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Mars Climate Orbiter nearing Sept. 23 arrival

By MARY HARDIN

Mars Climate Orbiter, the first of two JPL spacecraft to reach Mars this year, is set to go into orbit around the red planet to become our first interplanetary weather satellite and a communications relay for the Mars Polar Lander, which will arrive at Mars this December.

The Orbiter will fire its main engine at about 1:55 a.m. Pacific Daylight Time on Thursday, Sept. 23, to slow itself down so that it can be captured in orbit around the planet.

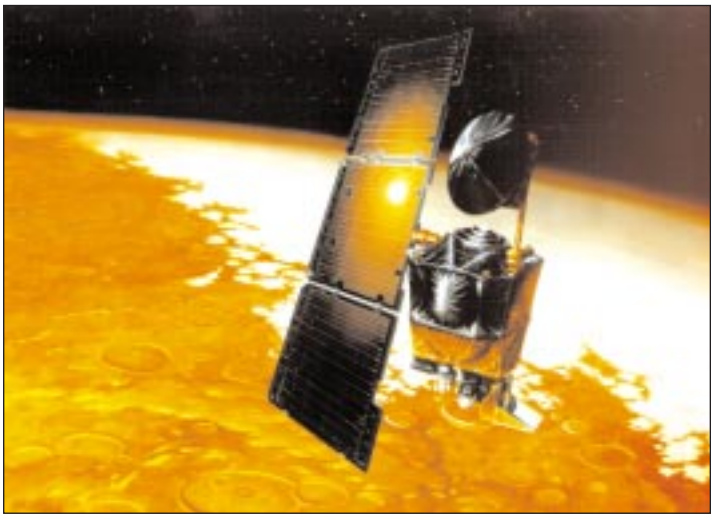
"The curtain goes up on this year's Mars missions with the orbit insertion of Mars Climate Orbiter," said Dr. Sam Thurman, flight operations manager for the Orbiter at JPL. "Hopefully, the happily-ever-after part of the play will be the successful mission of the Mars Polar Lander that begins in December, followed by the mapping mission of the Orbiter that is set to begin next March."

Once captured in orbit around Mars, the Orbiter will begin a period of aerobraking. During each of its long, elliptical loops around Mars, the Orbiter will pass through the upper layers of the atmosphere each time it makes its closest approach to the planet. Friction from the atmosphere on the spacecraft and its wing-like solar array will cause the spacecraft to lose some of its momentum during each close approach. As the spacecraft slows during each close approach, the maximum altitude of the orbit will decrease and the orbit will become more circular.

"The period of time from Mars orbit insertion for the Orbiter through the end of surface operations for the Mars Polar Lander is the big crunch time for us," Thurman said. "If you look at the number of individual engineering jobs we have to do in this six-month period and how the Orbiter and the Lander interact to accomplish their respective missions—all with a team of 80 people to do it—to me that's where we're breaking new ground. It's going further and faster with fewer people and with a smaller budget. If we're successful, I think we'll raise the bar on the whole faster, better, cheaper mantra to a new level—to a level that's not been attained by anyone else."

Mars Climate Orbiter's first assignment after it completes aerobraking will be to serve as the communications relay for its sister spacecraft, the Mars Polar Lander. After the Lander's surface mission ends in February 2000, the Orbiter's science mission begins with routine monitoring of the atmosphere, surface and polar caps for a complete Martian year (687 Earth days) or the equivalent of almost two Earth years.

The first view of Mars taken by the Mars Climate Orbiter color imager, left, was acquired Sept. 7, when the spacecraft was approximately 4.5 million kilometers (2.8 million miles) from the planet.



"We're interested in what happens during all the seasons of a Mars year. Weather is what happens from day-to-day and the year-long effect of all of that is climate," said Dr. Richard Zurek, project scientist for the Orbiter at JPL. "Mars Climate Orbiter will do what weather satellites do—it will take pictures of clouds, it will look for storms, and it will try to understand the atmospheric winds by measuring temperature and pressure and by watching how the atmospheric distributions of dust and water vapor change with time."

Today the Martian atmosphere is so thin and cold that it does not rain; liquid water placed on the surface would quickly freeze into ice or evaporate into the atmosphere. The temporary polar frosts that advance and retreat with the seasons are made mostly of condensed carbon dioxide, the major constituent of the Martian atmosphere. But the planet also hosts both water-ice clouds and dust storms, the latter ranging in scale from local to global. If typical amounts of atmospheric dust and water were concentrated today in the polar regions, they might deposit a fine layer every year, so that the top meter (or yard) of the polar layered terrains could be a well-preserved record showing tens of thousands of years of Martian geology and climatology.

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SRTM delay extended

The launch from Kennedy Space Center of JPL's Shuttle Radar Topography Mission (SRTM) onboard Space Shuttle Endeavour has been delayed, with launch possible no earlier than Nov. 19.

KSC engineers were also assessing the impact of this week's Hurricane Floyd. The SRTM payload rode out the storm in the Space Station Processing Facility high bay inside the payload canister with the doors closed.

The 11-day mission to produce the most complete topographic maps of Earth ever assembled was delayed from early October because of continuing wiring inspections and repairs in the orbiter's midbody and aft engine compartment, as well as fabrication of an SRTM freon line reinforcement clamp assembly. The manufacturing of the clamp was done at KSC and was scheduled to be ready this week for a fit check, pending return of KSC staff following the hurricane. The fixture had been scheduled to be installed for flight in the payload bay this week. ❑

Family Day coming October 2

Today is last day to pick up tickets

All JPL badge-holders are invited to show off their work areas to their immediate families, as well as share lunch, special tours and other activities, during Employee Family Day on Saturday, Oct. 2 from 10 a.m. to 3 p.m.

Tickets are required for the event, and are available through Friday, Sept. 17 from 11:30 a.m. to 1:30 p.m. outside each cafeteria. Tickets are also available all day today at the following locations:

- ERC, Building 114-104
- Environmental Lab, 144-221
- Human Resources, 180-200
- Public Services, 186-113
- Credit Union, 218
- Reward and Recognition Office, 291-205.
- Systems Division, 301-230K
- Observational Systems Division, 306-416
- Emergency Preparedness, 310-106

"This will be a unique opportunity for JPL families to see where and how work gets done on Lab, something they normally can't do when they visit," said Nancy Kapell of the Reward and Recognition and Employee Services Group.

Scheduled activities include talks by astronauts and former JPL employees Drs. Stan Love and John Olivas in von Kármán Auditorium. Love will appear at 10:15 a.m. and 2 p.m.; his topic will be "Why We're Going to Send People to Mars." Olivas will speak at noon about NASA's astronaut training program. Both astronauts will also be available for autographs in the museum adjacent to von Kármán Auditorium.

In addition, the award-winning JPL multimedia presentation "Welcome to Outer Space" is scheduled to be shown at 11:30 a.m., 1:10 p.m. and 1:40 p.m. in von Kármán.

Lunch will be served from 10:30 a.m. to 2:30 p.m. in the mall. Musical entertainment will be provided by the band "City Heat."

Other activities scheduled throughout the day include a children's area staffed by the JPL/Caltech Child Educational Center and a booth staffed by the Caltech Credit Union, where JPL families are eligible to open accounts.

The ERC will be open for souvenir purchases, and a number of JPL facilities are scheduled to be open for tours and other activities. For more information, call Kapell at ext. 4-9432. ❑

Special Events Calendar

Ongoing

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

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

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

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

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. Call (626) 397-3110.

Friday, September 17

Dodger Baseball—Last day to purchase tickets at the ERC for the Sept. 26, 1:10 p.m game against the San Diego Padres (Fan Appreciation Day). Tickets are $13.

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

JPL Perl Users Group—Meeting at noon in Building 301-127.

Von Kármán Lecture Series—"Twenty Years of Discovering Jupiter: Voyager and Galileo Celebrate Significant Anniversaries"will be moderated by Dr. Al Hibbs with Dr. Ed Stone, Dr. Andy Ingersoll, Dr. Torrence Johnson, William O'Neil and James Erickson on the panel. To be held at 7 p.m. in The Forum at Pasadena City College, 1570 E. Colorado Blvd. Seating is limited. Open to the public.

Wednesday, September

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

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

Thursday, September 23

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

Social Security—Representative Ann Villeroy will be available in the Building 167 cafeteria from 9 to 11 a.m. Employees can request personal earnings and benefits statement and ask general questions.

Friday, September 24

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

Sunday, September 26

Caltech-Occidental Chamber Orchestra—Performance will be held at 8 p.m. in the campus' Ramo Auditorium. Admission is free. For information, call (626) 395-4652.

Tuesday, September 28

Fidelity Investment Workshop—Fidelity representative Jason Rasmussen will present "Turning Your Savings Into Income" from noon to 1 p.m. in the 180-101 conference room. This presentation is designed for participants that are within 5 years of retirement; however, all employees are welcome to attend. It will give an in-depth description of distribution options available for your Fidelity TDA balance, including IRA rollovers, annuities, systematic withdrawal plans and lump-sum distributions, and will go into the pros and cons of each.

Wednesday, September 29

"Caltech/JPL: Unique in Its Triumphs and Challenges"—Caltech President Dr. David Baltimore, 1975 Nobel laureate in medicine, will share his perspective on the unique triumphs and challenges of managing Caltech, which was recently ranked first among national universities by *U.S. News & World Report*. Held at Caltech's Athenaeum; reception at 6 p.m., dinner at 7 p.m. (no-host bar), program: 8:15 p.m. Presented by the Caltech Management Association. Members and member's guest: $38.50; non-members: $48.50 (includes CMA membership for FY 2000). Reservations must be received by Sept. 24. Contact Alice Tangney at ext. 4-4894 or Janester Short at (626) 395-6625, or send e-mail to CMA.Announce@jpl.nasa.gov.

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

Thursday, September 30

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

Friday, October 1

"Inside Switzerland"—This travel film will be presented at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $9 and $7. For information, call (626) 395-4652.

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

JPL Perl Users Group—Meeting at noon in Building 301-127.

Hollywood Bowl honors JPL, NASA

PHOTO COURTESY OF GEORGE SHULTZ

Hollywood Bowl Orchestra conductor George Daugherty, center, accepts a picture of Mars taken by Pathfinder at the Hollywood Bowl's Sept. 3 and 4 concert that celebrated JPL, NASA and U.S. space exploration. From left are astronauts Garrett Reisman and Janice Voss, Jurrie van der Woude of JPL's Public Affairs Office, astronaut Gordon Cooper, Daugherty, astronauts Michael Gernhardt and Buzz Aldrin, JPL Director Dr. Edward Stone and Betty Shultz of JPL's Public Affairs Office. Visuals from JPL and NASA accompanied space-themed music during the shows, which included salutes to current and past JPL projects as well as JPL team members on Pathfinder.

New Educator Resource Center offers open house

By JOHN G. WATSON

JPL employees are invited to attend an open house on Saturday, Sept. 25, 10 a.m.-2 p.m., marking the inauguration of a new Educator Resource Center and Applied Technology Classroom in Pomona.

In 1998, JPL and the Pomona Unified School District agreed to house the state-of-the-art facilities in the District-owned Village at Indian Hill educational mall, located at 1460 E. Holt Ave., Suite. 20.

"We are excited about the capabilities of these beautiful facilities and about the new relationship with the District," said site administrator Gene Vosicky of JPL's Communications and Education Office. "We would like take this opportunity to share the Center and Classroom with the JPL community."

The center is a focal point for educators to become acquainted with NASA/JPL educational materials and resources. Special educator sessions highlight JPL's electronic networking capabilities as well as classroom applications of NASA/JPL-produced educational materials. Goals also include becoming involved in collaborations, cooperative agreements and associations with school districts, state education agencies, colleges and universities.

The Applied Technology Science Classroom, laid out in stations through which students rotate, integrates a wide variety of technologies into the science curriculum. The purpose of the room is to increase students' knowledge of technology and science by involving them in scientific investigations in an inquiry-based approach. It also serves as a model for educators on how to utilize technology in the instructional process.

Connecting the Center and the Classroom is a large visitor center for exhibiting spacecraft models, artifacts and information on the role of JPL in space exploration.

For further information, call (909) 397-4420. ❑

JPL-forensics connection noted

By JOHN G. WATSON

JPL had a strong presence at "Sneak Preview of the Millennium: The Future of Forensic Science," at held at UCLA on Aug. 22-28. Sponsored by the International Association of Forensic Sciences, the conference was designed to bring together law enforcement forensics experts with institutions developing new technologies and with companies offering high-tech products.

Among the presenters were:

• JPL's Dr. Murray Darrach, discussing JPL development both of the Chemical Sensing of Unexploded Ordnance with the Mobile Underwater Survey System (MUDSS), a trace explosives detector, and of a miniature mass spectrometer that could be used by astronauts to detect poisons in their cabin air, among other applications;

• Dr. William Hug, president of Photon Systems, Covina, a JPL Small Business Innovation Research partner specializing in ultraviolet Raman spectroscopy for forensic applications;

• Dr. Erik Severin of Cyrano Sciences, Pasadena, which holds a license from Caltech for JPL-developed electronic nose technology; and

• Dr. Dan Farkas of Clinical Micro Sensors, Inc., Pasadena, a JPL Technology Affiliates partner specializing in DNA diagnostics using electronic detection, a ground-breaking change from the standard (and far more expensive) biochemical detection.

The JPL coordinator was Madeline Wallace, leader of the Regional Economic Growth Initiative within JPL's Commercial Technology and Regional Development Program. Wallace, who sponsored a forum at JPL last January to help make police departments aware of JPL technologies, is now working with conference organizers on future technology partnership possibilities. Barry Fisher, director of the L.A. County Sheriff's Crime Laboratory, will tour JPL Sept. 23 as part of those discussions. ❑

News Briefs

Fred McNutt

Fred McNutt has been appointed as JPL's new chief financial officer.

In his position, McNutt will have responsibility for JPL's overall fiscal operations, including finance, the controller's office, acquisition and management of the prime contract under which JPL is operated for NASA by Caltech.

McNutt received a master's degree in business administration from USC and has more than 25 years financial experience encompassing budgetary control, governmental compliance, financial planning, payroll and accounting. His most recent position was as the vice president and controller for a division of the Raytheon Corp. Earlier, he served as corporate vice president and controller for Hughes Aircraft Co. ❑

A workshop hosted by JPL and the Government-Industry Data Exchange Program, a cooperative data interchange between government and industry participants, will be held on Lab Sept. 29 in Building 180-101, from 8 to 11:30 a.m.

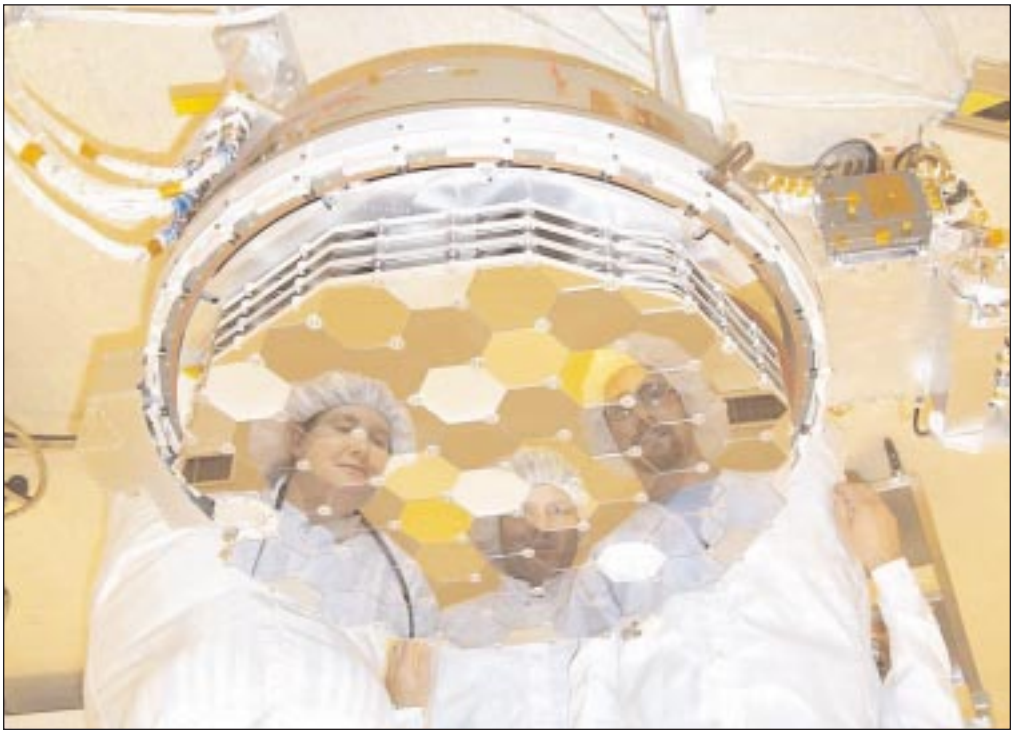
The program will provide a means to exchange data useful in the research, design, development, production and operational life cycle of systems and equipment. The aim of the session is to familiarize JPL personnel with the JPL Closed Loop Alert System, which acts as an information hub collecting problem reports on technical issues from a variety of sources. It notifies JPL flight projects so the projects can review them as part of their preventive action effort.

The system is based upon the NASA Alert System, which provides for the immediate reporting between NASA installations on identified failures, malfunctions, and unexpected degradation or contamination of parts and materials obtained from manufacturers or other suppliers. An important purpose of this system is to establish a standardized method to alert JPL project offices, safety offices, quality assurance and reliability and other appropriate offices of problems.

The program will be conducted by JPL and data exchange operations center personnel and will cover a program overview, slide presentations, demonstration of on-line computer retrieval, and questions and answers dealing with user-related topics.

The address for the Closed Loop Alert System Web site is http://parts/ 507/clas/cla-syst.htm. For further information on the session, contact JPL representative **Bob Karpen** at ext. 4-8556 or Alert Administrator **Jean Gill** at (626) 685-4134. ❑

Reflections of Genesis



Engineers (from left) Louise Jandura, Bob Troy and Andy Stone are reflected in Genesis' collector arrays, which will gather solar wind samples for return to Earth in early 2003. JPL is also providing the sample canister for the mission, which is scheduled for launch in January 2001. Environmental testing has been completed at JPL.

Mars

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The Orbiter carries two science instruments: the Pressure Modulator Infrared Radiometer (PMIRR), a copy of the atmospheric sounder on the Mars Observer spacecraft lost in 1993, and the Mars Color Imager (MARCI), a new, light-weight imager combining wide- and medium-angle cameras. The radiometer will measure temperatures, dust, water vapor and clouds by using a mirror to scan the atmosphere from the Martian surface up to 80 kilometers (50 miles) above the planet's limb. The PMIRR instrument was provided by JPL, supported by Oxford University and the Space Research Institute (Russia); its principal investigator is Dr. Daniel McCleese (JPL).

Meanwhile, the imager will gather horizon-to-horizon images at up to kilometer-scale (half-mile-scale) resolutions, which will then be combined to produce daily global weather images. The camera will also image surface features and produce a map with 40-meter (130-foot) resolution in several colors, to provide unprecedented views of Mars' surface. The MARCI instrument was provided by Malin Space Science Systems (MSSS); its principal investigator is Dr. Michael Malin, who also leads the Mars Orbiter Camera investigation on Mars Global Surveyor. ❑

“We used to decide on what the mission was going to be, and then develop the technology as part of that mission. Now we're supporting lots of different technologies that could be used for many different missions. It can help us develop our priorities.

For Earth science, outreach contributes to policy decisions about urban planning, determining ozone protocols, the ban on chlorofluorocarbons (CFCs), and others. The reason people know these protocols are needed is because of the work that we do.”

What on Earth is going on?

By MARK WHALEN

Dr. Diane Evans, chief scientist in JPL's Earth Science Program, works with the Laboratory's Earth science program managers and offices and helps represent the Lab's strategic interests in NASA's Earth Science Enterprise.

She discusses the state of the program, technology development for the future of the discipline and the value of Earth science studies.

Question: What is JPL's role within NASA's Office of Earth Science (Code Y)?

Answer: It's very exciting that NASA has assigned us responsibility for the portion of the Earth Science Program related to the solid Earth and physical oceanography. That means we have the same level of responsibility that we have for programs in Code S (Office of Space Science). Now Charlie Yamarone is the program manager for the JPL Earth Science Program.

This is the first time JPL has had this level of responsibility for Code Y. Before it was at Headquarters, and then at Goddard Space Flight Center for a number of years.

NASA has relied much more on the centers to help them develop their annual strategic plans. As a member of the Code Y strategic planning team, I represent JPL's interests to NASA Headquarters and the other centers, and I bring back what the other centers and Headquarters would like to see from us.

What are your other roles as chief scientist for JPL's Earth Science Program?

Part of my job is to represent the basic research we do here. We have about 100 principal investigators in the Earth Science Program, and that base has a lot of breadth. They do a lot of publishing in peer-reviewed literature and contribute to many conferences; they also provide me with a lot of input into the kinds of science questions to which JPL technology and engineering strengths would be best applied.

A lot of my role is to match science goals to what the technical divisions want to do—in terms of instrument development, information systems technology and component technology development—and go forward with those ideas as ones we propose for the Earth System Science Pathfinder Program, for example.

What are some other goals in technology development that will benefit Earth science?

We want to shorten the time span between the decision to go forward with a mission and actually flying that mission. The idea is that we maintain good underpinnings for the science we're going to do, and that we have a robust technology line to choose from when missions go forward. We used to decide on what the mission was going to be, and then develop the technology as part of that mission. Now we're supporting lots of different technologies that could be used for many different missions. It can help us develop our priorities.

What are some examples of these multi-use technologies?

We use imaging spectrometers as an atmospheric corrector, but also use them to map minerals and rock types, as well as vegetation species and health. When we work in microwave integrated circuits, those technologies go into all of our advanced radar systems, and depending on which wavelengths of radar are being used, they can measure cloud properties or see through clouds. But basically the components are the same thing.

The Instrument Incubator Program at JPL has received about $15 million this year. How will the program support technology development?

This year, JPL received funding for nine proposals out of 27 that were submitted NASA-wide. These proposals will support many of the post-2002 missions.

One of the proposals, led by Todd Gaier, will study millimeter-wave microwave integrated circuit atmospheric temperature and humidity sensors. Another study on microwave integrated circuits is for high-altitude sounding radar on a remotely piloted aircraft. Bjorn Lambrigtsen is the principal investigator.

BOB BROWN / JPL PHOTO LAB

Dr. Diane Evans is chief scientist in JPL's Earth Science Program.

The Advanced Altimeter for Ocean Studies, for which Li Fu is the principal investigator, is another exciting proposal. It combines our advanced systems in radar technologies with the concepts of interferometry, and will enable us to get much better and more frequent coverage over the global oceans than TOPEX/Poseidon can.

Another multi-purpose instrument is the Multi-Angle Imaging Spectro-Radiometer (MISR) that will fly on Terra, which will have a lot of value in measuring surface and vegetation properties from multiple angles; we also know that's one of the key ways to study clouds and aerosols in the atmosphere. But it's a pretty big instrument, so the idea is to make it smaller so we could fly it more frequently, or fly it on a smaller spacecraft. Dr. David Diner, the MISR principal investigator, is leading a study on a miniaturized, advanced MISR camera for EOS follow-on missions.

Another radar example is second-generation precipitation radar adaptable for multi-mission and multi-orbit applications, led by Eastwood Im. It's using a radar frequency that's between one used to measure clouds and one used to look at the surface.

The Global Positioning System (GPS)-based Oceanographic and Atmospheric Low-Earth Orbiting Sensor, led by Steve Lichten, uses the free signal on GPS satellites to provide information on atmospheric properties as well as bounce off the surface of the ocean to provide sea-surface heights.

We're currently measuring sea-surface temperature, ocean color and, of course, JPL missions are measuring ocean topography (TOPEX/Poseidon) and ocean

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winds (SeaWinds on QuikScat). The study of sea-surface salinity is a critical factor in ocean circulation because it determines the density of the water. Denser water sinks to the bottom, and brings up warmer water as part of the overall conveyer belt system that drives the weather, particularly in the Atlantic Ocean.

Those salinity studies require incredible precision and sensitivity of the instrument, so we'll utilize Eni Njoku's study of a spaceborne microwave instrument for high-resolution remote sensing of the Earth using a large-aperture mesh antenna to help us get the signals.

Basically, the only measurement we'll be missing from cloud properties after we gather data from CloudSat and the EOS platform is ice particles, and Steve Walter is the PI for a study on a submillimeter-wave cloud ice radiometer. We're hoping to fly this in concert with the other instruments on cloud studies.

Finally, George Aumann's Instrument Incubator study on the Spaceborne Infrared Atmospheric Sounder for EOS follow-on missions will be used as a pathfinder for operational systems.

Are there other opportunities coming up in Earth-science technology development?

Yes. Later this month, there will be a research announcement that will focus on component-level instrument technologies, and another one will follow later this fall on advanced information systems. NASA's Earth Science Enterprise is coming out in a really aggressive way in its funding commitments to make sure that they have the technologies required to meet their post-2002 objectives. This will provide lots of opportunities for JPL.

How much of all this planning would be affected by the possibility of cuts to NASA's budget next year?

Unfortunately, Earth science technology development was one of the line items that would be hit hardest. That's an area of the most concern. Code Y is now stepping up to the necessary investment in technology, and if that particular decision stays it would have a severe impact on their ability to achieve their long-term goals.

The Earth System Science Pathfinder Program would also be affected by budget cuts—and not only the ongoing programs—such as the possible cancellation of the Gravity Recovery and Climate Experiment (GRACE) and CloudSat, which were just selected, but it would impact our ability in the future to propose new, focused science initiatives.

This is equivalent in Code Y to the Discovery program in Code S, so it was a really good opportunity for us to cooperate with universities to get new, emerging science questions answered. So it's a big impact.

What are the concerns beyond FY 2000?

The post-2002 mission sets would be affected. After the current Earth Observing System missions, the plan is to fly a series of systematic measurements and again some experimental science systems. So the Earth System Science Pathfinders would give us some new seminal science missions, but we're also worried about the systematic measurements being impacted by the budget.

Who will be most affected by the decisions on the NASA Earth science budget? How might JPL fare?

Those in the university community are equal stakeholders with JPL and NASA in these decisions, so they're taking this situation quite seriously. For example, JPL is managing the GRACE and CloudSat programs for university principal investigators—the GRACE principal investigator is from the University of Texas and the CloudSat principal investigator is from Colorado State University—and pretty large programs would be pulled out from under them if these decisions stay.

We shouldn't be complacent, but should be careful about not getting so distracted that we stop preparing for GRACE and CloudSat, for example. Basically, our NASA sponsors have told us to stay the course, continue to get our work done, and try not to get too distracted by this.

How else do universities participate in the Earth Science Program?

For the long term, we've been working with university investigators to develop future, post-2002 proposals and mission concepts. For example, another announcement of opportunity is scheduled to come out next February or in the spring. Some of the missions being discussed address the next major, high-priority science questions, such as sea-surface salinity and measuring when the freezing and thawing of the soil occurs in the high-latitude regions, which has a big impact on the carbon cycle and the respiration of carbon dioxide.

So it sounds like a lot is riding on the upcoming budget decision.

Yes. The future is what's at stake here. And a decision to basically limit what the country is going to do in terms of future science and technology capabilities is really disturbing. I think it's generically disconcerting—not just for the NASA budget, but the fact that the things being targeted are going to be limiting the country's ability to sustain science and technology, period, as well as investment in the future.

Besides the concerns of the next year's budget, how do you make plans for beyond fiscal 2000?

NASA is in the process of working with the Office of Management and Budget to plan the FY 2001 budget, and I've been asked to articulate the accomplishments of the past year and what our plans are for the future —what we believe we will learn in the next five to 10 years. I think people want to know that their money is being well spent and that there's a plan to answer some of the compelling questions in Earth science.

NASA has recently embraced a philosophy that includes a transition from an observation-based strategy to a science-based strategy. Can you explain how that works?

Just as in the space science program, the focus now is not necessarily the spacecraft or the instruments; the question is the science you're trying to accomplish. You shouldn't be wed to any particular technology, as there might be a variety of different ways to make measurements that will answer the science questions.

Before, we would tend to gravitate toward some facility instrument and not be as open-minded to other ways to measure phenomena. The goal with new technologies is that there may be new ways that may be more cost effective, more precise or easier to do for the long term.

When will these strategies come into play?

We're moving into this for the post-2002 missions, so this hasn't occurred yet. We are currently flying the Earth Observing System missions. The paradigm change is beyond when we fly the initial chemistry missions. We'll fly Terra, the EOS-AM, EOS-PM and EOS-Chem as planned.

The original plan 11 years ago was to fly "cookie-cutters" of these missions—AM 2 and 3, PM 2 and 3 and so on—basically with exact copies of the instruments. That strategy never allowed for scientific and technological advances.

So now, in order to prioritize the essential science measurements we need, we are looking at the science questions that the instrument will try to answer in the first place. The U.S. instruments tended to be broad and answer a number of science questions. Now we need to focus on the most compelling and most important to do first.

What was the turning point in the reexamination of the Earth science strategy?

It was really with NASA's new associate administrator for Earth science, Dr. Ghassem Asrar. A key was that he came in and saw that through the leadership of the agency's administrator, Daniel Goldin, things like instruments, spacecraft and launch vehicles have gotten so much smaller. Asrar realized he could take advantage of those kinds of changes with NASA overall and bring them to bear on Earth science in particular.

How does JPL best contribute to these studies?

We're very good at understanding the science problems that need to be addressed, and what potential technology might be available to make measurements to address those problems. We pride ourselves in having end-to-end capabilities. If one of our scientists or one of our university colleagues comes up with a scientific problem, we can provide not only a measurement concept but also a sensor and mission design to address that scientific question. So basically we have end-to-end capability. Then when the data are gathered, we can contribute to the data visualization as well as knowledge dissemination.

Do you think the public understands the benefits of the Earth science missions overall and how they fit together?

Yes. A good example is that it's becoming clearer to pretty much everyone how the ocean impacts our weather. It's possible to project the frequency and magnitude of hurricanes. I think everyone believes now that through these measurements they can have access to a reliable advance-warning system for weather phenomena a season ahead of time. Because of what TOPEX/Poseidon showed, millions were saved during El Niño conditions because people were able to plan ahead to deal with it.

Another example is that before the 1994 Northridge earthquake,

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Getting ready for the ISO 9001 surveillance audit

By JUDY LUKAS
ISO 9001 consultant, Office 501

If you are one of the few people who are selected by auditors for an interview at the surveillance audit scheduled for Sept. 30 and Oct. 1, relax. The auditors are only looking for objective evidence to verify JPL's compliance to the Product Delivery System. They know that their mere presence can make people nervous and will do their best to put you at ease.

The auditors will ask questions in order to get the specific information required by the ISO 9001 standard. They will also verify that JPL is following its own system procedures that may impose additional requirements. Keep in mind that any nonconformity notes that auditors may write always pertain to a part of the system that requires fixing and are not directed toward individuals.

Here are some tips for making your audit experience as pleasant as possible.

• Give the auditor your full attention.

• Listen to the question asked and answer it fully. If you can readily show an example to support your answer, then do so.

• Don't be afraid of talking to the auditor but keep your remarks relevant to the questions asked. Conversely, when you have answered the question, you can stop talking.

• If asked a question you can't answer confidently about work done in another area or by someone else, tell the auditor and direct him or her to the people who can supply the information.

• Know where to find your procedures so you can locate them easily if asked for them. Bookmarks are a big help for electronic documents. Your employee notebook is another big help.

• Be sure that you can demonstrate how you know the procedure you are using is the current version. (That's a favorite auditor question.)

• Review your procedures if you haven't read them in a while.

• Above all, be confident. The auditor will be asking you about the work you do, and you are the expert. ❑

Evans

Continued from page 6

there were GPS measurements showing that the crust was building up in the basin; Andrea Donnellan's paper in Nature indicated the magnitude of an earthquake that would be required to relieve that buildup of stress.

For Earth science, outreach has a broad interpretation, where it contributes to policy decisions about urban planning, determining ozone protocols, the ban on chlorofluorocarbons (CFCs), and others. The reason people know these protocols are needed is because of the work that we do. And the success of those protocols is determined by some of the results we get.

Also, I'd like to think much of the understanding is through the availability of data over the Internet, where individuals log on and see where a hurricane is, for example. In the future, people will get the answer to questions: "Should I water my crops, or shouldn't I?"; others will be able to watch storms come across the screen and decide for themselves. In the Earth system, things are all connected, and we have to be able to see them and observe them simultaneously to understand connections better.

Has the success of the science been seen to be a big contributor to the success of business and industry?

Clearly, geospatial information is the basis for the planning that's done for urban infrastructure, in terms of assigning water works, highway projects or any large-scale engineering work. That's where programs like the Shuttle Radar Topography Mission (SRTM), imaging spectroscopy and thermal infrared remote sensing come in.

SRTM is particularly exciting because we'll get 80 percent of the Earth's land surface mapped with the best quality digital topographic maps ever. It's not just geologists and solid-Earth scientists who will be helped by this. Soil scientists will benefit in ecosystem and vegetation studies; hydrology studies will gain critical data sets on hazards to discern the path of flooding, lava and mudflows. It all depends on topography, and a fundamental database will be made available for the first time to the broad scientific and civilian user community. So that's very exciting.

How might SRTM also open up whole new areas of science?

The concept of using the mast on SRTM for the advanced altimeter is a novel idea and we're really hoping that we can implement an interferometer on the Jason-2 ocean topography mission as well. So it helps advance the interferometry age. We've been flying an interferometer on an aircraft and we did some experiments a few years ago on SIR-C/X-SAR, but now we get to do it as a focused mission. This was an area that was pioneered by JPL, and now there will be optical interferometry for Origins missions. It was interesting to have what was a very obscure science five years ago become a household word.

SRTM will also lead the way to the next area in interferometry we're interested in, which is monitoring topographic change. We need to see this for impending changes like volcanic eruptions or changes in crustal deformation that might be related to hazardous situations like earthquakes. So we're looking forward to having this fundamental, baseline data set that we'll get from SRTM to open up lots of research in both solid-Earth science and other areas of Earth science.

What can we look for next after SRTM?

We have the ACRIMSat mission, which will measure total solar irradiance, scheduled to launch in October. The New Millennium Earth-Observing Mission-1 will be next, with a launch from Vandenberg in December. A magnetometer and GPS provided by JPL will be part of its package, as well as an advanced land-imaging instrument. It's been many years since missions have been flown with magnetometers to detect changes in the magnetic field, so this is a really exciting opportunity for us to have a magnetometer mission flying. The GPS instrument will show atmospheric occultation and possibly ocean reflections.

You must feel proud of SeaWinds, which has been very successful since launching last June.

SeaWinds results have been incredible, and Jim Graf and his team deserve hearty congratulations. In addition to tracking the hazardous iceberg near the South Pole, it's shown pretty amazing data over hurricanes Dennis and Cindy in the Atlantic recently, as well as Olga in the Pacific. It's been a phenomenal data set, and its success has gotten everybody excited.

SeaWinds has also helped other areas of the program—it helps move the science forward and also convinces people of the importance of what we're doing. That's critical right now. SeaWinds is such a classic example of not only value for science, but also value for hazards, shipping—a key data set.

Now people are beginning to see the possibilities of using the data over land targets as well. And that's one of the exciting things about the program—once you have success, you find more use for the data than you ever anticipated. It's the serendipity of discovery that we didn't anticipate. I don't think there has been a single mission where we haven't been surprised. ❑

For the record

An article in the Sept. 3 issue of *Universe* on the late Gene Giberson incorrectly stated the name of the first U.S. satellite, on which he worked. The spacecraft was Explorer 1. ❑

Passings

Charles Stein, 77, a retired member of the technical staff in Section 341, died of stroke June 29 in his Studio City home.

Stein joined JPL in 1971 and retired in 1987. He is survived by his wife, Natalie, three children and three grandchildren. Services were private. ❑

Andrew Pease, 27, a member of the engineering and science support staff in Section 386, died of cancer July 17 at Verdugo Hospital.

Pease had worked at JPL since 1993. He is survived by his mother, Josephine, brothers Kevin and Steven and sister Ellen Day. Burial was at San Fernando Mission Cemetery in Mission Hills. ❑

K. Janet Moore, 80, a retired senior department clerk in Section 195, died of cancer July 26.

Moore worked at JPL from 1960-77. She is survived by her cousin, Verna Bowe. Services were held at Forest Lawn Memorial Park in Hollywood Hills. ❑

Muriel Horton, 76, a retired programming analyst in the former Section 315, died of natural causes Aug. 5 in Corvallis, Ore.

Horton worked at the Lab from 1958-88. She is survived by her daughter, Carol Horton Tremblay and two grandsons.

Memorial services were held in Corvallis. ❑

LETTERS

I am very grateful for the many years that I have enjoyed working with such talented and nice people at JPL and Caltech/LIGO. Thank you very much for your generosity and good wishes for my retirement. The pleasant memories of my associates at JPL and LIGO/Caltech will remain with me the rest of my life. Sincerely,

Bill Tyler

❑❑❑

Thank you to the ERC and my friends and co-workers for the lovely plant and the sympathy I have received on the sudden death of my mother. The caring JPL community has helped me greatly through this difficult time. Sincerely,

Ginny Ford

❑❑❑

I would like to thank all of my JPL colleagues and Cassini Project personnel for their wonderful support regarding the loss of my wife in May. I was blessed to have her with me for 36 years. You have helped to make this difficult time bearable.

Ross V. Goodman

FOR SALE

AIRLINE TICKET, American Airlines, R/T, anywhere in contiguous U.S.; must be used by Feb. 2000, $450/obo. 562/420-2313.
BABY BED: natural crib, exc. cond., $60. 626/585-1858.
BED, maple, double, with nearly new mattress and box spring, exc. cond., $350; SEWING MACHINE in cabinet, with all metal parts, $80. 248-9561.
BICYCLE, men's red 26-in. 10-sp. mtn. bike, $50; GOLF BAG, green upright, $20; GOLF BAG STAND, $10; take all for only $70, or golf bag and stand for $25. 787-1029.
CD, extra Red Hat #1 from book, $20. 626/573-2564.
CRIB, make offer. 626/441-0323.
CRIB, German-made pale-colored hardwood, includes mattress, bedding, $225; CARSEAT, 0-40 lbs., straps adjust in front, $25; SWING, Graco (blackwatch), $40. 626/794-8471.
COMPUTER, Dell 486, with 15" VGA monitor, 3.5" disk drive, Okidata printer, some software ('95), $300/obo. 362-3358, Valerie Pickett.
COMPUTER, Mac Power PC 7100 AV, 104MB RAM, 500MB HD, AV model does video capture w/13" Trinitron monitor, $500. 353-2103, Bill.
COMPUTER, Mac Quadra 650, 68040 processor, 32 MB RAM, 105MB HD, $200. 353-2103, Bill.
COMPUTER, Macintosh Syquest 200MB removable media storage, SCSI, w/cartridge, $100; more cartridges available. 353-2103, Bill.
COMPUTER DRIVE, Iomega Zip ($90); SOFTWARE: Microsoft Publisher 97 ($29), new Jeopardy ($10), unopened 1999 Yellow page USA, 14 million listings, major search capabilities ($9), Photo Studio Special Edition ($9), Macafee Anti Virus and Security Suite w/9 mo. free updates ($19, orig. $79), Compton encyclopedia ($5), Analyze Your Dreams CD ($8), X-men Apocalypse CD ($4), New Bruderbund Application Bible CD ($10. orig $59), Greeting Card Creator ($5), Premier Edition Draw Print Studio ($19), You Don't Know Jack CDs, all types ($15/ea.). 366-6134.
CRYPTS, companion, Live Oak Mem. Pk., 200 E. Duarte Rd., Monrovia, #6002 A&B, $2,000. 281/399-0013.
DESK, like new, $100; swag lamp, $15; ceiling chandelier, $50; elect. leaf blower, used once, $50. 353-3836.
DINING ROOM TABLE, oak, exc. cond., including expansion leaves and 6 chairs, $150/obo. 909/981-7492, Darlene.
DINING ROOM TABLE & CHAIRS, square 41" x 41" oak table w/4 chairs, good starter set, $75 or offer. 626/396-3018.
FOOTBALL CARD, 1-Randy Moss autographed 8 X 10" photo, rookie of year 1998 FB, w/certificate of authenticity, $60; 200 assorted football/baseball cards, major stars, rookies, inserts, favorite teams/players included, $20. 626/914-6083.
MODEM, Apple Geoport adapter fax/modem, Model M1694 express for power Mac, $25. 541-0062.
MOVING SALE, kids' stuff: car, made in France, kids 1-3 yrs, $9; firetruck, fwd/rev/light/sound, $9; travel bed & play yd for 0-3 yrs., gd cond., $25. 626/798-3904.
MOVING SALE, qn sofabed, $95; coffee table, gd cond., $25; coffee tbl. $15; Hamilton Beach food proc., $20; JVC portable CD component syst., 10 mo. old, $110; 25" JVC TV, $85. 626/798-3904.
MOVING SALE, lots of good junk (some free): sofa, credenza, chairs, chests, books, videos, etc.; no reasonable offer refused. 626/797-3156.
POOL, Doughboy, 16-ft. diam. by 4 ft. deep, exc. cond., incl. ladder, pump, DE filter, acces., $2,000. 249-9534.
REFRIGERATOR, Kenmore 19 cu. ft. with icemaker, $250/obo; PRINTER, Apple Color StyleWriter 2400, $50/obo. 790-6851, Roger or Margaret.
SEWING MACHINE, Singer Touch-Tronic 2000 Memory, dk. wood cabinet, like new, $150. 951-3467.
SHOES, ballet and tap, child's size 12, $10/each. 626/794-0081, Bonnie.
SKI MACHINE, Nordic Track, $350. 626/358-7480.
TELEVISION, RCA 17 in., color, remote control, works fine, $75. 951-3653.
WALL SECTIONAL, stunning Danish modern solid teak, with glass doors and black panels, approx. 7' high, picture avail., $350/obo. 323/722-4412.
WATER FILTERS, Pur faucet replacement, sealed, $6 each. 626/573-2564.

VEHICLES / ACCESSORIES

'97 BMW Z3, white, 30K mi., premium wheels, pwr. steering/dr. locks, $25,000. 541-0131, after 6 p.m.
'91 CADILLAC Seville, 4 dr., black ext., gray leather int., 4.9L V8, 4 spd. auto, loaded, 100K mi., exc cond., orig. owner, $10,500. 790-1419.
'87 CADILLAC Seville, blue, exc. driving cond., 80,000 miles, orig. owner, 4 almost new tires, 1-yr.-old transmission, CD player, reliable for both long and short trips, $4,500. 626/796-2921.
ENGINE ANALYZER, Sears; timing lt., never-used auto Dust Buster, $60/all. 323/221-8620, Richard.
'87 FORD Bronco, Eddie Bauer pkg., all amenities, orig. owner, 136K mi., all service records, new tires, just registered smog, $6,800/obo. 626/794-5464.
'92 HONDA Accord EX, 4-dr., auto, a/c, sunroof, exc. cond., alarm, all service receipts, 108K mi., must sell, $6,800/obo. 323/722-4412.
'90 HONDA Accord LX coupe, 133k mi., silver exterior, 5-sp., vg cond., $4,900. 626/914-9337.
'94 JEEP Grand Cherokee Laredo, 98.3k miles, 4x4, silver, loaded, well maintained, 2 new front tires, vg cond., $10,000. 626/441-0150.
'88 MITSUBISHI Mighty Max pickup, 2WD, 2.6L engine, extended cab, rack over cab for long loads, $2,500. 956-6603.
'95 NISSAN Maxima SE, V6 3.0 L, 4-dr, auto, a/c, tilt wheel, cruise, pwr windows/dr. locks, dual airbags; 1 owner, all records, 55K mi., $12,500. 929-0918.
'95 PLYMOUTH Acclaim, 4-dr, silver gray, auto, a/c, PS/W/L, cruise, tilt whl, V6, 90K mi., AM/FM/cass., very roomy 6-passngr, orig. owner, gd cond., $5,995. 790-0335.
'89 TOYOTA Camry, auto, power pkg., gd. running cond., 143K, 1 owner, $3,000 firm. 626/799-3890.
'88 TOYOTA Celica conv. GT, stick, pwr. windows, a/c, new tires/front rotors/brake pads/ignition cables/distributor, nose bras, car cover, 88K mi., exc. cond., $5,500/obo. 626/963-8271.
'91 VW Passat, 4 dr., 107K mi., red, black leather int., a/c, cruise cont., sliding roof, full pwr., allow wheels, new tires, leaving country; Blue Book: $6,350, sell $5,000. 626/806-1990 or 626/449-7490.
'74 VW bug, great cond., 1800 engine, top speed of 85 mph, can keep up w/traffic on fwy, 26 mpg/city, 33 mpg/highway, new tires, needs no work; estimated value $3,900, sell $2,800. 626/791-3797.

WANTED

ELECTRONIC KEYBOARD, fullsize keys, 3 octaves minimum. 626/441-6848.
ROOM, BATH, KITCHEN privileges, 2-3 nights/wk. for JPL retiree living out of area and teaching M&T eves. at GCC; seeks quiet loc., reas. rate. 261-6096 after 9:30 p.m. or 909/244-4330 weekends.
SPACE INFO/memorabilia from U.S. & other countries, past & present. 790-8523, Marc Rayman.
TALENTED PROGRAMMER to write custom screensaver/reminder program for Windows95. 626/396-3018, Chris.
WASHER/DRYER, STOVE, REFRIGERATOR, all used. 790-0088.

FREE

CAT, young, white male, blue eyes, fixed, very friendly, to a good home. 626/573-2564.
COCKER SPANIEL, rescued; blonde, neutered, 4 yrs. old; gd disposition; playful; great with small children; to good home, all shots; healthy. 843-6442.
KITTENS, 6 weeks old. 353-4705, Don or Cheryl.
SWING SET, treehouse and slide, wooden, needs work, you move. 626/794-0081, Bonnie.

FOR RENT

ALTADENA, house to share w/1 other, 1 bd. in a 3-bd., 2-ba. house, 2 mi./JPL, washer/dryer, garage, permanent net connection, avail. Oct 1., $600 + 1/2 util. 626/791-2212, Carlos, lv. msg.
ARCADIA furnished room, includes utilities, laundry, kitchen privileges, pool; no smokers, $350. 626/448-8809, Shary.
EAGLE ROCK, furn. rm in sgl.-fam. house, nice area, 10 min./JPL, priv. entr. and ba., share kitch./laundry privileges, $350 incl. util. 323/256-1785.
LA CANADA, 1 bd., 1 ba., upstairs, $700. 790-7445.
PASADENA, near San Marino border; share 2-bd., 2-ba. condo with mature, non-smoking, professional woman; all privileges, parking, pool, Jacz.; very quiet; walk to Caltech, PCC, South Lake; have 2 cats, small pet OK; $500. 626/398-0539.
PASADENA, room in 3-bd., 3-ba. apt., fully furn., carpet, parking, laundry facilities, 2 mi./PCC/ Caltech, $425 + 1/3 util. 626/351-9641.
SIERRA MADRE apt., 2 bd., 1.5 ba, quiet 6-unit bldg., top of Baldwin with valley and mtn. views, $850. 626/355-7318.
SUNLAND, beautiful 4-bd. home, lg. fenced yd., hardwood floors, 8036 Greystone Ave. 548-0588.

REAL ESTATE

BIG BEAR, new cabin 2 blocks from lake, 2 bd., 2 ba., mud/laundry rm., $129,000. 909/585-9026.
E. ALTADENA, 3 bd., 2.25 ba., 3/4 acre, vw. to ocean, see http://www.hunnicutt.net/rice. 858/759-8953.
LA CANADA, 3 bd., 2 ba., LR w/fireplace, fam. rm, central heat & air; hdwood. flrs.; newly decorated inside; new landscaping; reduced to $394K. 244-8253.
MONROVIA, 3 bd., 1.75 ba. w/guest house, cntrl heat & air, cathedral ceilings, FP, updated kitch., cedar-lined closets, 2-car carport, detached laundry/utility rm, covered patio, $288,000. 626/358-7480.
SIERRA MADRE CANYON, beautiful home surrounded by oaks, peaceful escape from the ordinary, spectacular view, 3 bd., 2 ba., lg. kitch., formal din. rm., $440,000. 626/355-7177.

VACATION RENTALS

BIG BEAR cabin, quiet area near village, 2 bd., sleeps 8, compl. furn., F/P, VCP, $75/nt. 249-8515.
BIG BEAR, 7 mi./slopes, full kitch., f/p, 2 bd., 1 ba., sleeps 6, reasonable rates; 2-nt. min., no smokers, no pets, exc. hiking, biking, fishing nearby. 909/585-9026, Pat & Mary Ann Carroll.
BIG BEAR LAKEFRONT, lux. townhome, 2 decks, tennis, pool/spa, beautiful master bd. suite, sleeps 6. 949/786-6548.
CAMBRIA, ocean front house, sleeps up to 4, exc. view. 248-8853.
DAYTONA BEACH, FL for Y2K, priv. beach access, 1 bd., 2 ba., cable TV/VCR, FM stereo, full kitch. w/dishwasher & microwave, laundry w&d in-rm, veranda overlooking ocean, Jacuzzi, sauna, pool, game room, indoor garage; easy access to shopping, nightlife; JPL discount, 5-day min., sleeps 4; avail. 12/17/99-1/7/00. 909/981-7492.
HAWAII, Maui condo, NW coast, on beach w/ocean vw., 25 ft. fr. surf, 1 bd. w/loft, compl. furn., phone, color TV, VCR, microwv., 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. 949/348-8047.
LAKE TAHOE, N. shore, 2 bd., 2½ ba., slps 6-7, priv. sandy beach, pool, great loc., all amenities, hiking, kayaking, river rafting, bike trails, 2 mi./casinos, JPL disc., 3-day min. 626/355-3886, Rosemary or Ed.
MAMMOTH condo, studio + loft, 2 ba., fireplace w/ wood, Jacz., sauna, game rm., color CB, TV/VCR, full kitch. w/microwave, terrace, view, amen., low summer rates. 714/870-1872.
MAMMOTH, Chamonix condo, 2 bd., 2 ba., sleeps 6, fully equip. elec. kitch., microwave & extras, fireplace, cable TV, VCR, FM stereo, pool & sun area, o/d Jacuzzi, sauna, game, rec. & laundry rms, BBQ area, conv. to lifts, hiking, shops & summer events, daily/weekly rates, summer rates thru Oct. 249-8524.
MAZATLAN gold crown resort (Pueblo Bonito), avail. Nov. 22-29 (Thanksgiv. wk.), $500/obo. 848-7445.
OCEANSIDE, on the sand, charming 1 bd. condo, panoramic view, walk to pier or harbor, pool, spa, game rm., sleeps 4. 949/786-6548.
PACIFIC GROVE hse, 3 bd., 2 ba., fp, cable tv/vcr, stereo/CD, well eqpd kit w/microwave, beaut. furn, close to golf, bches, 17 Mile Dr, Aquarium, Cannery Row, JPL discnt. 626/441-3265.
SAN FRANCISCO, Nob Hill honeymoon suite (for 2 only); full kitch., maid, concierge; walk to Chinatown, Top o' the Mark, Union Sq.; $125/nite; $750/wk; reserve early. 626/797-3156.
SOUTH LAKE TAHOE KEYS, waterfront, 4 bd., 3 ba., hcp access fair, sleeps 12+, frplc. on 2 levels, decks overlook priv. dock, & ski lifts, gourmet kitch., bikes, 20' sail & paddle boats, color TVs, VCR, stereo, assn. pools, hot tub & beach, lighted tennis, 10 min./skiing, casinos, golf, 1 hr./wine country, 3-day min.; $1,095/wk for high seas., 15 June to 15 Sept., 22 Nov. to 1 March; $495/wk low season, + $90 cleaning fee. 949/515-5812, Jim Douglas.

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Universe

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