Running water would also be the agent necessary to deposit these rocks in a sand or clay matrix.

"If you consider all of the evidence we have at Ares Vallis—the rounded pebbles and cobbles and the possible conglomerate, the abundant sand- and dust-sized particles and models for their origins, in addition to the high silica rocks," Golombek said, "it suggests a water-rich planet that may have been more Earth-like than previously recognized, with a warmer and wetter past in which liquid water was stable and the atmosphere was thicker."

A panoramic view of Pathfinder's Ares Vallis landing site was featured on the cover of the Dec. 5, 1997 issue of Science, showing traces of this warmer, wetter past. The Ares Vallis flood plain was covered with a variety of rock types, boulders, rounded and semi-rounded cobbles and pebbles, deposited by floods which occurred early in Mars' evolution.

"Before the Pathfinder mission, knowledge of the kinds of rocks present on Mars was based mostly on the Martian meteorites found on Earth, which are all igneous rocks rich in magnesium and iron and relatively low in silica," Golombek and his colleagues reported in Science. Chemical analyses of more than 16 rocks and studies of different regions of soil—along with spectral imaging of rock colors, textures and structures—confirmed that these rocks had compositions distinct from those of the Martian meteorites found on Earth.

"The rocks that were analyzed by the rover's alpha proton X-ray spectrometer were basaltic or volcanic rocks, with granite-like origins, known as andesitic rocks," Golombek said. "The high silica or quartz content of some rocks suggests that they were formed as the crust of Mars was being recycled, or cooled and heated up, by the underlying mantle. Analyses of rocks with lower silica content appear to be rich in sulfur, implying that they are covered with dust or weathered. Rover images show that some rocks appear to have small air sacks or cavities, which would indicate that they may be volcanic. In addition, the soils are chemically distinct from the rocks measured at the landing site."

Golombek noted that the rocky surface and rock types found in Ares Vallis matched the characteristics of a flood plain on Earth, created when a catastrophic flood washed rocks and surface materials from another region into the basin. Ares Vallis was formed in the same way that the 40-kilometer-long (25-mile) Ephrata Fan of the Channeled Scabland in Washington state was formed, and the Pathfinder scientists traveled to that area a year before the landing to study the geology and experiment with rover prototype hardware.

Additional data from the Pathfinder landing site revealed that magnetic dust in the Martian atmosphere had been gradually blanketing most of the magnetic targets on the lander over time. "The dust is bright red, with magnetic properties that are similar to that of composite particles," Golombek said. "A small amount of the mineral maghemite has been deposited almost like a stain or cement. These results could be interpreted to mean that the iron was dissolved out of crustal materials in water, suggesting an active hydrologic cycle on Mars. The maghemite stain could be a freeze-dried precipitate."

Another team of scientists used daily radio Doppler tracking and less frequent two-way radio ranging techniques during communications sessions with the spacecraft to pinpoint the location of the Pathfinder lander in inertial space and the direction of Mars' rotational axis.

Dr. William Folkner, an interdisciplinary scientist at JPL, and co-investigators were able to estimate the Martian polar moment of inertia, which showed that Mars had a dense metallic core surrounded by a lighter mantle. The results implied that the radius of Mars' core was larger than about 1,300 kilometers (807 miles) and less than about 2,400 kilometers (1,490 miles). Mars' core and mantle were probably warmer than Earth's at comparable depths.

"Variations in Mars' rotation around its own spin axis are thought to be dominated by mass exchange between the polar caps and the atmosphere," Folkner said. "During winter, part of the atmosphere condenses at the poles. If the southern cap increased symmetrically as the northern cap decreased, then there would not be any change in moment of inertia or rotation rate. However, because of Mars' orbital eccentricity, differences in elevation and albedo, the polar caps are not formed symmetrically.

"The unbalanced waxing and waning of the Martian polar ice caps results in seasonal changes in air pressure at the Pathfinder and Viking landing sites," he added. "These changes in air pressure are correlated with changes in Mars' rotation rate, which have been observed in our radio tracking measurements."

The season and time of arrival of Mars Pathfinder in the late northern summer resulted in some variations in the temperature of the upper atmosphere compared to Viking data, Dr. Tim Schofield, JPL team leader of the atmospheric structure and meteorology instrument, and colleagues reported.

High in the atmosphere, at altitudes of 80 kilometers (50 miles) above the surface, temperatures were cold enough to make carbon dioxide condense and form carbon dioxide clouds. At altitudes of between 60 and 120 kilometers (37 and 75 miles), the Martian atmosphere was an average of 20 degrees colder than Viking measurements, Schofield said. Seasonal variations and Pathfinder's entry at 3 a.m. local solar time, compared with Viking's entry at 4 p.m. local solar time, may account for these variations. On the surface, however, daytime temperatures were typically 10 to 12 degrees warmer than Viking surface temperatures.

Pathfinder measured regular pressure fluctuations twice a day, which suggested that a moderate amount of dust was being uniformly mixed in a warm lower atmosphere, as was the case with Viking data. The daily average pressure reached a minimum on the 20th day of the mission (Sol 20), indicating the winter south polar cap had reached its maximum size.

Schofield said that surface temperatures followed a regular daily cycle, with a maximum of 15 degrees Fahrenheit during the day and a minimum of minus 105 degrees Fahrenheit at night. The science team also observed rapid daytime temperature fluctuations of up to 30 degrees Fahrenheit in as little as 25 to 30 seconds. These observations suggested that cold air was warmed by the surface and convected upward in small eddies.

Among a variety of other science findings, Pathfinder also observed winds that were light and variable compared to the winds encountered by the Viking landers. The winds blew steadily from the south during the Martian nights, but during the day they rotated in a clockwise direction from south to west to north to east. Whirlwinds or dust devils were detected repeatedly from mid-morning through the late afternoons.

Additional scientific findings are likely to result in the months ahead as researchers continue to analyze data from this mission. Meanwhile, another mission—Mars Global Surveyor—will be observing the planet from space, while other missions gear up for launches in the near term. As part of a sustained program of exploration, Mars is likely to become a familiar place to everyone over the next decade. ❑

Next generation: Mars '98

The Mars Surveyor '98 program is the next generation of spacecraft to be sent to Mars. Consisting of an orbiter—to be launched Dec. 10, 1998, and lander, set for launch on Jan. 3, 1999—the Mars '98 mission will add to the knowledge gained by the Global Surveyor and Pathfinder missions. The general science theme for the 1998 Surveyor missions is "Volatiles and Climate History."

The Mars '98 orbiter will arrive at Mars Sept. 23, 1999, while the lander will touch down Dec. 3, 1999.

Upon arrival at Mars, the spacecraft will use a series of aerobraking maneuvers to achieve a stable orbit, and then use atmospheric instruments and cameras to provide detailed information about the surface and climate of Mars.

The '98 orbiter mission will carry a rebuilt version of the Mars Observer Pressure Modulated Infrared Radiometer (PMIRR), as well as the Mars color imaging system. PMIRR will observe the global distribution and time variation of temperature, pressure, dust, water vapor and condensates in the Martian atmosphere. The imaging system will observe synoptically Martian atmospheric processes at global scale and study details of the interaction of the atmosphere with the surface at a variety of scales in both space and time. In addition to the science payload, the orbiter spacecraft will provide an on-orbit data relay capability for future U.S. and/or international surface stations.

The lander will land near the southern polar cap and is equipped with cameras, a robotics arm and instruments to measure the composition of the Martian soil. Two small microprobes are also piggybacking on the lander, which will penetrate into the Martian subsurface to detect water ice.

The science package for the lander includes the Mars Volatile and Climate Surveyor (MVACS) integrated lander payload, the Mars Descent Imager (MARDI) and an atmospheric lidar experiment provided by the Russian Space Agency Institute for Space Science. The integrated lander payload includes a surface stereo imager with Mars Pathfinder heritage; a meteorology package; an instrumented robotic arm for sample acquisition, soil manipulation and closeup imaging of the surface and subsurface; and the thermal and evolved gas analysis experiment for determining the nature and abundance of volatile material in the Martian soil.

The images obtained while the lander descends to the surface will establish the geological and physical context of the landing site. The atmospheric lidar experiment will determine the dust content of the Martian atmosphere above the landing site.

Dr. John McNamee of JPL is Mars Surveyor '98 project manager. ❑

CANADIAN SPACE AGENCY

This radar image shows icebergs calving from the Land Glacier in the Marie Byrd land sector of Antarctica. The glacier is shown flowing through a break in the coastal range, called Ruppert Coast, which extends more than 1,000 meters (3,280 feet) in elevation. The dark area surrounding the glacier on the right side of the image is accumulated snow and is characteristic of the ice sheet that covers nearly the entire Antarctic continent. When the glacier reaches the coast it forms a floating ice shelf that may become cracked by ocean tides.

Lab contribution helps to create best-ever map of Antarctica

JPL played a significant role in creating the best map ever of Antarctica by participating in the Antarctica Mapping Mission in 1997.

The mapping mission used data from the Canadian Space Agency's imaging radar satellite, RADARSAT. JPL provided the complicated mission planning to accomplish the mapping within a three week period in September and October 1997. The Lab also helped with the Synthetic Aperture Radar (SAR) processing and adding data system capabilities to the Alaska SAR Facility (ASF) to incorporate the new data into its data archive.

The science campaign was led by Dr. Kenneth Jezek, from the Byrd Polar Research Center, Ohio State University (OSU). In addition to JPL, the mapping mission was a collaborative effort with OSU, CSA, NASA, ASF at the University of Alaska, Fairbanks, the Vexcel Corporation and the National Imagery and Mapping Agency. In order to obtain this unprecedented map of Antarctica, RADARSAT was rotated 180 degrees so it could image the opposite side of its orbital tracks. This maneuver allowed the satellite to take the first radar images of the continent south of 77 degrees latitude.

Imaging radar is the perfect tool for mapping Antarctica, since radar can image during darkness and through clouds. Antarctica is the last remaining continent to be mapped with high resolution radar, with even cloud-enshrouded Venus having been mapped with radar earlier this decade.

During the dedicated campaign, RADARSAT imaged Antarctica and stored the data onboard, then later in its orbit transmitted the stored data to three ground stations, two in Canada and one at ASF. ASF is processing all the Antarctica data and OSU will generate the complete Antarctic mosaic, that will serve as the baseline for decades to come for gauging future changes in the ice sheet. ❑

Scatterometry program ends year with promise

By MARY HARDIN

For the Lab's scatterometry program, 1997 was a good news, bad news, good news kind of a year.

The NASA Scatterometer (NSCAT) was successfully launched back in August 1996 on Japan's Advanced Earth Observing Satellite (ADEOS). The ocean wind monitoring instrument was one of the first to detect changes in the equatorial trade winds in early 1997 and contributed to the early forecasts of the El Niño phenomenon.

Unfortunately, right when the instrument was collecting its most important El Niño observations, the ADEOS satellite suffered a fatal solar array problem and the mission was lost on June 30, 1997.

However, in an unprecedented move, NASA has approved an immediate new start for a mission dubbed QuikSCAT, for a "quick" scatterometer mission that will pick up where the global ocean wind observations made by NSCAT left off. The mission will fill in the ocean wind data gaps created by the loss of NSCAT and prior to the launch of JPL's SeaWinds on Japan's ADEOS II in the summer of 2000.

"The challenge levied to us requires the satellite, instrument, ground system and launch vehicle be developed, integrated and launched in less than a year, something that has not been accomplished before," said JPL's Jim Graf, the QuikSCAT project manager.

"To accomplish this extremely short schedule, the satellite was chosen from a source with existing satellite hardware and Ball Aerospace was chosen under NASA's newly instituted Indefinite Delivery/ Indefinite Quantity contracts to be the spacecraft contactor," Graf said. "The instrument will be assembled by JPL from SeaWinds hardware spares."

QuikSCAT is planned for launch from Vandenberg Air Force Base, aboard a Titan II vehicle. Total cost for the QuikSCAT mission is approximately $93 million, including $39 million to Ball Aerospace Systems Division for the spacecraft and $22 million for the launch vehicle. JPL's cost to develop the instrument is $13 million. The remainder of the funds are spent on science, operations and ground system support. Congress approved NASA's use of fiscal year 1997 appropriated funds to start the mission.

JPL's NSCAT/SeaWinds program office has been assigned the QuikSCAT management responsibility and will provide management, ground systems and a SeaWinds-type scatterometer instrument. Another unique aspect of the mission will be the collaboration with NASA's Goddard Space Flight Center, which will procure the satellite under the newly instituted Rapid Spacecraft Procurement, which enables a quick acquisition of a science bus.

QuikSCAT will use a rotating dish antenna with two microwave beams of the same design as SeaWinds. The antenna will radiate microwave pulses at a frequency of 13.4 gigahertz across 90 percent of the Earth's ice-free oceans. The instrument will collect wind speed and wind direction data in a continuous 1,800 kilometer-wide (1,118 mile) band, making approximately 400,000 measurements every day.

Measuring ocean winds is important because winds are a driving force for oceanic motions, ranging from small-scale waves to large-scale systems of ocean currents. Winds directly affect the turbulent exchanges of heat, moisture and greenhouse gases between the atmosphere and the ocean. These air-sea exchanges, in turn, determine regional weather patterns and shape global climate.

The QuikSCAT instrument is being built at JPL in the Spacecraft Assembly Facility high bay 2 right next to SeaWinds.

See QuikSCAT, page 8

JPL has major role in Earth Observing System

By MARGUERITE SYVERTSON
Division 32 outreach specialist

After 15 years of scientific studies, agency reviews and cutting hardware, NASA will launch the first spacecraft of the Earth Observing System (EOS) in mid-1998 from Vandenberg Air Force Base. Onboard EOS AM-1 (so named because of its morning equator crossing time) will be five instruments that will study the land surface, clouds, aerosols, oceans, and energy budget. JPL scientists and engineers play a major role in two of these instruments: the Multi-Angle Imaging Spectroradiometer (MISR) and the Advanced Spaceborne Thermal Emission Reflectance Radiometer (ASTER).

"MISR and its aircraft counterpart, AirMISR, and the associated data processing software, are all built by JPL. This has made for a well-integrated team that is very responsive to science needs," explained Dr. David Diner, principal investigator for MISR. The instrument comprises nine cameras that observe the Earth at nine different angles, both fore and aft of the spacecraft. Each camera operates at four different wavelengths (red, green, blue, and near infrared) for a total of 36 different images.

"The experiment represents a new way to look at the Earth," Diner said. "We'll use the multi-angle images to obtain detailed characterizations of airborne dust and haze, clouds and the surface. This will help us understand the Earth's climate." MISR will also provide stereoscopic images of both the land surface and clouds.

ASTER is a cooperative effort between NASA and Japan's Ministry of International Trade and Industry. The instrument was built in Japan, and the international science team is jointly led by Dr. Hiroji Tsu of Japan's Earth Remote Sensing Data Analysis Center and Dr. Anne Kahle of JPL. ASTER's 14 channels in the visible, near infrared, shortwave infrared, and thermal infrared will allow scientists to study volcanoes, geology, topography, evapotranspiration, clouds, ice, and land changes at spatial resolutions of 15 to 90 meters.

Managed by Goddard Space Flight Center, EOS is a long-term mission to study changes in Earth's land cover, oceans and atmosphere in order to understand natural and human-induced changes in the environment. Along with the instrument science teams, 55 interdisciplinary science teams from around the world will use EOS data to study everything from the agriculture of China to Earth's angular momentum.

Two interdisciplinary investigations are led by JPL scientists: "Air-Sea Interaction and Ocean Circulation in Climate Changes," by Dr. Timothy Liu, and "Retrieval, Assimilation and Modeling of Atmospheric Water Vapor from Ground and Space GPS Networks: Investigation of the Global and Regional Hydrological Cycles," led Dr. Jean Dickey. Many other JPL scientists are co-investigators on EOS teams.

Future EOS spacecraft include the PM-1 (named for post meridiem, or afternoon, equator flyover) mission, scheduled for launch in late 2000, and the EOS-CHEM (for chemistry) mission, scheduled for launch in 2002. JPL's Atmospheric Infrared Sounder (AIRS) will fly as one of six instruments aboard PM-1. AIRS will make extensive measurements of surface and air temperatures, humidity, clouds and atmospheric composition to improve climate models, weather predictions,

See EOS, page 8

'97's challenges bring changes to DSN

By SHIRLEY WOLFF
TMOD outreach coordinator

1997 brought many changes to the Deep Space Network (DSN). It was the first full year in which the DSN operated under the management of NASA's Space Operations Management Office. Major organizational changes were introduced within the Telecommunications and Mission Operations Directorate (TMOD) that will result in a truly integrated, end-to-end, multi-mission ground system derived from the DSN and the Advanced Multi-Mission Operations System (AMMOS). It was also a very busy year for tracking activities.

The DSN provided communications support for 46 NASA and other missions, including international customers. Cassini was one of 14 launches, and the Mars Global Surveyor orbit insertion one of 12 critical mission events supported during 1997. The DSN continues to track the twin Voyager spacecraft—in space for more than 20 years—and now more than 6 billion miles from Earth.

The unique demands of the Mars Pathfinder mission created some special communications challenges. To accommodate the difficulties of communicating with the relatively low-powered lander, a rapid paced, quick-response time was essential, requiring the DSN to be exceptionally flexible with schedules. An unusual request from Pathfinder was the requirement to receive semaphore signals sent during the descent and landing. The Galileo telemetry subsystem was modified to process and display the semaphores in real-time. This allowed project personnel to see that events were happening as planned and even that the spacecraft had landed right side up.

For the Galileo mission, the DSN continued to implement the complex arraying function for the return of science data following Jovian moon encounters. Arraying the 70-meter antenna at Goldstone with a 70-meter and two 34-meter antennas in Canberra, Australia, plus the addition of a 64-meter antenna leased from the Parkes Observatory, increased by 10 times the quantity of raw data that could be received from Galileo.

During 1997 two new 34-meter beam waveguide antennas, one each in Canberra and Madrid, Spain, began operational support for the many flight projects that use the DSN. The Canberra antenna played a role in the arraying support during the Galileo prime mission, while the Madrid antenna was operational in time for the October launch of the Cassini mission. Both of the new antennas provided the additional X-band uplink capability required by such missions as Mars Pathfinder, Mars Global Surveyor and Cassini.

Recognizing that the Space Flight Operations Facility (SFOF) has the potential for being a single point of failure for missions, TMOD developed a new Emergency Control Center, which began operations in early October in time for the Cassini launch. Located at the Echo Site of the Goldstone complex, the center provides a backup site from which JPL can sustain emergency mission operations.

TMOD is also preparing for a future where smaller, faster, cheaper spacecraft mean more missions flying concurrently, with greater tracking and data acquisition demands. New technologies will be required to meet this obligation and those under development during the past year include improved error correcting codes, called turbo codes, which will become the standard codes for future missions. Also in the experimental stage is the Spacecraft Transponding Modem (STM), the miniature spacecraft peripheral of the future. The STM combines the functionality of a spacecraft transponder, command unit, telemetry encoding, timing services, and frame interface in a package with far less mass, power and cost than today's transponders.

The DSN Science Team has been supporting the development of an educational program made possible by the decommissioning of DSS 12, a 34-meter antenna at Goldstone. The antenna has been converted into a dedicated radio telescope, remotely controlled by trained volunteers at the Apple Valley Science and Technology Center. A pilot program that enables middle- and high-school teachers to conduct radio astronomy observations from their classrooms was begun in April. Students from nine schools in Alabama, California, Idaho, Kentucky and Michigan successfully conducted observations of Jupiter and participated in data analysis. The program will be expanded during 1998 to include schools nationwide.

In the year ahead, TMOD will continue to upgrade and develop new systems and technologies for the DSN and associated systems to meet the growing demands of JPL's future missions. ❑

Galileo

Continued from page 1

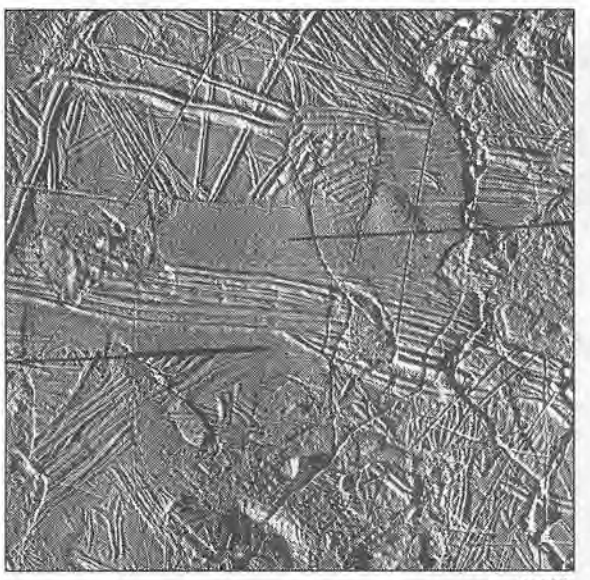
a superb job leading the team."

"Accomplishing what we have set out to do with such a small team is going to be a real challenge," Mitchell said. "But we have an excellent team in place, and I'm looking forward to it."

The first flyby of the Galileo Europa Mission took place on Dec. 16, when the spacecraft swooped past Europa at an altitude of 200 kilometers (124 miles), making it the closest Europa encounter of the entire Galileo mission. The extended mission will include seven more Europa flybys, four encounters with Callisto, and one or two close flybys of Io, depending on spacecraft health.

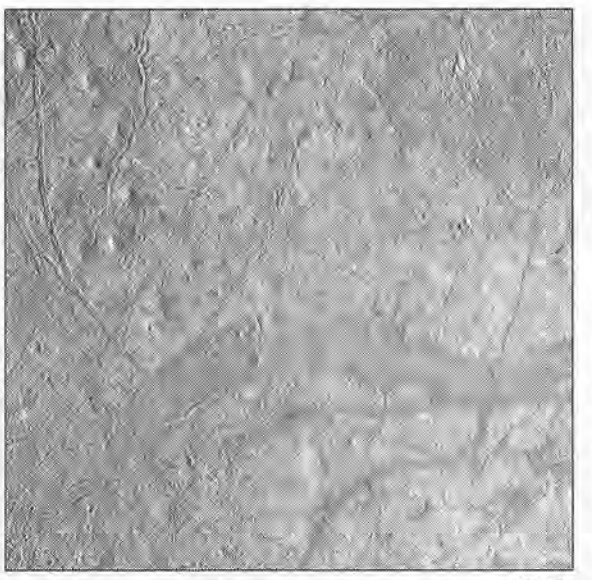
Pictures and other data returned by Galileo during its primary mission continued to fascinate the public in 1997. New images of Europa revealed evidence of ice flows, a complex network of crisscrossed ridges, chunky ice rafts and relatively smooth, crater-free patches. The areas of rafting added to the mounting evidence of liquid oceans under Europa's icy crust at some point in its history. The presence of oceans would increase the odds that life could have existed there.

"We're intrigued by these blocks of ice, similar to those seen on Earth's polar seas during springtime thaws," said Dr. Ronald Greeley, an Arizona State University geologist and Galileo imaging team member. "The size and geometry of these features lead us to believe there was a thin icy layer covering water or slushy ice, and that some motion caused these crustal plates to break up."



P49435

The mosaic above shows some of the highest resolution images of Europa obtained by Galileo's imaging system during its 11th orbit around Jupiter. Hundreds of ridges cut across each other, indicating multiple episodes of ridge formation either by volcanic or tectonic activity within the ice.



P49436

This Europa image, also taken during Galileo's 11th orbit around Jupiter, shows dark and splotchy terrain, including a smooth, gray band in the lower portion. This represents a zone where the Europan crust has been fractured, separated, and filled in with material derived from the interior.

Galileo investigators discovered a hydrogen atmosphere around Ganymede and both hydrogen and carbon dioxide in an atmosphere on Callisto. The spacecraft also found that Europa has an ionosphere, produced by ionization of its tenuous oxygen atmosphere. This finding came after a series of six occultation experiments, when the radio signal was interrupted while Europa was positioned between Galileo and Earth. These experiments were performed during Galileo's encounters with Europa in December 1996 and February 1997.

"While this discovery does not relate to the question of possible life on Europa, it does show us there are complex surface and atmospheric processes occurring there, and Europa is not just some dead hunk of material," said lead investigator Dr. Arvydas Kliore of JPL.

Galileo also transmitted new evidence of numerous high-temperature volcanoes on Jupiter's volatile moon, Io. One recent discovery revealed a new dark spot the size of Arizona on Io. The visible change occurred between Galileo's seventh and tenth orbits of Jupiter, and produced a dark area about 400 kilometers (249 miles) in diameter, surrounding a volcanic center named Pillan Patera.

"This is the largest surface change on Io observed by Galileo during its entire two-year tour of the Jovian system," said Galileo imaging team member Dr. Alfred McEwen, a University of Arizona research scientist.

Other significant results from Galileo this past year included the confirmation of the spacecraft's 1996 discovery of a magnetic field and magnetosphere on Ganymede, and the discoveries that all the Galilean moons except Callisto have a core. Callisto did show signs of surface erosion and blanketing at fine scale.

"Before Galileo, we could only make educated guesses about the structure of the Jovian moons," said Dr. John Anderson, a JPL planetary scientist. "Now, with the help of the spacecraft, we can measure the gravitational fields of the satellites and determine their interior structure and density. We can determine how the matter is distributed inside."

Galileo's instruments also detected some interesting, Earth-like phenomena on Jupiter, including the presence of lightning and aurora. Recent findings confirm the suspicion that the thunderstorms provide energy for the low pressure centers on Jupiter, which in turn feed the Great Red Spot, white ovals and other large storms.

In 1997, Galileo also found clusters of volcanic vents and hot spots in greatest concentration on Io in the areas closest and farthest from Jupiter. Other discoveries include evidence of salt and carbon dioxide in Europa's icy crust and landslides on Callisto.

While the spacecraft was busy making scientific history, Galileo team members made history of their own in January. O'Neil, Johnson, and others met with Pope John Paul II during a trip to Italy.

"None of us ever anticipated that Project Galileo would result in a papal audience, "O'Neil said. "The Pope seemed very interested in learning about Galileo results. He encouraged continuing exploration of the universe."

O'Neil and Johnson received honorary doctorates from the University of Padova and attended the Three Galileos Conference, a meeting designed to honor Galileo the man, Galileo the mission, and Galileo the new national telescope of Italy. ❑

MGS

Continued from page 1

short amount of time and on a tight budget. The time and cost of the mission broke all the records—26 months to build the spacecraft at a cost of only $148 million, which was well under the cost cap and a fraction of what it cost to build previous spacecraft destined for Mars.

Mars Global Surveyor carried six scientific instruments to study Mars' climate, surface topography and subsurface resources. Its primary scientific objective, though, was to map the entire surface of the red planet.

The journey to Mars wasn't as smooth as the team had hoped for, but each problem that cropped up was remedied in a creative and swift manner. In mid-November, as the spacecraft began to aerobrake into the upper fringes of the Martian atmosphere, structural damage to the yoke hinge of one of the solar panels, incurred during initial deployment of the panels shortly after launch, caused the unlatched panel to begin flexing during each dip lower into the Martian atmosphere.

Mechanical stress analysis tests suggested that the solar panel yoke—a triangular, aluminum honeycomb material sandwiched between two sheets of graphite epoxy—had probably fractured on one surface during initial deployment. The analysis further suggested that the fractured surface, with increased pressure on the panel during aerobraking, began to pull away from the aluminum honeycomb beneath it.

The flight team at Lockheed Martin Astronautics in Denver, in collaboration with atmospheric specialists at JPL, decided upon a more gradual aerobraking strategy in which to lower the spacecraft. Aerobraking was reinitiated at 0.2 newtons per square meter (3/100,000 of 1 pound per square inch), about one-third of the original aerobraking level. That level was thought to be safe, but could be adjusted in the event of additional trouble with the panel.

Science teams then came up with a new aerobraking strategy and a new mapping orbit.

The new mapping orbit would be a mirror image of the original mapping orbit, but it would take an additional year to set up. The spacecraft would have to take a six-month hiatus in the spring of 1998 to allow Mars to move into the proper alignment for mapping. The spacecraft's orbit would take Global Surveyor across Mars' equator at 2 a.m. rather than at 2 p.m., and the side of Mars that would have been dark would now be illuminated by the Sun.

"From the perspective of the science instruments, the orbit will look just like the original orbit, except that instead of taking data from north to south on the sunny side of Mars, Global Surveyor will be making its observations in a south to north direction in the sunlight," said Glenn E. Cunningham, Mars Global Surveyor project manager, at a mid-November press briefing at JPL. Rather than reaching its final mapping orbit in mid-January 1998, and beginning the science mission in mid-March 1998, Mars Global Surveyor would achieve its final orbital position in mid-January 1999, and mapping was to begin in mid-March 1999. Apart from the year's delay in beginning mapping, the new mapping orbit would preserve all of the science objectives of the mission.

During next year's hiatus, Global Surveyor will remain in a fixed, elliptical orbit in which it will pass much closer to the surface of Mars during each periapsis—or closest part of its orbit around Mars—than it will in the final mapping orbit. These close-range bonus passes will provide superb opportunities for data acquisition. The spacecraft's full suite of instruments, including the laser altimeter, will be turned on during this time to study the planet close up.

"We expect to gain some spectacular new data during this time," Cunningham said. "The spacecraft's orbit will still be elliptical during this period, with a duration of between eight to 12 hours, but at periapsis, the surface resolution will be much greater and the lighting angles will be spectacular."

If additional problems arise with the aerobraking process, the new mission plan will offer the Surveyor team other opportunities to reach an elliptical orbit that will satisfy many of the mission's science objectives. These so-called "off-ramps" from the aerobraking process will be detailed in a new mission plan to be reviewed by NASA officials in February 1998.

With renewed vigor that the science mission had not been compromised, the flight team resumed aerobraking on Nov. 7. Since then, the spacecraft's scientific instruments have performed flawlessly, continuing to return new information about Martian magnetic properties, its atmosphere, surface features, temperatures and mineralogy.

Among the most intriguing science discoveries was confirmation that Mars had a weak, non-uniform, planet-wide magnetic field. The discovery continues to baffle scientists, but it was the first time that Mars' magnetic field had, in fact, been studied.

The spacecraft's magnetometer, which began making measurements of Mars' magnetic field after its capture in orbit on Sept. 11, detected the magnetic field just four days after the beginning of its orbit around Mars. The existence of a planetary magnetic field has important implications for the geological history of Mars and for the possible development and continued existence of life on Mars.

"Preliminary evidence of a stronger than expected magnetic field of planetary origin was collected and is now under detailed study," said Dr. Mario Acuna, principal investigator of the magnetometer/electron reflectometer instrument at NASA's Goddard Space Flight Center, Greenbelt, Md. "This was the first opportunity in the mission to collect close-in magnetic field data. Much additional data will be collected in upcoming orbits during the aerobraking phase of the mission to further characterize the strength and geometry of the field.

"The current observations suggest a field with a polarity similar to that of Earth's and opposite that of Jupiter, with a maximum strength not exceeding 1/800 of the magnetic field at the Earth's surface.

"This result is the first conclusive evidence of a magnetic field at Mars," Acuna continued. "More distant observations obtained previously by the Russian missions Mars 2,3 and 5 and Phobos 1 and 2 were inconclusive regarding the presence or absence of a magnetic field of internal origin."

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A magnetic field shields a planet from fast-moving, electrically charged particles from the Sun, which may affect its atmosphere, as well as cosmic rays, which are an impediment to life. If Mars had a more active dynamo in its past, as we suspected from the existence of ancient volcanoes there, then it may have had a thicker atmosphere and liquid water on its surface.

—Dr. Mario Acuna
principal investigator of the
magnetometer/electron reflectometer instrument

The magnetic field holds important clues to the evolution of Mars. Planets like Earth, Jupiter and Saturn generate their magnetic fields by means of a dynamo made up of moving molten metal at the core. This metal is a very good conductor of electricity, and the rotation of the planet creates electrical currents deep within the planet, which give rise to the magnetic field. A molten interior suggests the existence of internal heat sources which could give rise to volcanoes and a flowing crust responsible for moving continents over geologic time periods. The latter phenomenon is called plate tectonics.

"A magnetic field shields a planet from fast-moving, electrically charged particles from the Sun, which may affect its atmosphere, as well as cosmic rays, which are an impediment to life," Acuna said. "If Mars had a more active dynamo in its past, as we suspected from the existence of ancient volcanoes there, then it may have had a thicker atmosphere and liquid water on its surface."

It is not known whether the current weaker field now results from a less active dynamo, or if the dynamo is now extinct and what the scientists are observing is really a remnant of an ancient magnetic field still detectable in the Martian crust.

"Whether this weak magnetic field implies that we are observing a fossil crustal magnetic field associated with a now extinct dynamo—or merely a weak but active dynamo similar to that of Earth, Jupiter, Saturn, Uranus and Neptune—remains to be seen," Acuna said.

Mars Global Surveyor is the first in a sustained program of robotic exploration of Mars. In December 1998, a second pair of spacecraft will be launched toward the red planet, carrying instruments that will augment this new global portrait of Mars. As those spacecraft arrive at Mars, Global Surveyor will be generating a global map of the planet that will aid in the selection of future landing sites. ❑

RETURNING SAMPLES OF OTHER WORLDS TO EARTH

Stardust mission to start spacecraft assembly, test

By MARY BETH MURRILL

Stardust, the "faster, better, cheaper" Discovery Program mission that will send a spacecraft to gather a sample from a comet, has met the milestones necessary to begin assembly and test of the spacecraft hardware and software in early January at Lockheed Martin Astronautics in Denver.

Scheduled for launch in February 1999, the Stardust spacecraft will embark on a seven-year journey through the coma and to within about 150 kilometers of the nucleus of Comet Wild-2 (pronounced "VILT-2). It will be the first space mission to gather dust and other material from a comet and bring it back to Earth for scientific analysis.

Stardust's scientific bounty from its five-year voyage will also include samples of the interstellar dust that passes through the solar system. Return of this interstellar material will provide scientists with their first opportunity for laboratory study of the composition of the interstellar medium.

"We've experienced good cost and schedule performance in 1997," said Stardust Project Manager Dr. Kenneth Atkins. "We've learned lessons from previous Discovery projects like Mars Pathfinder, and we've been working to leverage common efficiencies with the other Mars projects being worked by JPL and Lockheed Martin." The project finalized its designs in June and has completed and collected almost all the hardware and software components in preparation for the system assembly and test, Atkins said.

In February, Stardust mission engineers from JPL and Lockheed Martin will convene for a parachute drop test for the Stardust sample return reentry capsule system on the snowy desert plateau of the Utah Test and Training Range near Salt Lake City. The test range is the scheduled delivery site for Stardust's sample return in January 2006.

Comet Wild-2 is a 'fresh' comet which was recently (in 1974) deflected by Jupiter's gravity from an earlier orbit lying much farther out in the solar system. Having spent most of the last 4.6 billion years in the coldest, most distant reaches of the solar system, Wild-2 represents a well-preserved example of the fundamental building blocks out of which the solar system formed.

Both the comet and interstellar dust samples will be collected in aerogel, a lightweight transparent silica gel, the lowest density solid material in the world. (Aerogel was most recently used as a lightweight insulating material to protect the Mars Pathfinder Sojourner's electronics from the harsh, cold climate of Mars.)

See Stardust, page 8

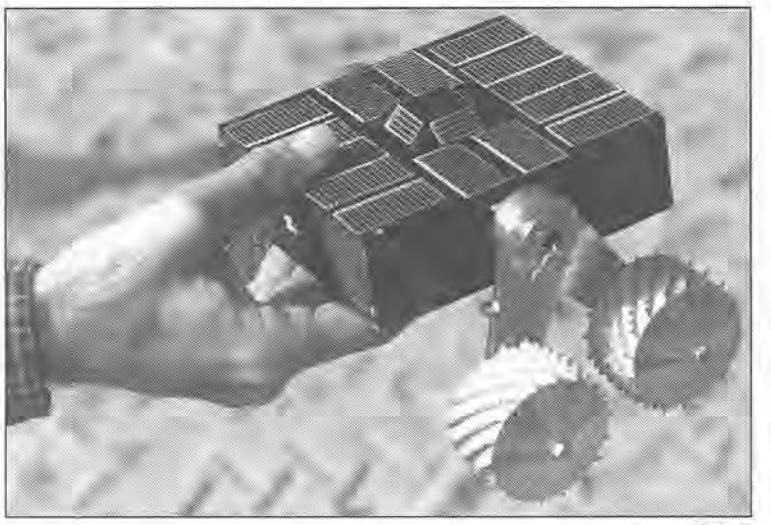
Planning begins on asteroid 'nano-rover'

By MARY BETH MURRILL

A formal project office was established in 1997 to manage the U.S. contribution to the Japanese-managed Muses-C mission to collect and return to Earth a sample from an asteroid.

This innovative mission will use new flight technology, including solar electric propulsion, to send a spacecraft to asteroid 4660 Nereus and deliver a JPL-developed rover, which measures about the size of a shoebox, to the asteroid's surface. The Japanese Muses-C spacecraft will also fire explosive charges into the asteroid, collect the samples that are ejected from the impacts, and return the samples to Earth in a capsule for laboratory analysis. The mission is scheduled for launch in 2002.

"This represents an opportunity for the U.S. and Japan's space engineers and scientists to combine their expertise to achieve major science and technology goals in a cost-constrained environment," said Ross Jones, project manager for the U.S. portion of the mission called Muses-C ("N" stands for "NASA"). Overall management of the Muses-C project resides at Japan's Institute of Space and Astronautical Science.



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This solar panel–powered rover will travel with the Muses-C spacecraft. Measuring about 20 centimeters (8 inches) in length, it will be built by JPL and weigh about 7/10 of a kilogram (25 ounces).

In addition to providing the rover, JPL will arrange for the testing of the Muses-C reentry heat shield at NASA's Ames Research Center, arrange for supplemental Deep Space Network tracking of the spacecraft, and assist in spacecraft navigation. JPL's responsibilities also include arranging for recovery of the return capsule and performance of work to meet the requirements of the National Environmental Policy Act.

The asteroid samples will be returned to a landing site in the U.S, and American and Japanese investigators will collaborate on shared data from the rover and the spacecraft.

In 1997, the JPL Muses-CN project team completed hardware and software integration of a nano-rover prototype. Performance evaluations of the camera and spectrometer for the rover also began, as did research and analysis of navigation and sample reentry work. Preliminary plans for the heat shield design review and testing are in place at the Ames Research Center.

Muses-CN project highlights at JPL in the coming year will include the completion of the rover engineering model design, and release of the announcement of opportunity to the science community, beginning the selection process for scientists who will be investigators on the project. ❑

Tech transfer mission a key for corporate America

End of '97 marks first decade of program

By MERLE McKENZIE
Manager, Commercial Technology Program

Technology has a powerful effect on the productivity and profitability of corporate America. Corporate interest in JPL's technology can have a powerful impact on the Laboratory's future. JPL's "other mission," technology transfer and commercialization, bridges these two needs and the cultures they represent. The Commercial Technology Program Office at JPL provides this vital function.

The end of 1997 also completes the first decade of JPL's technology transfer program. The results—and perspective—are at hand to assess and judge why this leveraging of JPL technology into U.S. companies is so important and how it best works.

The importance of the function has been nationally recognized. As a result of the Government Performance and Results Act, Congress is looking to all federal agencies to ensure the use of the federal technology base by U.S. companies. In response, in 1997's release of the NASA Strategic Plan, the Space Science Enterprise established the goal of transferring technology to achieve globally-competitive economic returns to the nation.

JPL is already successful in this area. Fundamentally, the concept is simple: as part of its exploration mission, JPL continually feeds its technology pipeline from early research to mission application; U.S. companies can then make use of this technology in their markets. In practice, however, three elements are essential for technology transfer to really work. First, companies need to know that JPL proactively pursues technology transfer and how to access it. Second, the JPL technology pipeline needs to be managed and matched to the needs of the companies. Third, the cultural differences between industry and the Laboratory have to be actively bridged. In 1997 JPL continued to make significant progress in all three of these areas.

As the 10-year cornerstone of technology transfer, the JPL Technology Affiliates Program continues to solve individual company problems by employing special JPL technology and expertise. In this last fiscal year, JPL technologists worked on 85 company tasks funded by the companies at $3 million. One example of this work was the transfer of antenna and satellite tracking technology to KVH, Inc., via a NASA license. The result was a new product for mobile, direct broadcast reception, now offered for purchase. The Affiliates Program also provides an avenue for companies to access JPL's test facilities. This expertise and capability shortens a company's product development cycle, getting products into markets sooner.

As part of an annual survey, corporate affiliates gave Technology Affiliates high marks, and continue to vote with their wallets, with an overall repeat customer rate of 75 percent. To date, Technology Affiliates has solved more than 300 problems for U.S. companies and, equally important, built the knowledge and practice required to bridge the culture gap between JPL and industry.

The Technology Cooperation Agreement program completed its NASA-sponsored activity last year. This program is focused on cost-shared, dual-use technology development. To date, 40 joint research and development activities were completed with 44 companies. An example in 1997 is Schick Technologies, Inc., which incorporated JPL research in active pixel technology into a low-cost device for bone density assessment. Direct NASA support for such agreements has been completed, but use of this mechanism will continue through leveraging of existing technology development resources.

Over the last two years, three additional technology transfer processes have been developed. The first targets technology applications in growth markets of high potential value to JPL. The second establishes JPL's intent to play a role in regional economic growth. The third directly supports JPL mission outreach through licensing of copyright, trademark or design patents.

1997 results of these processes include many new relationships. For example, JPL is exploring cooperation on emerging global environmental markets with the Pasadena-based Jacobs Engineering Group, a worldwide engineering and construction company, along with with many local and regional economic development entities. JPL also has licensed, through Caltech, with more than 35 companies whose products engage the public (e.g., Mattel Inc.).

All of these technology transfer programs and mechanisms build from the powerful licensing foundation provided by the collaboration of the Commercial Technology Program Office with Caltech's Office of Technology Transfer and Chief Patent Counsel, and the NASA Patent Counsel and Technology Commercialization Office. The proactive work of these offices is well recognized in the licensing of both software and hardware technology.

Looking to 1998, the new year's resolutions for technology transfer include: additional documentation of processes, increased communications within the Laboratory to demonstrate the technology transfer program's value, and additional focus on supporting JPL's exploration mission. Those who work in the program look forward to new growth in their role in the technology future of both JPL and U.S. industry. Stay tuned! ❑

Lab has strong year for contributions to education

By STEPHANIE ZELUCK

1997 was a year of high activity for JPL's many educational programs, laying the groundwork for how new innovations will influence the teaching of science and mathematics in the next millennium. Among a variety of JPL educational programs, the following show the wide range of programs that are based upon unique JPL/NASA activities and materials that bring inspiration and discovery into the classroom.

KidSat, NASA's pilot education program allowing students across the country to use a space shuttle–mounted digital camera to study the Earth, continued on shuttle flight STS-81 in January, and ended its pilot phase with its inclusion onboard STS-86 in September 1997.

Working with JPL software engineers, students at nearby La Cañada High School developed software to interface with the camera, a data system to archive the downloaded images, and classroom studies called "explorations" that involved detailed studies of areas imaged by the KidSat camera. Additionally, 50 student mission operations centers allowed students around the U.S. to submit image requests to a mission operations gateway at UC San Diego, where they were verified, sent to payload operations at Johnson Space Center, and sent as a camera control file up to the space shuttle.

Curriculum for the KidSat project was developed by JPL, UC San Diego and the Johns Hopkins University Institute for the Academic Advancement of Youth.

Back down on Earth, JPL signed memorandums of understanding to participate in academic development and research opportunities with two universities—California State University Northridge (CSUN) and Columbia University of New York City.

In May, the Laboratory agreed with CSUN to actively share data with the university and provide teacher and student opportunities for enrichment. CSUN is continuing to work with JPL in developing curriculum materials and providing resources in the form of student assistance.

One project included within the partnership is Project SUN (Students Understanding Nature), a worldwide network of detectors operated by students that monitor ultraviolet and continuous flux of solar radiation at the Earth's surface. JPL scientists are using these data to learn more about the Earth surface environment.

The agreement between JPL and Columbia University's Columbia Earth Institute, signed in August, calls for a collaborative study of Earth systems and their impacts on society.

JPL organizations expected to participate in the collaboration will include engineering and science groups involved in synthetic aperture radar, global positioning system technology and applications, Earth imaging, oceanographic science and technology, and atmospheric science and technology.

Under the agreement, activities being considered include joint areas of research and study; exchange of principal investigators and technical personnel; JPL hosting of students on a volunteer basis; participation in post-doctoral research programs; research internships and fellowships; and joint sponsorship of symposia, workshops and conferences.

On the two-year college front, a new program called the Jet Propulsion Laboratory Undergraduate Scholars (JPLUS) will annually award the leading first-year student from each of 25 local community colleges who are majoring in physical science, mathematics, computer science or engineering fields.

JPLUS was created by JPL's Educational Affairs Office as a way to reach out and support undergraduate-level students using the extensive Southern California community col-

See Education, page 8

Niño

Continued from page 1

to move eastward along the equator until it reaches the coast of South America. This displaced pool of unusually warm water affects evaporation, where rain clouds form and, consequently, alters the typical atmospheric jet stream patterns around the world. The change in the wind strength and direction also impacts global weather patterns.

"Since the beginning of NSCAT's operation in September 1996, the scatterometer observed stronger than normal easterly winds in the central and western tropical Pacific, which piled up warm water in the west as indicated by the higher than normal sea level and sea surface temperature," said Dr. W. Timothy Liu, NSCAT project scientist at JPL.

Unfortunately, the NSCAT observations stopped in June 1997 when Japan's Advanced Earth Observing Satellite (ADEOS) suffered a fatal solar array problem and the mission was lost.

Another key component to the JPL El Niño watch has been the water vapor data collected from NASA's Upper Atmosphere Research Satellite (UARS).

"JPL's Microwave Limb Sounder experiment on UARS detected an unusually large build-up of water vapor in the atmosphere at heights of approximately 12 kilometers (eight miles) over the central-eastern tropical Pacific. Not since the last strong El Niño in the winter of 1991-92 have we seen such a large build-up of water vapor in this part of the atmosphere," said JPL's Dr. William Read. "Increased water vapor at these heights can be associated with more intense winter-time storm activity from the 'pineapple express,' a pattern of atmospheric motions that brings tropical moisture from Hawaii to the southwestern United States.

"This phenomena is an example of how the ocean and atmosphere work together to dictate the severity of El Niño events." ❑

Education

Continued from page 7

lege system.

Winners receive $500 and a certificate naming them as a JPL scholar for exemplary work in each of the first two years of school. They will also be given an opportunity to compete for a $4,000 Caltech/JPL Summer Undergraduate Research Fellowship (SURF).

The JPLUS program was dedicated to the late Robert B. Leighton, a longtime physicist and astronomer at Caltech who began his career at Los Angeles Community College. The program has been under way since last May.

Taking hold of the latest in technology, the Consortium for the Application of Space Data to Education (CASDE) created a cutting-edge CD-ROM helping educators, students and environmental resource managers learn how to apply remotely-sensed data to physics, geography and environmental monitoring.

The CD-ROM provided several types of multispectral images as part of "Virtual Nebraska," a prototype of state-wide electronic snapshots called "Virtual America" that will eventually expand to include other regions. The images help in obtaining detailed information about selected cities, including vegetation indexes, census data, water boundary information and land use. The disc also contains links to the CASDE home page, which in turn links to real-time weather related images and data from the GOES-8 and -9 satellites.

CASDE is a partnership between JPL, the University at Nebraska, Lincoln, and Johns Hopkins University. Another CASDE CD-ROM is expected for release in early 1998.

More information on JPL educational projects can be found on the World Wide Web at the following addresses: **KidSat:** http://www.jpl.nasa.gov/kidsat. **Project SUN:** http://sunshine.jpl.nasa.gov . **CASDE:** http://www.casde.unl.edu/casde.html . ❑

EOS

Continued from page 5

and observations of phenomena such as El Niño and La Niña (where trade winds intensify over the Pacific, typically causing more rain in Indonesia and drought in the U.S.). The AIRS science team is led by JPL Chief Scientist Dr. Moustafa Chahine.

The Microwave Limb Sounder (MLS) and the Tropospheric Emission Spectrometer (TES) will fly on the CHEM mission. MLS will continue measurements of ozone, chlorine monoxide, and other constituents that affect stratospheric ozone loss, as well as humidity in the upper troposphere, that have been made by the MLS instrument aboard the Upper Atmosphere Research Satellite since 1991. Dr. Joe Waters is the MLS principal investigator.

TES will monitor those gases involved in ozone formation, acid deposition (acid rain), and volcanic eruptions in the lower atmosphere (troposphere). These measurements will increase scientists' understanding of the carbon cycle, pollution, ozone loss and natural variations in Earth's atmosphere. Dr. Reinhard Beer is principal investigator. ❑

QuikSCAT

Continued from page 5

The SeaWinds instrument is still on track to fly on the Japanese Space Agency's ADEOS II satellite; however, the launch will be delayed by approximately nine months. The engineering model of the instrument has been successfully integrated on the satellite in Japan. Also, a major design change to the SeaWinds instrument was implemented in 1997. NSCAT's performance dramatically exceeded its science requirements, and the change to SeaWinds modified the instrument's resolution from the required 50 kilometers to match NSCAT's actual measurements of 25 kilometers. The hardware and software changes were extensive and the team accomplished them on schedule and without impacting commitments to Japan. ❑

Stardust

Continued from page 7

In November, the project received tens of thousands of responses to its invitation to the public to "send your name to a comet." JPL's Microdevices Lab will etch the names on a silicon wafer that will be placed on the Stardust reentry capsule. The names, collected in partnership with The Planetary Society, will make a round trip to Comet Wild 2, returning to Earth in the sample return capsule. ❑

LETTERS

We wish to thank our JPL friends for their expressions of sympathy for the passing of my brother, Bill, and the ERC for the beautiful plant.

Renee and John E. Miller

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I would like to thank the ERC, and all my coworkers, for their condolences on the death of my mother, and for the lovely poinsettia which was sent to my home. Even at such a time it reminds me of how lucky I am to work with these wonderful people.

Chris Roach

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I would like to say 'thank you' to all the people at JPL who sent me cards with their prayers and well wishes, plants, telephone calls, and gifts during my recent operation -- you don't know how much that meant to me. God bless all of you -- you are very special people.

Socorro Shiraishi

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I would like to thank the ERC very much for the plant they sent me as a condolence for my grandmother's recent death. It was a surprise and came at an important time. Thanks so very much.

Stephen Leroy

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On behalf of my family, I would like to thank all of my friends and co-workers for their thoughts and prayers during the illness and death of my grandmother. Your thoughtfulness gave us great comfort and for that we would like to thank you from the bottom of our hearts. Also a big thanks to the ERC for the beautiful plant.

Carmen Bustamante

FOR SALE

ADVENTURE PASSES to CA national forests, 20 unused, $4 ea. (normally $5). 213/851-2761.

ARMOIRES (2) and vanity w/3 mirrors; antique art deco, walnut color, waterfall; $950/obo. 915-4978.

AUTO ACCESSORIES for Saturn SL series: bra, only used a few times, retail $129, sell $80/obo; Spikes Spider (equivalent to snow chains), used only once, retail $219, sell $175/obo; will incl. maint. manual for free on a first come, first serve basis. 626/445-6170, Valarie.

BABY ITEMS: twin in-line stroller by Belline, $60; adjustable high chairs (2); portable changing table, $5; box of crib sheets and receiving blankets, $5. 805/297-3592.

BIKE, folding, by Dahon, 3 spd., front brake, 20" wheel w/fenders and back rack; fold to very compact size; vg cond.; $130/obo. 626/445-4319.

BIKES, men's 27" Schwinn, $45; men & ladies beach cruiser; girl's 20", $20. 289-2688.

BOOKS, science fiction, classic titles/authors from mid-'50s; call for list of titles; $5 ea. 626/793-7970.

CAMERA LENSES, 2 Minolta lenses for less than one; 50 mm and 28 mm wide angle lens, both with auto focus or manual, $80. 626/813-9959.

CARPET, wool, light slate blue, 12' x 13', exc. cond., pd. $750 10 yrs. ago, sell $350. 626/357-8210.

CELLULAR TELEPHONE, Motorola model #MICRO T-A-C 550, leather case, battery w/overnight charger, car adapter charge cable, manual; in the box; hardly used; $149/obo. 570-0864.

COLLECTIBLES: great Star Wars figures packaged in sets, hard to get beanie babies, Mars Rover Hot Wheels toys and remote control Mars Rovers, other collectible goodies. 626/398-9984, Diana.

COMPUTER CD software for Macintosh, call for list, all $25 and under. 790-3899.

COMPUTER SECURITY KIT (Grimes) for older Macintosh, $10. 790-3899.

COMPUTER, Apple Power Book Duo 280c,12 MB, 320 HD, 28.8 modem, ducking station, 1 GB HD, and all access., $1,200/obo. 832-5556.

DIAMOND, 1.10 caret, VVS1, color I, orig. purchased 1986, proof of sale, $4,750 (pd. $6,000). 909/596-8117.

DIET COURSE, 20 Jenny Craig audiotapes, $40. 790-3899.

EXERCISE MACHINE, Ohaus triple beam balance, 2,610 g., w/attachment weights, little used, $50. 365-3799.

LAWN EDGER and trimmer, McLane, 3 hp gas engine, exc. cond., $60. 626/289-6802.

MONITOR, Radius 21", 2-page display capable of 256 shades of gray, model #TPD; barely used; $349/obo. 570-0864.

ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyboards, 144 rhythm patterns, pd. $7,500, sacrifice for $3,000. 790-3899.

PERSONAL INFORMATION MANAGER, Seiko "Phone-Pal", $25. 790-3899.

ROCKER RECLINERS (2), vg cond., $100 ea. 951-3467.

SKI/EXERCISE EQUIPMENT, Nordic Track Pro Model, exc. cond., cost $600, sell $300. 626/798-9902.

SKIS, Autier, 194, w/Marker titanium bindings, $195; SKI BOOTS, Lange, sz. 12, $95. 213/957-2992.

SKIS, Kastle, Speed Machine GT, 193 cm, never been used, $290. 626/397-7333, Robert.

SKIS, Rossignol DV6S, 188 cm, w/Salomon 857 bindings, almost new, $200. 714/870-1872.

STEPPER, with special pulse monitor, hardly used, exc. cond., $70. 626/446-5718.

SUITCASE, women's 27" w/wheels and shoe space, green soft cover, 1 yr. old, $75; SECRETARY DESK, ca. 1900s, w/middle drawer and 2-shelf bookcase below, $145. 626/793-3571.

SWEATER, Coogi, from Australia, new, $325 at Nordstrom, sell $100. 790-3899.

TICKETS, Kings hockey; individual games; seats located at blue line, Colonnade, section 27, row 11; $45 incl. two tickets and parking. 626/331-9998.

TRAILER, 4' x 8' collapsible; TRICYCLE, adult, side-by-side tandem, 3 spd.; both like new; both for $595/obo. 805/251-7616, Ben.

TREE, live 10 ft. pine, $80/obo. 885-6317.

TYPEWRITER, IBM Selectric III, correctable w/extra elements, (RR clone), exc. cond., $95. 909/596-8117.

WATCH, Piaget, mint cond., 18 ct. wht. gold, 22 flawless diamonds totaling 2.44 carat; blue oval face; weighs 72g; purchased in '73 from Piaget; only worn 3 times; worth $15,000; orig. sales receipt & guarantee papers from Piaget; watch no longer manuf. and considered a collector's item; picture of identical watch online at http://www.elvis-tcb.com/jewels.htm; sell $8,000/obo. 909/350-9218.

WEIGHT SET, Olympic; bench, apparatus, dumbbells, and over 350 lbs. in weights; $175/obo. 541-0794, Marty.

AUTOS / RVs

'94 CADILLAC DeVille, black, like new, low mi. (40K), gold pkg., $19,500/obo. 248-4647.

'91 CHEVROLET S10 pickup, V6, 5 spd., a/c, cass., 2-tone blk. & gray, Tahoe pkg., great cond., 92K mi., $4,500. 248-8789.

'65 CHEVROLET Malibu, all orig., not running, $1,500 w/o engine, $2,000 w/engine. 353-5649.

'63 CHEVROLET Corvette Stingray, gold/saddle int., both tops, $14,900/obo. 887-6903, Mike.

'80 CHRYSLER New Yorker, tropical teal metallic (1 yr. old), 4 dr., all power options, less than 70K mi., leather interior (fair), 2 sets tires/wheels, everything but cruise control works; new water pump, starter; great hwy. cruiser, no drips, smoke, etc.; 360 cu. in. V8; 2nd owner; $2,950/obo. 562/945-1729, Steve.

'96 DODGE truck, blue, auto., 38K mi., loaded, $17,400/obo. 887-6903, Mike.

'96 FORD Escort station wagon, white, auto, super clean, loaded, dual air bags, $6,250. 768-1612.

'94 FORD Escort LX, 2 dr. hatchback, 5 spd., blk., 29K mi., very clean, alloy rims, loaded, $4,150/obo. 504-4905.

'92 FORD Explorer XLT 4x4, leather, auto, loaded, new tires and brakes, 80K mi., exc. cond., $10,900. 957-7434.

'92 FORD E350 luxury van, 460 eng., 11 reclining seats, tow, vg cond., $9,500. 805/265-9572.

'78 FORD Fairmont, 4 dr. sedan, vg cond., orig. owner; blue book 825-1665; $900. 790-7062.

'90 HONDA Accord EX, 4 dr., top-of-line, exc. cond., sunroof & CD player, a/c & all elec., fwy. mi., $6,995/obo. 626/799-4605.

'91 ISUZU Rodeo XS, 4x4, cruise, AM/FM/cass., manual trans., 1 owner, exc. cond., all records, just smogged, $9,200/obo. 790-2238, after 6 p.m.

'78 JEEP CJ5, V8, 304, Golden Eagle, bikini top, 4WD, $3,000. 805/250-8066, Wendy.

'73 JENSEN HEALEY c.v., in storage for several yrs.; recent motor work; gd. cond.; $4,000. 951-3467.

'85 MAZDA RX-7 GS, orig. owner, full maint. records, a/c, alloy wheels, 5 spd., cruise cntl., vg cond., $2,100/obo. 349-3064.

'85 MERCEDES 500SEL, new paint, chrome wheels and moldings, well-maintained, maintenance record avail., 148K mi., runs great, extra clean; $15,495/obo. 570-0864.

'75 MERCEDES 280C, sunroof, new paint & upholstery (2 yrs.), vg cond., all records, $4,250. 799-0109.

'91 NISSAN X-cab, auto, air, ps, pb, wide tires, very clean, must sell, $5,900/obo. 289-2688.

'85 NISSAN Stanza, 4 dr., 116,408 mi., exc. cond., $2,000. 353-2467.

'95 PLYMOUTH Neon Sport, white, 4-dr., auto., pwr. steering, ABS, fog lights, fold-down back seats, exc. cond., $7,400. 951-9635.

'77 SUNLAND motor home, 23 ft., Dodge 440, ps, pb, auto., roof air, 4K generator, slps. 4 + lg. ba., gd. tires, runs great, many extras, smogged Sept., $6,500 or trade. 626/335-2963, lv. msg./ask for Jerry.

'93 TOYOTA Corolla LE, 4 dr., auto., a/c, cruise control, pwr. windows & door locks, factory CD player and AM/FM stereo cass., 50K mi., immac. cond., runs great, $8,500/obo. 249-9437, eves.

'69 VW Baja Bug, stock engine, incl. modified tow bar, used as tow vehicle for motor home, runs exc., $1,400/obo. 349-3064.

'66 VW Type 3 Karmann Ghia, very rare, less than 100 operating in N. America, show quality, award-winning collector's piece, 86,500 actual mi. 790-6851, Roger or Margaret.

WANTED

CARPOOLER from Orange County (Tustin), work 6:45-3:30. 714/731-6076.

COMPUTER (laptop), older model, PC or Mac, suitable for word processing applications. 213/254-8415.

COMPUTER CONNECTOR KIT, AppleTalk, for ImageWriter II; will trade Imagewriter II w/o AppleTalk for one with. 790-6851, Roger.

COMPUTER, portable DOS/Windows-based PC; nonprofit org. seeks loan (few mos.) or gift (tax-deductible). 213/745-2473 (Wed. or Fri.), L.A. Co. Breeding Bird Atlas at Nat. Hist. Museum or 213/221-2022, Larry.

JUICERS, Norwalk Hydraulic Press type and VitaMix (w/metal container). 891-6836, Steve.

PICNIC TABLE w/benches, reasonable cond., for use as potting bench. 909/596-4390.

RADIOS, table model; vacuum tubes and radio magazines; all from 1920s and '30s. 242-8961, Floyd.

SPACE INFORMATION & memorabilia from U.S. & other countries from past & present. 790-8523, Marc.

TUTOR to help develop a Web site using Adobe Pagemill. 766-5354.

VANPOOL RIDERS, full and part-time for van #20, w/stops in Northridge and Granada Hills. Ext. 4-7076, Suzanne.

FREE

CATS, good homes sought for 3 lovable felines; female gray tabby, 2 yrs.; female black longhair, 4 yrs.; male orange tabby, 1½ yrs.; all shots; spayed/neutered; good w/children. 952-8465, Alex.

KITTEN for adoption, 7 wks. old, great personality, litter trained, no fleas, healthy. 626/796-3466.

PERIODICALS: Science News, 4/76 thru 4/95; National Geographic, 6/92 thru 7/96 in official binders. 584-7653.

FOR RENT

ALTADENA house, 2 bd., den w/fireplace, 1 ½ ba., lg. yd., double garage. 445-0123 x-210, Romie Sena.

ALTADENA house, charming 2 bd., 1 ba., nr. Christmas Tree Lane, hrdwd. flrs, fireplc., refrig., stove, washer/dryer, fenced backyd., fruit trees, $1,250, incl. water, gardener, trash, negotiable. 626/794-9579, eves.

ALTADENA, studio apt. at back of house, separate entrance, nice area near Eaton Cyn., $425 incl. util. 626/398-7504.

ALTADENA/Rubio Canyon area, room in private residence, no smoking, no pets, $350. 626/797-8082.

EAGLE ROCK, spacious 2-bd. house w/office, beautiful view, all appliances, lg. yd., 1-car gar., great kitch., security gate, wood floors, $1,000. 213/254-5350.

EAST PASADENA house, , near Eaton Cyn. Nature center, 2 bd., 2 ba., double garage, f/p, blt.-in stove & oven, + 2 rooms attached to front of house with ½ ba. for office; 1607 N. Altadena Dr. 626/794-3906.

GLENDALE, townhouse style 2-story, c/a, 2 bd., 2.5 ba., new carpet, kit./blt.-ins, $725. 240-1523, mgr.

GLENDALE, roommate wanted to share 3 bd. condo, great location, near fwys. & stores, $525 + ½ utils. 247-4025.

GRANADA HILLS, N. of Rinaldi, 3 bd.,2 ba., f/p, new kitchen with blt.-ins, laundry hookups; new floor tile, bar baroque, wet bar; exc. cond., $1,100. 832-5556.

MONROVIA (N. of Foothill), 2-bd. house (rear), cent. air & heat, lndry. rm., ceiling fans, fenced yd., garage; 20 min./JPL; $875 (disc. avail. for early payment). 626/447-1888.

MONTROSE, studio, unfurn. or partly furn., clean, quiet, many trees, 4 min./JPL; for single person, no pets; 2332 Montrose Ave.; $510. 249-7793.

PASADENA, 2 bd., 1 ba., 2nd floor apt., stove, a/c, disposal, lndry., cvrd. prkg.; new carpets, drapes, lino., paint; $630. 790-7062.

PASADENA condo, 2 bd., 2 ba., sec. bldg., 2nd level, spacious, forced air heat & cooling, Sierra Madre Blvd.; rent to own, first 6 mos. rent can be used as purchase down payment; $895. 584-6526.

ROSEMEAD room, share ba. w/1 guy; near fwy. & grocery stores; pool, Jacuzzi, washer/dryer, quiet, clean, a/c-heater, cathedral ceiling; no smoking, no drinking; share utils.; $213. 626/573-5534, Alex.

SIERRA MADRE, share 2 bd., 2 ba. house, exc. location, $425 + ½ util. 626/355-2564, Barbara.

SIERRA MADRE CANYON cottage, quiet, charming, secluded, 2 bd., 1 ba., recently remodeled kitch. & bath; covered laundry area has washer and dryer; incl. parking spot; avail. Feb. 1; $895. 626/564-9607, Diana deNoyelles; e-mail: ddenoyel@co.la.ca.us.

SOUTH PASADENA, 1718 Huntington Dr., good area east of Marengo; fully furn. bungalow studio apt., carport, laundry, air cond./heat; non-smoker; avail. Feb. 1 and April 1; utils. pd., $565. 626/792-9053, Marilyn.

TUJUNGA, 2-story, 3 bd., 2.5 ba. house, w/fenced yd., lg. kitchen, central air, 2-car garage, f/p, washer/dryer, fridge; 1,808 sq. ft., 10 min./JPL; $1,350. 951-1539.

REAL ESTATE

BIG BEAR, new cabin 2 blks. from lake, 2 bd., 2 ba., mud/laundry room, $129,000. 909/585-9026.

CRESCENT CITY, Calif., 3 bd., 2 ba., 1,710 sq. ft., '91 modular home on solid foundation, exc. cond., 60 x 120 fenced corner lot, walk to ocean, island kitch., skylights, sunken tub master ba., landscaped yd., 2-car garage, walk-in pantry & linen closet, lndry. rm. w/sink, near salmon fishing, $98,000. 805/481-8914 or email shartman@gte.net.

GREEN VALLEY LAKE, a secluded village in the San Bernardino Mtns., custom 3-story log home and buildable adjacent lot, beautiful 180-deg. view, lg. decks, shade trees, walk to lake and skiing, call for flyer w/detailed info., cabin $149,000, adjacent lot $19,900. 303-1927.

HIGH DESERT, 5 acres, custom 1,600 sq. ft. home, garage, carport, patios, spa rm., gazebo; 2 wells, mobile sites, 3 lakes w/fish, hundred fruit & shade trees, all fenced and more, $169,750. 626/797-8776.

LAKE CO., N. Calif., 2 1/2 acre lot, in beautiful Kelseyville near Clear Lake, perfect site for permanent or retirement home, 30 walnut trees, paved road, electricity, $36,000. 626/337-7522.

PASADENA, Caltech condo, totally remodeled 2 bd., 2 ba., 1,200 sq. ft., new kitchen and h/w floors, new carpets & paint, top unit in park-like setting; walk to Caltech or Lake Ave., 15 min./JPL; nice pool and spa; $169,000. 626/585-9048.

PASADENA, spacious condo, 2 bd., 2 ba., 2nd level, on Sierra Madre Blvd. in sec. bldg.; rent to own, below-market bargain, $121,950. 584-6526, owner.

TUJUNGA, beautiful 2-story, 3 bd., 2.5 ba. house w/fenced yd., 2 living areas, lg. kitchen, stone f/p, central air, 2-car garage; 1,808 sq. ft., 10 min./JPL; $185,000. 951-1539.

VACATION RENTALS

BIG BEAR cabin, cozy, lg. f/p, slps. 8, 2 bd., compl. furn., TV, VCR, $75/night. 249-8515.

BIG BEAR LAKE cabin, 1 mile to ski slopes, lake, shops, village, forest; 2 bd., slps. 6, fully furn., f/p, TV, VCR, phone, full kitchen, microwave, BBQ and more; JPL disc. price from $65/night. 909/599-5225.

BIG BEAR LAKEFRONT luxury townhome, slps. 6, stone f/p; indoor pool/spa; near skiing. 714/786-6548.

BIG BEAR, 7 mi. from slopes, full kitchen, f/p, 2 bd., 1 ba., slps. 6; no smokers, no pets; exc. hiking, biking, fishing nearby; reasonable rates, 2-night min. 909/585-9026, Pat & Mary Ann Carroll.

CAMBRIA, ocean front house, exc. view, slps. up to 4, $130/night for 2, $185/night for 4; special offer, stay 3 nights and 4th night is FREE, through 1/31/98. 248-8853.

MAMMOTH at Snowcreek, 2 bd., 2 ba., loft, slps. 6-8; fully equipped kitchen incl. microwave, d/w; cable TV, VCR, phone, balcony w/view to mtns.; Jacuzzi, sauna; conv. to shops, restaurants, lifts, spec. JPL rates. 626/798-9222 or 626/704-0455.

MAMMOTH condo in Chamonix at lifts 7, 8, 16, 17; walk to warming hut; 2 bd., 2 full ba., slps. 6, fully equipped elec. kitchen, incl. microwave & extras, f/p & wood, color TV, VCR, FM stereo; o/d Jacuzzis, sauna, game, rec. & lndry. rms.; conv. to shops, lifts; spec. midweek rates. 249-8524.

MAMMOTH condo, 2 bd. + loft, 3 ba., slps. 8, spa, full kitchen, TV/VCR, JPL disc. rates; walk to Canyon Lodge. 249-8088.

MAMMOTH condo, slps. 5, shuttle stop nearby, downtown, $50 Sun.-Thurs., $65 Fri. & Sat. 353-7839.

MAMMOTH condo, studio + loft, 2 ba., fireplace w/wood, Jacuzzi, sauna, game rm., color cbl. TV/VCR, full kitchen w/microwave, terrace, view, amen. 714/870-1872.

MAUI condo, on beach w/ocean view, 25 ft. from surf, 1 bd. w/loft, compl. furn., incl. phone, color TV, VCR, microwave, dishwasher, pool & priv. lanai, slps. 4, 4/15-12/14 rate $95/nite/2, 12/15-4/14 rate $110/nite/2, $10/nite/add'l person, less 10% JPL & Caltech disc. 714/348-8047.

OCEANSIDE, on the sand, charming 1 bd.+ condo, panoramic view, walk to pier/marina, pool, spa, game rm. 714/786-6548.

PACIFIC GROVE hse., 3 bd., 2 ba., fp, cable tv/vcr, stereo/CD, well-eqpd. kit. w/microwave, beaut. furn., close to golf, beaches, 17 Mile Dr., Aquarium, Cannery Row, JPL discnt. 441-3265.

PINE MOUNTAIN cabin, 2 bd., 1.5 ba.; Big Bear w/o the traffic, nr. Mt. Pinos; cross country skiing; $75/night. 310/831-4234, Peter.

ROSARITO BEACH condo, 2 bd., 2 ba., ocean view, tennis ct., pool, priv. security prkg., new 18-hole golf course w/in 5 mi., 20 mi. south of border, short walk to beach. 626/794-3906.

SOUTH LAKE TAHOE KEYS waterfront home, 4 bd./3 ba., slps. 12+; f/p on 2 levels, decks overlooking private dock and ski lifts; gourmet kitch.; bicycles, 20' sail & paddle boats, 3 color TVs, VCR, stereo w/tape & disk; assn. indoor & outdoor pools, hot tub & beach; 8 lighted tennis cts.; 10 min. to skiing; casinos, golf; 1 hr. to Western Sierra wine country; $995/wk. for high season (June 15-Sept. 15; Nov. 22-Mar. 1); $495/wk. low season, + $90 cleaning fee; 3-day min. 626/578-1503, Jim Douglas.

TAHOE DONNER, bright & sunny, fully furn. house, 3 bd., loft, 2 1/2 ba., microwave, fireplace, TV, VCR, AM/FM stereo, slps. 6-8; quiet st., wooded area; close to skiing, tennis, golf. 794-7382, Nancy/Fred.

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Universe

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Mark Whalen

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JPL Photo Lab

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Universe

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Explorer 1 turns 40

Pickering, Stone to revisit launch of first U.S. Earth-orbiting satellite

By MARY BETH MURRILL

The U.S. space program turns 40 on Saturday, Jan. 31—and the public is invited to share in the celebration when space pioneers and others gather at Caltech's Beckman Auditorium at 8 p.m. to revisit the historic launch of the Explorer 1 satellite, developed by JPL four decades ago, before NASA was even born. The event is free of charge.

"Explorer 1: Forty Years After, A Look Back and a Look Ahead" will feature Dr. William Pickering, the former director of JPL and a pioneering space telecommunications researcher who led the Laboratory's work in the Explorer era. He will describe the political, technical and scientific challenges and benefits of the Eisenhower-era race into space after the Soviet Union stunned the world with the launch of Sputnik in 1957. JPL's current director, Dr. Edward Stone, will follow with a presentation on all the exciting space discoveries made since then, and offer his vision for future explorations.

JPL was still operated as a research laboratory for the U.S. Army when it was selected in the autumn of 1957 to develop the first U.S. satellite, science package, communications system and the high-speed upper stages for the Army's Redstone rocket that would launch the tiny, 9-kilogram (20-pound) Explorer 1. JPL and the Army completed the assignment and successfully launched the satellite in less than three months.

"JPL started out as a graduate student project trying to learn how to make a rocket that wouldn't explode and would do what it was supposed to do," Pickering said. Eventually, JPL had a key role in the Army's ballistic missile program, working on the overall rocketry and guidance and control systems. It was this expertise that led to JPL being chosen to work on Explorer 1, he said.

The intensive effort to complete the Explorer mission was accomplished by a team of experts from U.S. academia and the military, along with top World War II German rocket scientists such as Dr. Wernher von Braun, who emigrated to the U.S. in the postwar years to help lead development of American rocket capability. A globally linked telecommunications system developed by JPL tracked Explorer 1 and received its scientific data as it circled the Earth. Amateur radio operators around the world were invited to listen in on Explorer 1's radio communications, including one key amateur radio shack operated largely by JPL ham radio operators at the Los Angeles County Sheriff's substation in Temple City. A cosmic ray experiment onboard was developed by Dr. James Van Allen of the University of Iowa, and returned data that brought the discovery of the Van Allen Radiation Belts that circle the Earth.

JPL's work in accomplishing the successful development of Explorer 1 cemented the Lab's future as a hub for space science and engineering.

"By June of 1958, Congress passed legislation which set up NASA, said Pickering. "By October, NASA began to get down to business, and by September, NASA had picked up the JPL contract from the Army.

The question of what role in NASA we would play had to be addressed and the NASA people pointed out there were three parts to the space program: near-Earth satellites, the manned program, and the deep space program," he added. "I said we wanted the deep space program and they gave it to me and that was it," Pickering said.

For Stone, whose personal scientific endeavors largely focus on the study of cosmic rays, "Explorer 1 was very significant. It's the reason why I've been doing what I'm doing for the last 30 some years.

"The discovery of the Van Allen Radiation Belts was the first significant scientific discovery of the Space Age, and it really opened the field of magnetospheric physics and space plasma physics," Stone said. "It really demonstrated that space was a new frontier of exploration. The first time out, we found something unexpected, so by implication we knew there was a whole lot to be discovered in space.

"I was a graduate student at the University of Chicago when Explorer 1 launched and opened the Space Age," he added. "I wasn't committed to a thesis area at the time, but by 1961 I proposed to fly an instrument in space."

Stone recalled meeting Van Allen in the mid-'50s when van Allen gave a lecture at the

See Explorer, page 2

JPL LAB-ORATORY, FEBRUARY 1958

Following Explorer 1's successful launch into orbit in 1958, then–JPL Director Dr. William Pickering, left, hoisted a model of the spacecraft with Dr. James Van Allen of the University of Iowa, center, who designed a micrometeorite detector and cosmic ray experiment onboard, and Dr. Wernher von Braun, designer of the booster rocket. The photo above shows that the satellite, sometimes called a 'moon,' made headline news.

Galileo anomalies under study

Gyroscope likely culprit in attitude control glitches; situation not considered serious

By JANE PLATT

Members of the Galileo flight team are analyzing data from a test performed Friday night, which they hope will shed light on the cause of two recent incidents of anomalous behavior by the spacecraft. While the investigation continues, the spacecraft has resumed normal transmission to Earth of pictures and other science information stored on its onboard tape recorder.

While one anomaly occurred during the spacecraft's Dec. 16 flyby of Europa, and the other after the flyby, both involved the attitude control subsystem, which controls where the spacecraft and scan platform are pointing. Team members suspect the cause may have been one of the spacecraft's two gyroscopes. The gyroscopes are used to point the spacecraft when very precise pointing control and knowledge of the spacecraft's position and orientation are needed, usually for camera and other remote sensing science observations or for maneuvers that adjust the spacecraft's flight path.

The anomalies were not considered serious, but they did cause a temporary slowdown in the rate at which information was transmitted to Earth. That's because the anomalies caused Galileo's radio antenna to point in a direction about 10 degrees from Earth, about 8 degrees greater than the normal attitude for ideal data transmission. However, information is now being transmitted at a normal rate once again, thanks to a spacecraft turn performed last week which pointed Galileo's antenna within 3 degrees of Earth, a normal angle.

Galileo has begun sending back to Earth some high-resolution pictures taken during the Dec.16 Europa encounter. That flyby was the closest ever to be performed by Galileo, with the spacecraft dipping down to 200 kilometers (124 miles) above the icy moon's surface. This week, Galileo will also return fields and particles information on the interaction between Europa and Jupiter's magnetic and electric field environment.

A flight path maneuver is planned for Thursday evening, Jan. 22, to prepare for Galileo's upcoming Europa encounter on Feb. 10. Special precautions have been taken in the design of this maneuver to minimize its vulnerability to any gyro problems. Because of its proximity to solar conjunction, when the Sun will be between Galileo and Earth, no data collection is planned except for radio science information.

The spacecraft recently began a two-year extended mission, known as the Galileo Europa Mission, which will include a total of eight Europa flybys, four of Callisto, and one or two of Io, depending on spacecraft health. ❑

Former JPLer Thomas on way to Mir

KENNEDY SPACE CENTER

Former JPL researcher Dr. Andrew Thomas, right, poses with STS-89 mission specialist Salizhan Sharipov of the Russian Space Agency and his wife, Nadezhda Sharipova, shortly after arrival at the Kennedy Space Center shuttle landing facility. Endeavour was scheduled for a Jan. 22 liftoff on the eighth mission to dock with the Russian Space Station Mir. After docking, Thomas will transfer to the space station, succeeding Dr. David Wolf, who will return to Earth aboard Endeavour. Thomas will live and work on Mir until June.

Massey named Voyager manager

Ed Massey has been named project manager of JPL's Voyager Interstellar Mission. He replaces George Textor, who retired Dec. 31.

Massey is also project manager of the Ulysses mission to the sun. The Ulysses and Voyager missions will be managed under the same office.

A JPL employee since 1987, Massey has managed Ulysses since 1996. Prior to his JPL career, he held a number of increasingly responsible positions within the U.S. Air Force, the last of which was director of space test operations for the Air Force's Operational Test and Evaluation Center.

An Alabama native, Massey earned a bachelor's degree in electrical engineering from Tuskegee University in 1966, followed by a master's degree in systems management from USC.

Ed Massey

For his work on project control and administration for Ulysses, Massey received NASA's Exceptional Service Award in 1991. ❑

Holiday greetings

ERC PHOTOS

A young visitor to last month's ERC holiday party at La Cañada High School meets with Minnie and Mickey in left photo; at right, carolers treat the crowd to holiday music prior to Jim Gamble's puppet show. From left are bass Kevin Flynn, soprano Carol DiNolfo, alto Karen McLaughlin and bass Joon Park.

Explorer

Continued from page 1

Burlington, Iowa college where Stone was an undergraduate. "He gave a lecture on 'rockoons,' which were balloons that lifted rockets and instruments up to an altitude where they could be fired to reach higher altitudes. Van Allen had systematically been trying to get his instrumentation higher and higher up, so by the time the Space Age started, he was ready to take advantage of it."

The Mariner 2 mission to Venus—the world's first flyby of another planet—occurred just four years after the Space Age started in the U.S., Stone said. "It's incredible how quickly the technology was developed from Explorer 1, which was really very simple, to the complex planetary spacecraft that Mariner 2 represented. Things happened very quickly once they got started."

For more information about the Jan. 31 event at Caltech, contact JPL's Public Services Office at ext. 4-0112. ❑

Designs sought for Mars '98 logo

Budding artists and those with a flair for computer graphics have an opportunity to support NASA's next mission to Mars by designing a logo for the Mars Surveyor '98 orbiter and lander mission.

Anyone may enter the contest, said logo contest coordinator Cathy Davis of the Mars Exploration Directorate's Education and Public Outreach Office "We're interested in flashy, eye-catching designs that convey the excitement of this mission to Mars," she said.

Logos, which are multi-colored and typically about the size of a person's palm, can be any shape, such as square, oval or rectangular, and depict a variety of scenes relevant to the Mars Surveyor '98 mission.

"Artists should avoid adding a lot of small detail to their designs because the detail will be lost in the final format," Davis said. Designs can include images of the orbiter and lander spacecraft, the planet Mars, the southern polar cap region in which the Mars Surveyor '98 lander will land, or the spacecraft's trajectory from Earth to Mars. Designs may also carry the institutional logos of JPL, the NASA "meatball" and Lockheed Martin Astronautics, Denver.

Designs will be judged on style and content, and the winning entry will become the property of JPL for use as the Laboratory sees fit, Davis said. The Laboratory also reserves the right to modify the winning design for accuracy and compliance with JPL graphics standards.

Entries are due no later than Feb. 4, and should be mailed to Davis at mail stop T-1129. For further information, contact her at ext. 4-6111. The winner will be announced on Feb. 6.

"The contest winner will have the prestige of seeing his or her creation on the Mars Surveyor '98 spacecraft, as well as on memorabilia, T-shirts, coffee mugs, posters, CD-ROMs and other merchandise," Davis added. "These products will be developed for educational and public outreach purposes."

The Mars Surveyor home page is located at http://mars.jpl.nasa.gov/msp98/index.html . ❑

New hours for health office

The new hours of operation for the Occupational Health Services Office (previously known as Medical Services) and its Employee Assistance Program, Building 263, are 7:30 a.m. to 4:15 p.m. ❑

Science Bowl coming up

JPL personnel are invited to view the 6th annual Science Bowl regional competition at JPL, to be held Saturday, Feb. 8.

The quiz-show-like tournament of scientific knowledge will include 24 teams representing local high schools.

The double-elimination round begins at 12:30 p.m., with the finals taking place at approximately 3:15.

Those in attendance must check in at von Kármán Auditorium, where the finals will also be held. Double-elimination competition will be held in four JPL conference rooms.

Participating high schools are Arcadia, Beverly Hills, Diamond Bar, Downey, Hoover (Glendale), David Starr Jordan (Long Beach), Mark Keppel (Alhambra), La Cañada, Lakewood, Marshall Fundamental (Pasadena), Monrovia, John Muir (Pasadena), Norwalk, Palos Verdes Peninsula (Rolling Hills Estates), Redondo Union (Redondo Beach), Riverside Poly (Riverside), San Dimas, South El Monte, South (Torrance), South Hills (West Covina), University (Irvine), Warren (Downey), West Torrance (Torrance) and Woodbridge (Irvine).

JPL's competition represents one of five regions in California and one of about 50 nationwide. The winning team will go on to national competition in May at Chevy Chase, Md.

JPL's hosting of the event is overseen by the Laboratory's Public Services Office and is staffed completely by JPL volunteers, who serve as timekeepers, scorekeepers and moderators.

"Without the volunteers' help, there would be no Science Bowl here," noted Public Services Office Manager Kim Lievense. ❑

Special Events Calendar

Ongoing

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

Codependents Anonymous—Meeting at noon every Wednesday. For more information, 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. For more information, call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

HIV Support Group—Meets quarterly. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 for more information.

Overeaters Anonymous—Meets Tuesdays at noon. For more information, call Occupational Health Services at ext. 4-3319.

Parent Support Group—Meets the fourth Tuesday of the month at noon. For location, call Jayne Dutra at ext. 4-6400.

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. For more information, call (626) 397-3110.

Friday, January 23

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

Travel Film—Lecturer Bob Willis will present his film *Ukraine* at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $9 and $7. For information, call (626) 395-4652.

Saturday, January 24

Caltech Jazz Bands—The groups will perform a free concert titled "A Little Bit of Gershwin and A Whole Lot of Swing" at 8 p.m. in Caltech's Beckman Auditorium. For information, call (626) 395-4652.

Monday, January 26

ACW Noontime Seminar Series—Alison Winter, president and CEO of Northern Trust Bank of California, will present a talk titled "Playing and Winning the Game." She will discuss her set of "rules," which have helped successfully guide her career and relationships. At noon in the Building 167 conference room.

Tuesday, January 27

Computer Education and Training—This presentation will cover the migration plan, now underway, to move cc:Mail users to Eudora Pro. It will address starting the process, who will contact you and when, installing Eudora on your workstation, converting cc:Mail messages, and training and assistance available to help you start using Eudora. At noon in von Kármán Auditorium. Information from this talk will be available on the Web in the "Introductory Talks" section under "Computer Education & Training" on the ICIS home page at http://icis.

Wednesday, January 28

Computer Education and Training—This quick-start session for PC users will feature a representative from the Enterprise Information System Messaging Service, who will demonstrate how easy it is to start using Eudora Pro. Topics covered will include how to send, retrieve and address messages; creating distribution groups; sending attachments; saving drafts of messages; accessing bulletin boards and newsgroups; and additional training. At noon in the Building 167 conference room. Information from this talk will be available on the Web in the "Tips 'N Techniques" section under "Computer Education & Training" on the ICIS home page at http://icis.

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

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.

Thursday, January 29

JPL Dance Club—Clogging class will be held at noon in Building 300-217.

OEMA Technical Briefing—"New Radiation Effects Issues for Spacecraft Microelectronics and Photonics" will be presented by Dr. Charles Barnes, group supervisor of the Radiation Testing and Failure Analysis Group in the Electronic Parts Engineering Office (507). Barnes will discuss advances in electronics to achieve high performance that have resulted in scaling (miniaturization) of devices, which, in turn, has led to increased radiation vulnerability. At noon in von Kármán Auditorium.

Friday, January 30

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

JPL French Club—The cultural and sculptural significance of France's La Cathédrale de Chartes will be discussed during the club's noon meeting in the Building 167 conference room.

Saturday, January 31

Explorer 1: 40 Years After, A Look Back And A Look Ahead—Former JPL Director Dr. William Pickering will describe the events surrounding the successful launch of Explorer 1, the first American Earth-orbiting satellite, on Jan. 31, 1958. Current JPL Director Dr. Edward Stone will follow with a presentation about all the exciting space discoveries that have been made in the intervening 40 years—and what lies ahead. At Caltech's Beckman Auditorium at 8 p.m. Admission is free.

Sunday, February 1

Chamber Music—Darryl Denning on guitar, joined by Cuarteto Ysaÿe de Los Angeles, will perform a free concert at 3:30 p.m. in Caltech's Dabney Lounge. For information, call (626) 395-4652.

Tuesday, February 3

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

JPL Genealogy Club—Meeting at noon in Building 301-169.

Wednesday, February 4

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

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

Thursday, February 5

JPL Dance Club—Clogging class will be held at noon in Building 300-217.

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

Friday, February 6

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

Sunday, February 8

At The Piano—Caltech pianist-in-residence James Boyk will give a free concert at 2:30 p.m. in Dabney Lounge.For information, call (626) 395-4652.

Honors and Awards

Clawson receives quality assurance award for work on Pathfinder

James Clawson, manager of JPL's Reliability Engineering Office, has received NASA's 1997 "Best of the Best" Quality Assurance Special Achievement Recognition (QASAR) award for his leadership in the implementation of innovative, low-cost engineering approaches for the Mars Pathfinder mission.

Clawson, who led the project effort to structure and implement the Mars Pathfinder Mission Assurance Program, was responsible for risk management and streamlined engineering procedures and teaming to assure the success of the nation's first landing on Mars in more than 20 years.

"Jim personally led the project effort to establish a low-cost, rapid development concept for Mars Pathfinder and left a faster, better, cheaper legacy for future projects," said JPL Director Dr. Edward Stone. "The Pathfinder mission assurance innovations saved the project approximately $8 million compared to the cost of using more conventional approaches. This savings allowed the project to achieve its challenging mission objective within a very constraining cost cap."

The QASAR award recognizes individuals within NASA or other government agencies, prime contractors and subcontractors for significant quality improvements to products or services for NASA. NASA Headquarters and all NASA centers have local QASAR award programs. Annually the "Best of the Best" in each award category is chosen for agencywide recognition.

NASA PHOTO

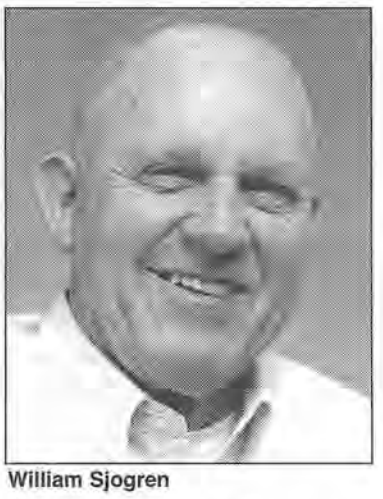
James Clawson, second from left, receives NASA's Quality Assurance Special Achievement Recognition award from Frederick Gregory, NASA associate administrator for safety and mission assurance. Next to Clawson is his wife, Mary; at right is Al Brejcha, acting manager of JPL's Office of Engineering and Mission Assurance.

During spacecraft development, Clawson was the mission assurance manager, overseeing key elements such as electronic parts engineering, reliability engineering, environmental requirements, hardware and software quality assurance and system safety. His major challenge was to develop a low-cost mission assurance approach with acceptable risks. Clawson is also chairman of JPL's Lessons Learned Committee, which addresses issues in interplanetary space exploration.

Clawson joined JPL in 1985, after spending 18 years at the Johnson Space Center, Houston, as a thermal control team leader for the space shuttle orbiter program and working on thermal analysis of the Apollo lunar program. He supported the Apollo 11 mission, watching actual data from the first piloted lunar landing. Prior to his position as Mars Pathfinder mission assurance manager, Clawson was the technical group supervisor of the Thermal Environments Group at JPL, which defined environmental and test levels for interplanetary missions.

During his early career, from 1958 to 1967, Clawson was with the Boeing Company, Seattle, working on such projects as the X-20 "Dyna-Soar" spacecraft, a predecessor of the space shuttle; the Short Range Attack Missile project; and the Minuteman intercontinental ballistic missile program. He also worked extensively in thermal and structural laboratory testing. ❑

Dr. David Halpern



William Sjogren

Dr. William Wilson

AGU, IEEE bestow Fellowships to JPL scientists

JPL scientists Dr. David Halpern and William Sjogren have been elected Fellows to the American Geophysical Union (AGU), an international scientific society dedicated to advancing the understanding of Earth and the solar system. The AGU has a membership of approximately 36,000 scientists in 130 countries.

In addition, Dr. William Wilson has been elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), an honor given annually to less than one-tenth of 1 percent of its membership.

Halpern was recognized for his pioneering work on El Niño; research of equatorial and coastal currents; and scientific and organizational leadership in programs to study interactions between the ocean and atmosphere.

Halpern, who joined JPL in 1986, is a senior research scientist and manager of JPL's Climate Variability Program. He has also managed the NASA Ocean Data System based at JPL and has published more than 275 scientific articles. He is now using data from JPL instruments to study monsoons and middle-latitude influences of El Niño, including the strange occurrence of three El Niño episodes from 1991 to 1995.

Halpern is also a Fellow of the American Meteorological Society and of the California Academy of Sciences, and a recipient of the U.S. Department of Commerce Silver Medal in 1981 for technological developments that created the present-day El Niño Buoy Watch. He has eight Scientific Achievement Awards from the National Oceanic and Atmospheric Administration.

Sjogren was honored by the AGU for his pioneering work studying planetary gravity fields using radio data from orbiting spacecraft.

Sjogren joined JPL in 1962 and is a senior research scientist in the Navigation and Flight Mechanics Section 312. He has worked on the Ranger, Surveyor, Lunar Orbiter and Mariner planetary missions. He was principal investigator for gravity field determination on the Apollo 12, 14, 15, 16, 17 missions; Viking I and II; the Pioneer Venus Orbiter; Magellan and Mars Global Surveyor.

He was a co-discoverer of the Lunar Mascons, the very large unexpected gravity highs located in the circular maria basins. The discovery placed stringent constraints on the internal structure of the moon. He is the recipient of two NASA Scientific Achievement Awards and has published more than 130 scientific articles. He is presently estimating the gravity fields of the four Galilean satellites of Jupiter.

Wilson is supervisor of the Microwave Advanced Systems Group in the Microwave, Lidar and Interferometry Technology Section 386. The group has been working on low-noise microwave and millimeter-wave radiometers and systems for a number of aircraft and spacecraft instruments for remote sensing applications.

Wilson's work over the last several years includes a new application of polarimetric radiometers for the measurement of ocean wind speed and direction, including development of the first ground-based polarimetric radiometers, followed by airborne polarimetric radiometers at 19 and 37 GHz. Results of the research have shown a measurable signal due to the wind on the ocean surface, which can be measured over a wide range of wind speeds and in a variety of weather conditions.

This work has resulted in two IEEE technical papers, and in 1995 Wilson's group received the IEEE Geoscience and Remote Sensing Transactions paper prize award. ❑

Seven JPL teams honored for process improvements

In December and January, JPL Director Dr. Edward Stone and Deputy Director Larry Dumas presented seven teams with the Laboratory's Process Improvement Award. The award recognizes teams that have made exemplary improvements to JPL processes.

Chosen by a peer committee with concurrence from Stone and Dumas, the teams were selected based on process improvements that are demonstrated though metrics, initiative, return on investment and alignment with JPL strategies.

For more information on this or other JPL awards, visit the Reward & Recognition Home Page at http://eis/sec614/reward/rr.htm .

This year's Process Improvement Award recipients are:

Radiation Testing and Effects Team: *For providing JPL and NASA with vastly improved mission assurance services with respect to the effects of the space radiation environment on electronic and photonic parts and subsystems*: Charles Barnes (Section 507), James Coss (507), Larry Edmonds (507), Hossein Farmanesh (507), Allan Johnston (507), Choon Lee (507), Tetsuo Miyahira (507), Duc Nguyen (507), Donald Nichols (507), Michael O'Connor (507), Bernard Rax (507), Harvey Schwartz (341), Luis Selva (507), Gary Swift (507), Michael Wiedeman (507).

Electronic Parts Acquisition Team: *For improving the electronic parts acquisition process from "parts need identification" to delivery of the parts*: Stephen James (507), Rigoberto Medina (621), Michael Parks (507), Patricia Parrett (621), David Peters (507), Edgar Svendsen (507), Donna Turnbow (507).

JETAIR Team of Financial Controls: *For automating and improving the process of generating, approving and processing journal requests to transfer charges between project account numbers*: Florencio Cunanan (222), Thu Dao (212), Agnes Kwong (212), Greg Matz (212), Linda Yang (212).

Flight Hardware Logistics Program Team: *For developing innovative ways to allow the use of long lead-time material on short-cycle-time projects and to reduce material cost to the projects*: A. Earl Cherniack (510), Jay Dettinger (353), Robert Gregg (211), Stuart Imai (621), Sanford Jones (503), R.L. Keith (344), Charles Kyriacou (336), Jerry Langmaier (340), Edward McNevin Jr. (507), Philip Moynihan (387), David Norris (387), Lawrence Palkovic (644), David Porter (311), Randall Taylor (620), Larry Wright (504).

Proposal Process Team: *For developing a process that simplifies and speeds up the efforts of JPL proposal teams, enabling both more and better proposals to be prepared*: Cheryl Baker (311), Frank Barath (700), Mary Bothwell (380), Jerry Brown (311), Calvin Chambers (213), Thomas Fraschetti (380), Michael Jones (311), Sanford Jones (503), Charles Leising (310), Helmut Partma (800), Stephen Proia (230), Ronald Salazar (311), Troy Schmidt (311), Jay Schmuecker (300), Edward Schneider, (700), Nicholas Thomas (702), Gregg Vane (712), Susan Volk (702), Rebecca Wheeler (311), Alfred Zieger (730).

Cassini Mission Sequence System Team: *For improving the quality and reducing the cost of generation of sequence test data, the processing of sequence test data, and the analysis of the results through Mission Sequence System software*: Eugean Hacopians (393), William Krueger (314).

Procurement Requisition Direct Entry Team: *For designing and implementing a streamlined procurement requisition process that allows end users to directly enter purchase requisitions on-line while validating the financial data, and having each requisition automatically routed to the appropriate buyer*: Francine Fisher (623), Virginia Kemp (623). ❑

3 win award for parallel-computing paper

Three JPL scientists are the recipients of a prestigious award for a key paper detailing their new code enabling faster, more efficient parallel computing. Ping Wang, Daniel Katz and Yi Chao were awarded the $1,000 Best Paper prize from a field of 384 entries at SC '97: High Performance Networking and Computing, a supercomputing conference held last November. The event was co-sponsored by the Institute of Electrical and Electronics Engineers and the Association for Computing Machinery.

The trio's paper, Optimization of a Parallel Ocean General Circulation Model, discusses their successful efforts to design and implement a well-optimized code to significantly improve computational performance and reduce the total research time to complete complex studies.

The team applied this code to a 3-D simulation, known as an ocean general circulation model of the entire Atlantic Ocean, a task requiring a large amount of memory and processing time. ❑

December NOVA winners named

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

Section 194: Ann Crossland, Ivette Nicholls, Ann Schofield-Osaki, Melinda Stell, Bernardino Suva.

Section 195: Kathryn Harris.

Section 197: Nancy Aguilera, Glenn Turpin.

Section 311: William Blume, Robert Glass, Barnwell Legge, Kevin Roust, David Seal, Jeffrey Smith.

Section 312: Peter Antreasian, Julia Bell, Paul Burkhart, Dennis Byrnes, Laureano Cangahuala, Alan Chamberlin, Louis D'Amario, Robert Davis, Theodore Drain, Gregory Garner, Eric Graat, Charles Halsell, Robert Haw, Clifford Helfrich, Claude Hildebrand Jr., Jennie Johannesen, Pieter Kallemeyn Jr., William Kirhofer, George Lewis, Robert Mase, James Miller, Neil Mottinger, William Owen Jr., Joan Pojman, Christopher Potts, Joseph Riedel, Carl Sauer Jr., E.M. Standish Jr., Stephen Synnott, Robin Vaughan, Tseng-Chan Wang, Bobby Williams, Michael Wilson, Sun Wong, Donald Yeomans, Tung-Han You.

Section 320: Stephen Gillam, Deronda Mayes.

Section 323: Steven Smith.

Section 331: Brian Abbe.

Section 333: Michael Britcliffe, Richard Cirillo Jr., Mark Fiore, Mark Gatti, Paula Lee, Harry Reilly Jr., David Rochblatt, Benjamin Saldua, Philip Stanton, Henry Valtier.

Section 344: Kenneth Hicks.

Section 354: Robert Bamford.

Section 357: Bevan Cutler, David Rooney.

Section 388: Kris Capraro, Lawrence Goforth, Damon Knight, Sam Le, Jean Lorre, Michael Mueller, Steven Pohorsky, Victor Tuk, Gary Yagi, Payam Zamani.

Section 391: Christian Hidalgo, Rommel Mojica.

Section 393: Eva Bokor, Lonnly Ching, Shirley Ann Cizmar, Kent Fry, Linh Hua, Joseph Hutcherson, Thomas McVittie, Sofia Merida, Ines Mikulski, Calvin Miyazono, Tu-Anh Phan, Felicia Sanders, John Stagner.

Section 395: Amir Fijany.

Section 450: David Spencer. ❑

TAP Honor Awards

JPL's Technology and Applications Programs (TAP) Directorate held its annual Honor Awards ceremony last month.

Exceptional Achievement Awards were presented to Brian Abbe, Amir Fijany, Robert Glass, Kenneth Hicks, Barnwell Legge, Thomas McVittie and Stephen Smith.

Exceptional Service Awards were won by Jason Hyon, Paul Maker and Steven Walter.

Group Achievement Awards went to the following teams: Command and Control Support Agency Project, Microrobotics, Robot Assisted Microsurgery, Traffic Surveillance and Detection Technology Project, Tunneling Accelerometer Experiment, Ultraviolet Emission Processes, and Variable Dynamic Testbed Vehicle Project. ❑

Passings

Thomas Risa, 54, a staff engineer in Section 313, died Oct. 31 at Arcadia Methodist hospital following a long battle with multiple sclerosis .

Risa had been a JPL employee since 1967. He is survived by his sister, Amy Williams, and brother George Caldwell.

Services were private. ❑

Edward McNevin Jr., 59, a parts interface engineer in Section 507, died of cancer Dec. 8 at St. Joseph's Hospital in Burbank.

McNevin had worked at the Laboratory since 1967. He is survived by his wife, Ruth; sons Edward McNevin III (Skip) and Christopher; and granddaughter Alexis.

A memorial service was held Dec. 12 at Caltech's Athenaeum. A memorial fund in McNevin's name has been established at the JPL/Caltech Child Educational Center in La Cañada. ❑

Wilbur Burrus, 79, a retired heavy equipment operator in Section 643, died of Alzheimer's disease Dec. 17.

Burrus worked at JPL from 1952–83. He is survived by his wife, Sylvia, sons Max and Leon, and daughter Leuann.

Services were held near his home in Blackfoot, Idaho. ❑

Sarkie Tatian, 66, a retired member of the technical staff in Section 348, died of cancer Dec. 20 at his home in Glendale.

Tatian joined the Laboratory in 1983 and retired in 1993. He is survived by his wife, Rosemary, and son David.

Services were held at Forest Lawn in the Hollywood Hills. ❑

Andrew Amour, 32, an industrial hygienist in Section 601, died of natural causes Jan. 2 in Newhall.

Amour had worked at JPL since December 1997. He is survived by his wife, Jean.

Memorial services were held Jan. 12. ❑

Donald Nichols, 62, a staff engineer in Section 507, died of cancer Jan. 6 at his home in Long Beach.

Nichols had worked at the Laboratory since 1979. He is survived by his cousin, Sue Adams.

Services were private. ❑

Robert Haskins, 46, a research scientist in JPL's Weather and Climate Group, Earth and Planetary Atmospheres Research Element 3233, died of heart failure Jan. 3.

Haskins, who served as deputy team leader for the Atmospheric Infrared Sounder (AIRS) Project and co-investigator on the Pressure Modulated Infrared Radiometer (PMIRR) experiment on the Mars '98 mission, had worked at JPL since 1986.

He is survived by his wife, Sandra, and five children.

Services were held at Mountain View Cemetery in Altadena.

A memorial fund in Haskins' name has been established at the Caltech Credit Union. ❑

Retirees

The following JPL employees retired in January:

Leonard Jaffe, 43 years, Section 313; **Robert Petrie**, 40 years, Section 940; **Vincent Wirth Jr.**, 36 years, Section 313; **Richmond Benton**, 35 years, Section 644; **Nicholas Medici**, 33 years, Section 313; **George Textor**, 31 years, Section 990; **Robert Campbell**, 29 years, Section 344; **Barbara Brown**, 26 years, Section 750; **John Wilson**, 24 years, Section 507; **Herman Herrera**, 21 years, Section 644; **Jerry Battoe**, 19 years, Section 389; **Shirley Peak**, 14 years, Section 341; **Anna Cote**, 13 years, Section 644; **Peggy O'Dell**, 13 years, Section 392; **Barbara Weymann**, 11 years, Section 388. ❑

Focus on safety

From JPL's Safety Operations Section

This is the time to repeat the need to be careful during rainy weather.

Some simple, common sense rules to follow during rainy periods:

- Walk more slowly than usual and check the area for puddles as you go.
- Wear flat, rubber-soled shoes.
- Shake out umbrellas outside rather than indoors.
- Make sure puddles in buildings are wiped up.
- Don't jaywalk. Remember that cars are harder to see, and their stopping distances will be longer.
- Notify Facilities at ext. 4-4933 if an area appears to need a mat.

In addition, it is important to remember that areas with paint on the floor such as lines, handicapped spaces, etc., become more slippery in rainy weather. Try to avoid these areas; if it is absolutely unavoidable, walk with extreme caution. ❑

—Alison Weisbin

LETTERS

We would like to convey our deepest appreciation to the wonderful people at JPL who extended their condolences and support following the loss of Edward "Ted" McNevin Jr. in December. We would also like to thank everyone for their generous contributions to the Child Educational Center and the American Cancer Society in Ted's name. Additionally, we would like to personally thank Mark Whalen, JPL *Universe* editor, for including information about Ted's service in *Universe* on very short notice. Ted deeply loved JPL and the countless people who touched his life throughout his 30-year career at the Lab. Ted's dedication, as well as his diverse and lasting contributions to JPL's missions and culture, will be an everlasting source of great pride for the entire McNevin family.

Ruth S., Skip and Chris McNevin

❑❑❑

I wish to thank all those at JPL who were so kind to me after the death of my mother. Your good will meant a great deal to me at this time.

Alison Weisbin

❑❑❑

We would like to express our family's deepest gratitude for your concern and support after our home was destroyed by fire on Dec. 13. We have shared moments of warmth with many of you at our home and at the Lab; we know there will be others. On the days after the fire, so many JPL friends stopped by the office, called, sympathized, offered support, collected clothes, brought food, donated money, hugged and otherwise cared. Even in the face of our disaster this was one of life's touching moments. At the time we were most vulnerable, you were there to help. Many of us recognize that it's the people that give us the greatest pleasures working at the Lab. This has never been more so for our family. This truly is a small indication that JPL is, in a very personal sense, a world class team. It's the finest. When the house is rebuilt, the party's on us.

The Humfreville Team

❑❑❑

I would like to thank my co-workers in the library for their condolences on the passing of my grandmother. Your kind words were appreciated.

Kimberly Orr

FOR SALE

AUTOMOTIVE SERVICE MANUALS (complete) for '89 Ford Taurus & SHO, incl. elec. booklet, $10 for all (orig. $100+). 626/398-4960.

BABY ITEMS: high chair, gd. cond., $20; stroller, side-by-side twin, $30; potties (2), $5 each; backpack, Gerry, exc. cond., $25. 355-9733, after 6 p.m. or leave msg.

BABY ITEMS: stroller (Aprica), high chair, 2 car seats, crib mattress; all in exc. cond.; will sell separately or together. 310/546-5016, Diane.

BED, qn. size, firm, platform, purchased 4/97, $150. 845-8449.

BED, qn. Somma flotation system, vg cond., $125. 626/447-6423.

BICYCLES, his and hers Huffy 12 spd., 27" and 26", $100/obo for both. 909/393-9586.

BIKE, folding, by Dahon, 3 spd. internal hub, w/fenders and rear rack, 20 in. wheels, fold to compact size, $130. 626/445-4319.

BIKE, men's 27" Nishiki, $25. 831-3998, Scott.

CARPET, wool, light slate blue, 12' x 13', exc. cond., pd. $750 10 yrs. ago, sell $350/obo. 626/357-8210.

COMFORTER/BEDSPREAD, new, Stevens, red roses on white background, $25. 626/398-4960.

COMPUTER CD software for Macintosh, call for list, all $25 and under. 790-3899.

COMPUTER GAMES for IBM: Comix Zone, Fade to Black, Under a Killing Moon, Blood Omen Legacy of Kain, The Beast Within and Chronicles of the Sword; $10 to $25 ea. or trade for comparable games. 626/447-6423.

COMPUTER, 386/33 MHz, 8 MB RAM, 125 MB HD, color monitor, great for beginners/kids, $125/obo. 831-3998, Scott.

COMPUTER, Motorola BitSURFR Pro ISDN modem for Macintosh, external, unopened; see http://www.kithrup.com/~bsp; $140. 626/449-6358, Brian or bsp@kithrup.com.

COMPUTER, Power Computing's PowerTower Pro 250 (MHz), 64 MB RAM, 1MB L2 cache, two 2GB hard drives, Zip drive, 16x CD-ROM drive, 33.6 data/fax modem, keyboard, mouse and software (does not incl. monitor); $2,500. 795-6530, eves.

COMPUTERS, PC Intel 486/33 MHz, 16 MB mem, 500 MB HD and 125 MB HD, sound card w/speakers, 6XCD, 15" SVGA color monitor, 101 keyboard, 5.25 and 3.5 floppies, 33.6 fax/modem, Windows 95 installed, $500/obo; PC pentium/90 MHz, 16 MB RAM, 850 MB HD, sound card/speakers, 10X CD-ROM, 15" SVGA color monitor, 101 keyboard, 3.5" floppy, 33.6 fax/modem, mouse, software, and color Deskjet HP printer, $900/obo. 626/914-1737.

CRIB, Childcraft, white wood w/pastel bars; very cute; w/mattress, sheets, baby light; $75. 249-2123.

CRIB, white, incl. mattress, like new. 626/798-4120.

DIET COURSE, 20 Jenny Craig audiotapes, $20. 790-3899.

EXERCISE BIKE, "Cateye Exerciser", computerized, like new, orig. $900, sell $450/obo cash; SEWING MACHINE, Kenmore, hardly used, $200/obo. 213/663-2895.

EXERCISE EQUIPMENT, Nordic Track Skier Pro Plus, 1 yr. old, hardly used, $400/obo. 626/359-1789, Dian.

FIREWOOD, season; euc., pine, oak; delivered or pickup. 626/398-8856.

HORSE TRAILER, '72 King, 2 horse, ramp, rewired, good tires, $1,000/obo. 626/398-8856.

JEANS, Levi's, mostly 560 & 562, near new, boy's size 8-16, $5 ea. 500-9163, eves.

KEYBOARD/SYNTHESIZER, Korg K5, 5 octive, fully programmable, MIDI, $250; bass/keyboard amp, Gallien-Krueger, 15" speaker, $175; both $400. 352-5553.

LAWN EDGER and trimmer, 3 hp eng., w/owner's handbook and goggles, exc. cond., $60. 626/289-6802.

MICROWAVE, Sharp Carousel II, rarely used, $60/obo; BICYCLE, 16" girl's Huffy "Secret Treasures" w/training wheels, great shape, $35/obo; ROCKING HORSE, children's, great shape, $30/obo; TYPEWRITER, Smith-Corona portable, $40/obo; BIKE SEAT, children's, up to 40 lbs., $20; TOY BOX, Little Tikes, $20; BICYCLE RACK, auto rear-mounted, holds two bikes, $25; BOOSTER SEATS, children's, $7 each; CAR RAMPS, $10. 714/996-9334.

MONITOR, 14", $75; DESK (office), lg., all wood, in exc. cond., $175/obo. 562/944-7072, Steve.

ORGAN, Yamaha 415 electronic console w/13 pedals, 3 keyboards, 144 rhythm patterns, pd. $7500, sacrifice for $3000. 790-3899.

OVEN (double), 36" Caloric, self-cleaning, gd. cond., almond color. $200/obo. 768-4436.

RANGE, classic, gas, w/griddle, orig. fixtures, $90. 352-5553.

PERSONAL INFORMATION MANAGER, Seiko "Phone-Pal", $25. 790-3899.

SETTLE, box arm, 76" long x 30" tall, new brown leather, orig. box springs, orig. finish; could be lifetime/young; similar to Gustaf #208; $3,500. 626/441-2150.

SKI GEAR, 190cm K2-4400 skis w/747 Salomon bindings, $50; 120cm Scott Classic poles, $10; 9.5-10.5 sz. Daleboot ski boots, $15; misc. clothing and after-ski boots, various prices; all vg to exc. cond. 310/674-5338.

SKIS, Atomic ARC, 195 cm, used 2x, Marker M46 bindings, poles; all exc. cond.; $150. 310/546-5016.

SOFA, leather, cream beige color, $500; RECLINER CHAIR, matching, $150; both exc. cond., only 10 mos. old. 626/797-3714.

SOFA, qn. size fold-away, purchased 4/97, $200. 845-8449.

SPEAKERS (2), SRL 4.4, freq. response: 37-2K Hz, min. pwr. rqmts.: 12 w. RMS, max. pwr. handling: 60 w. RMS, impedance: 8 ohms, oak finish, w/stands, $150 both. 351-8036.

SUB WOOFER, brand new (2 mos. old), energy amplified, w/two CRX6 Boston speakers, $490. 832-5556.

SWEATER, Coogi, from Australia, new, sz. sm./med., $100; sells in Nordstrom for $325. 790-3899.

TEACUPS, Franciscanware Desert Rose pattern, $7/ea. 626/398-4960.

TENT, 10 x 16, never used, 3-rm. cabin dome by Bryce Canyon w/bonus 5' x 7' pup tent, beau. gray and burgundy, will let go at ½ price of $100. 310/674-5338.

TICKET (opera), single, for Feb. 13, L.A. Opera, Magic Flute, Balcony A, seat B-1, $48/obo. 790-6122.

TIFFANY'S CREDIT: use at any Tiffany's location or by mail order; great for wedding gifts, etc., $330 transferable credit, sell for $300. 355-1353, Anne/David.

TIRE CHAINS, two sets, sizes: 6.00-12,155R-13,135R-14; or CR70-13, P185/70R-13, 175R-13, P195/60R-14, 175/70R-14, 185/65R-15; $15 each. 790-5643.

TRICYCLE, adult, 2-seater, side by side tandem, 3 spd., w/trailer, 4' x 8' collapsible; both like new.; both for $495 total. 805/251-7616 Ben.

VACATION/CRUISE pkg. for 2 persons, 8 days/7 nights in Freeport, Bahamas, Ft. Lauderdale and Orlando, Fla.; incl. rental car; retail $3,200, sell for $2,700; must sell, going back to school. 626/359.3781, after 8 p.m., Erik.

WEED WACKER, gas, "Eager Beaver" brand, $30. 352-2036.

AUTOS

'89 ALFA ROMEO Spider Graduate 2.0L, 5 spd., 4 cyl., 2 dr. convertible, red, tan interior, valve job 8/97, runs strong, $6,100/obo. 626/256-1154 or don_alberto@usa.net.

'80 AUDI 5000S sedan, maroon, 99K mi., $1,000 firm. 626/793-9346.

'84 BUICK Century Limited, Olympic Special, 4 dr. sedan, exc. cond., 130K mi., $2,500. 626/793-6123.

'91 CHEVROLET S10 pickup, V6, 5 spd., a/c, cass., 2-tone blk. & gray, Tahoe pkg., great cond., smog ck., new batt., 92K mi., $4,500/obo. 248-8789.

'89 CHEVROLET Corsica, 4-dr. sedan, auto, CD player, new tires, rebuilt eng., 155K mi., $3,000/obo. 562/860-9140.

'85 CHEVROLET Corvette, manual trans., red exterior, gray interior, gd. cond., 1 JPL owner, all options, all service records, 176K mi., $7,900. 310/822-5964, eves.

'57 CHEVROLET pickup, new interior, 327 rebuilt engine, good shape, $4,500. 626/398-8856.

'96 FORD Escort station wagon, auto, 41K mi., very clean, new tires, loaded, $5,750/obo. 768-1612.

'91 FORD LTD Crown Victoria, white, police package, $6,950. 626/395-6379, Rich.

'89 FORD Escort GT 1.9L EFI, 5 spd., 4 cyl., 2 dr. hatchback, white, tan cloth interior; pwr.: mirrors, brakes and steering; tilt, runs strong, $1,100/obo. 626/256-1154 or don_alberto@usa.net.

'88 FORD Taurus, runs well, new tires, pump, a/c, $2,150. 626/844-9188.

'57 FORD T-Bird, D series, orig. as per invoice, pw, ps, Ford-o-matic, beautiful, starmist blue w/white top, 120K mi., $26,000 firm. 909/624-2148.

'94 MAZDA Miata special edition, black/tan/tan, 5 spd., air, pw, ps, cc, very clean, 21K mi., $8,750/obo. 504-4905.

'88 MAZDA RX-7 GXL, 1 owner, fully equipped, exc. cond., 87K mi., $3,400/obo. 805/252-1243.

'94 MERCURY Sable, loaded, 75K mi., $8,700. 797-2503.

'89 NISSAN Sentra, 2 dr., 5 spd., a/c, AM/FM cass., vg cond. throughout, no dents, paint exc., $2,600. 248-1369.

'84 PONTIAC Fiero, 1 owner, mint, 45K mi., all records, manuals, $4,000. 246-3777, weekday eve. only.

'93 SAAB, 900S, loaded, air, leather, sunroof, ABS, exc. cond., $10,990. 805/251-3854.

'97 SATURN SL2, 4 dr., 5 spd., ps, a/c, tilt, pdl., alarm, LoJack, alloys; great car, like new; loan payoff $12,862. 626/574-7567, eve., wknds.

'97 TOYOTA Tercel CE, 4 dr., auto., air, 30K mi., dk. blue, very clean, must sell, $7,250/obo. 768-1612.

'96 TOYOTA Previa minivan, sports pkg., auto, 25K mi., 2 sunroofs, CD, exc. cond., $23,500. 541-0131.

'90 TOYOTA Corolla, white, 4-dr., auto., a/c, 90K mi., exc. maint. history, great AM/FM/cass., $4,400/obo. 249-5736.

'86 TOYOTA Celica GT, 1 owner, cruise, air, exc. cond., black, 47K mi.; good buy, $6,000. 352-5508.

WANTED

DESK CHAIR, armless, to accompany child's ivory/ecru pseudo "French provincial" desk and bedroom furniture. 957-7039.

GO-CART, low end model, preferably not running but fixable. 626/359-0670, Steve.

JUICERS: Norwalk Juicer and/or VitaMix (preferably with plastic container). 891-6836, Steve.

PICNIC TABLE w/benches, reasonable cond., for use as potting bench. 909/596-4390.

SKIERS to join in the fun of the JPL Ski Club. 956-1744, Barbara.

VANPOOL RIDERS, full and part-time for van #20, w/stops in Northridge and Granada Hills. Ext. 4-7076, Suzanne.

VOLLEYBALL PLAYERS, coed, all levels, all ages, open play; every Tuesday night from 8-10 at Eagle Rock High School; $4/night. 956-1744, Barbara.

FREE

DOG, 2-yr.-old retriever/Lab mix, all shots, neutered, very healthy. 909/624-4450.

HOME, 3 bd., nr. Caltech, March 2-26; in exchange for pet sitting. 626/449-8035.

LIGHT FIXTURES, fluorescent, with bulbs, 4' and 8' available. (818) 243-8255.

TELEVISIONS, Montgomery Ward 19" color, not remoteable; Sears 12" b/w, not remoteable; LIGHT and heater for bathroom, Nutone, no vent mode; SCOPES, Tektronix AD514 (preplug-ins), w/ manual; EICO model 460; HEATERS (2), Sears baseboard, 1500 W, 6' long; FAN, 12" duct; LIGHT, pull-down. 768-3465, Harold or Torrie.

FOR RENT

ALTADENA, partially furn. room in 3-bd. house, 3 mi./JPL, share kitchen, laundry, fireplace, hdwd. floors, quiet neighborhood, $380 + 1/3 utils. 626/798-4492.

ALTADENA, charming 2 bd., 1 ba. house, near Christmas Tree Lane; hdwd. floors, f/p, refrigerator, stove, washer/dryer, fenced bkyd., fruit trees; include. water, gardener, trash; $1,250 negotiable. 626/794-9579.

ALTADENA, unfurn. 3 bd., 1 ba. house with garage apt.; close to JPL & Caltech; $1,450 (garage apt. rented last for $400). 626/798-8632.

EAGLE ROCK, furn. room in single family hse., nice area, 10 min./JPL, share entrance, ba., kitch. & lndry. privileges, $330 incl. util. 213/256-1785.

GLENDALE, for lease or lease option; Rossmoyne area, 2-story, 4 bd., 2 1/2 ba., formal dining rm., fenced yd., covered patio, Spanish charm; $1,950. 248-6173.

LA CANADA room, private entrance, pool, utils. incl., $450. 790-7805.

MONROVIA (north of Foothill), 2-bd. house (rear), cent. air & heat, laundry rm., ceiling fans, fenced yd., garage; 20 min./JPL, $875 (discount available for early payment). 626/447-1888.

MONTROSE studio apt., incl. stove & refrig.; 5 min./JPL; $350. 249-2235.

MONTROSE, for lease or lease option; executive home, 5 yr. old, 2-story, 4 bd., 2 1/2 ba., blt.-ins, central air and heat, attached garage, f/p, laundry rm., circular driveway, flat lot; $1,900. 248-6173.

MONTROSE studio, unfurn., many trees, 5 min./JPL, for single person, no pets, 2332 Montrose Ave. 249-7793.

PASADENA condo, 2 bd., 2 ba., sec. bldg., 2nd level, forced air heat & cooling, Sierra Madre Blvd.; rent to own, first 6 mos. rent can be used as purchase down payment; $895. 584-6526.

SIERRA MADRE CANYON cottage, quiet, charming, secluded, 2 bd., 1 ba., recently remodeled kitch. & bath; covered laundry area has washer and dryer; incl. parking spot; avail. Feb. 1; $895. 626/564-9607, Diana deNoyelles; e-mail: ddenoyel@co.la.ca.us.

SOUTH PASADENA, 1718 Huntington Dr., good area east of Marengo; fully furn. bungalow studio apt., carport, laundry, air cond./heat; non-smoker; avail. April 1; utils. pd., $565. 626/792-9053, Marilyn.

SUNLAND, room in 3 bd. house; no smoking; 14 min to JPL; $300 +1/2 util. 951-4488.

SUNLAND townhouse, 3 bd., 2 1/2 ba., kit./blt.-ins + laundry hkups., ca/h, liv. rm./frpl., lg. patio off din. rm., dir. access dbl. gar., pool/Jacuzzi/ tennis, close to 210/stores/park. $1,075. 353-7778.

TUJUNGA / LA CRESCENTA border, 4 bd. house, pool, spa, city view; $1,800/obo. 626/296-6827.

TUJUNGA, spacious house w/mtn. views, clean 2 bd./1 ba. + extra den, fenced bkyd., ca/ch, f/p, carpets, lndry. hookups; non-smokers; avail. 2/15; 10603 Fernglen; $950 + dep. (water & gardener incl.). 352-5553.

REAL ESTATE

BIG BEAR, new cabin 2 blks. from lake, 2 bd., 2 ba., mud/laundry rm., $129,000. 909/585-9026.

GLENDALE, Rossmoyne area, 2-story, 4 bd., 2 1/2 ba, formal dining rm., fenced yd., covered patio, Spanish charm; lease option; $359,000. 248-6173.

GREEN VALLEY LAKE, a secluded village in the San Bernardino Mtns., custom 3-story log home and buildable adjacent lot, beautiful 180-deg. view, lg. decks, shade trees, walk to lake and skiing, cabin $149,000, adjacent lot $19,900. 303-1927.

HIGH DESERT, 5 acres, 3 bd., 2 ba. home, spa rm., cement pond, gazebo; 2 wells, mobile home site w/hookups, 3 lakes w/fish, 100s of fruit & shade trees, all fenced; bargain at $169,750. 626/797-8776.

HIGH DESERT, horse property, 7½ acres, custom 1,600 sq. ft. home, all fenced, 2 patios, spa rm., double carport, 2-car garage; 2 wells, 7 lakes w/fish, 2 mobile sites (family or income), 75 fruit & almond trees, hundred shade trees, more; $189,750. 626/797-8776.

LAKE CO., N. Calif., 2 1/2 acre lot, in beautiful Kelseyville near Clear Lake, perfect site for permanent or retirement home, 30 walnut trees, paved road, electricity, $36,000. 626/337-7522.

MAMMOTH LAKESHORE CABIN, next to Twin Lakes Falls; cross-country ski in winter; fish, hike, bike in summer; sleeps 4-6, 1 ba., $65,000. 952-2091.

MONTROSE, 5 yr. old, 2-story, 4 bd., 2 1/2 ba., blt.-ins, central air and heat, attached garage, f/p, laundry rm., circular driveway, flat lot; lease option; $310,000. 248-6173.

PASADENA, charming home 12 min. from JPL, 3 bd., 1 1/2 ba., fireplace, hardwood floors throughout, French doors, ceramic tile in kitch./ba., 2-car gar., cent. air, lg. yd., lovely neighborhood; sale by owner, $265,000. 626/398-7712, Kathleen.

PASADENA condo, 2 bd., 2 ba., sec. bldg., 2nd level, spacious, forced air heat & cooling, Sierra Madre Blvd.; rent to own, first 6 mos. rent can be used as purchase down payment; $895/mo. 584-6526.

PASADENA, 2 bd., 1 ba., recently remodeled; new roof, fenced yd., landscape, garage, lndry. rm.; 15 min./JPL; Lake/Orange Gr. Area; $145,000. 213/258-4464, lv. msg.

SUNLAND townhouse, Alpine Meadows complex, 2 bd., 1.5 ba., 2 story, 2-car garage, pool, spa, tennis ct., rec. rm., well-maintained, $110,000. 248-0178.

TEHACHAPI area, new custom home, 2,200 sq. ft., 3 bd., 2 ba.; panoramic views from all windows; 2-car garage, 2,800 sq. ft. new Dutch barn, 2 ½ acres; $185,000 (OWC). 626/446-0078.

VACATION RENTALS

BIG BEAR cabin, 2 bd., slps. 8, compl. furn., f/b, TV, VCR, $75/night. 249-8515.

BIG BEAR LAKE cabin, 1 mile to ski slopes, lake, shops, village, forest; 2 bd., slps. 6, fully furn., f/p, TV, VCR, phone, full kitch., microwave, BBQ + more; JPL disc. price from $65/night. 909/599-5225.

BIG BEAR LAKEFRONT luxury townhome, indoor pool/spa, near skiing, stone f/p, slps. 6. 714/786-6548.

BIG BEAR, 7 mi. from slopes, full kitchen, f/p, 2 bd., 1 ba., slps. 6; no smokers, no pets; exc. hiking, biking, fishing nearby; reasonable rates, 2-night min. 909/585-9026, Pat & Mary Ann Carroll.

CAMBRIA, ocean front house, exc. view, slps. up to 4, $130/night for 2, $180/night for 4; special offer, stay 3 nights and 4th night is free, through 1/31/98. 248-8853.

MAMMOTH at Snow Creek, 2 bd., 2 ba. + loft, slps. 6-8, fully equipped kitchen incl. microwave, d/w, cable TV, VCR, phone, balcony w/view to mtns., Jacuzzi, sauna, streams, fishponds, close to Mammoth Creek; JPL disc. 626/798-9222 or 626/794-0455.

MAMMOTH condo in Chamonix at lifts 7, 8, 16, 17; walk to warming hut; 2 bd., 2 full ba., slps. 6, fully equipped elec. kitchen, incl. microwave & extras, f/p & wood, color TV, VCR, cable, FM stereo; o/d Jacuzzis, sauna, game, rec. & lndry. rms.; conv. to shops, lifts; spec. midweek rates. 249-8524.

MAMMOTH condo, 2 bd. + loft, 3 ba., slps. 8, spa, full kitchen, TV/VCR, JPL disc. rates; walk to Canyon Lodge. 249-8088.

MAMMOTH condo, slps. 5, shuttle stop nearby, downtown, $50 Sun.-Thurs., $65 Fri. & Sat. 353-7839.

MAMMOTH condo, studio + loft, 2 ba., fireplace w/ wood, Jacz., sauna, game rm., color cbl. TV/VCR, full kitch. w/microwave, terrace, view, amen. 714/870-1872.

MAMMOTH ski cabin in Knolls, 4 bd., sleeps 10, f/p, deck. 626/445-7443, 310/375-8421.

MAMMOTH ski condo; reservations nights of Feb. 13, 14, 15; 3 bd. + loft, 2 ba., full kitchen, o/d Jacuzzi, TV, slps. 9, near shuttle to chairs 15 & 24. 846-4159.

MAUI condo, 1 bd., 2 ba., on beach with ocean/garden view, pool, spa, tennis cts., putting green, exercise rm., phone, microwave, TV, VCR. 248-2704.

OCEANSIDE, on the sand, charming 1 bd.+ condo, panoramic view, walk to pier/marina, pool, spa, game rm. 714/786-6548.

PACIFIC GROVE hse., 3 bd., 2 ba., fp, cable tv/vcr, stereo/CD, well-eqpd. kit. w/microwave, beaut. furn., close to golf, beaches, 17 Mile Dr., Aquarium, Cannery Row, JPL discnt. 441-3265.

PINE MOUNTAIN, Big Bear w/o the traffic; 2 bd., 1 ½ ba.; $80. 310/831-4234, Peter.

SOUTH LAKE TAHOE KEYS waterfront home, 4 bd./3 ba., slps. 12+; f/p on 2 levels, decks overlooking private dock and ski lifts; gourmet kitch.; bicycles, 20' sail & paddle boats, 3 color TVs, VCR, stereo w/tape & disk; assn. indoor & outdoor pools, hot tub & beach; 8 tennis cts.; 10 min. to skiing, casinos, golf; 1 hr. to Western Sierra wine country; $995/wk. for high season (June 15-Sept. 15; Nov. 22-Mar. 1); $495/wk. low season, + $90 cleaning fee; 3-day min. 626/578-1503, Jim Douglas.

NOTICE TO ADVERTISERS

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Universe

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Mark Whalen

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