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Jet Propulsion Laboratory

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Inside

Likely cause of orbiter loss identified

Photo by Dutch Slager

Photo above: Mars Surveyor Operations Project Manager Richard Cook, center, makes a point at last week's briefing immediately following the loss of Mars Climate Orbiter. At left is Dr. Carl Pilcher, science director for solar system exploration at NASA Headquarters; at right is Dr. John McNamee, project manager responsible for development of the spacecraft.

A failure to recognize and correct an error in a transfer of information between the Mars Climate Orbiter spacecraft team in Colorado and the mission navigation team in California led to the loss of the spacecraft last week.

That preliminary finding from JPL internal peer review was announced by NASA Thursday.

"People sometimes make errors," said Dr. Edward Weiler, associate administrator for space science at NASA Headquarters in Washington, D.C. "The problem here was not the error, it was the failure of NASA's systems engineering, and the checks and balances in our processes to detect the error. That's why we lost the spacecraft."

The peer review preliminary findings indicate that one team used imperial units—inches, feet and pounds—while the other used metric units for a key spacecraft operation. This information was critical to the maneuvers required to place the spacecraft in the proper Mars orbit.

"Our inability to recognize and correct this simple error has had major implications," said JPL Director Dr. Edward Stone. "We have under way a thorough investigation to understand this issue."

Two groups have been established by JPL to assist in determining the cause of the accident. A special review board chaired by John Casani, retired JPL chief engineer, includes current and retired employees as well as outside participants.

In addition, an internal peer review group headed by Frank Jordan is meeting twice a week, and will serve as a principal source of data and technical information to JPL's special review board.

NASA is also expected to appoint an independent review board shortly. The JPL board is directed to support the activities of the NASA panel through open disclosure of findings and assistance as requested.

On Thursday, Sept. 23, Mars Climate Orbiter correctly began its engine burn to enter orbit around the planet, and passed behind Mars out of contact with Earth as planned. No radio signal was detected, however, when the spacecraft was expected to reemerge about 20 minutes later. Analysis showed that the orbiter apparently passed much closer to Mars than planned—within 57 kilometers (35 miles) instead of about 140 kilometers (87 miles)—and likely malfunctioned as it heated up in the atmosphere.

"NASA's Mars program is flexible enough to allow us to recover the science return of Mars Climate Orbiter on a future mission," said Dr. Carl Pilcher, science director for solar system exploration at NASA Headquarters. "This is not necessarily science lost; it is science delayed."

"We have a robust program to explore Mars that involves launching on average one mission per year for at least a decade," Pilcher added. "In fact, Mars Polar Lander will arrive in just over two months and its mission is completely independent of Mars Climate Orbiter. The science return of the lander won't be affected."

The project has begun an aggressive effort replanning how to return data from Mars Polar Lander when it arrives in December, chiefly using the lander's X-band transmitter for direct transmissions to Earth. The lander may also send some transmissions through Mars Global Surveyor, which is currently orbiting the planet. Mars Polar Lander was designed with a "triple-redundant" communications system so that it could send data through either orbiter or directly to Earth.

Public shows support following Orbiter loss

In the wake of last week's loss of Mars Climate Orbiter, dozens of letters and e-mails of sorrow and public support have been received by the project office.

Coming from throughout the United States and Canada and from as far away as the United Kingdom and New Zealand, supporters passed along their condolences about the mission in terms of mourning, astonishment and sadness, while at the same time encouraging team members and the Laboratory to keep their chins up and continue forward.

"It may look difficult today, but from this experience, I think you all will face far greater triumphs in the future," wrote one supporter. "Though we are disappointed, our faith in NASA is not shaken," wrote another. "We know that you will try again and we shall all celebrate success one day."

A citizen who described himself as an avid supporter and interested follower of Mars exploration said he is "saddened by the unexpected loss; I feel as though I have lost a close friend. My best regards go out to the scientists and staff at JPL/NASA for their continuing efforts at expanding our knowledge of the solar system."

One supporter summed up the sentiments of many with this message: "In spite of the loss of Mars Climate Orbiter, NASA and JPL continue to make me extremely proud to be an American."

PBS documentary to spotlight JPL

By Betty Shultz

Journalist Walter Cronkite, left, chats with JPL Director Dr. Edward Stone during interviews for PBS documentary.

Photo by George Shultz

Former CBS news anchor Walter Cronkite interviewed Laboratory Director Dr. Edward Stone and others at JPL last week as part of a one-hour Public Broadcasting System documentary on robotic space exploration.

The hour-long program, "Beyond the Moon," is produced by Cronkite Productions Inc., headed by Walter's son Chip Cronkite. It will present the history of solar system exploration as well as plans for future robotic space flight and will include contributions by other institutions, including NASA's Goddard Space Flight Center and Ames Research Center.

Cronkite interviewed Ken Jewett, lead mechanical engineer for the 2001 Mars rover, in the clean room of Building 198, where Jewett described the design and function of the Sojourner rover's look-alike, Marie Curie. Cronkite was also filmed in the Mars Yard, with "Rocky 7" demonstrating its ability to traverse Mars-like terrain.

Cronkite interviewed Stone in the director's office and in von Karman Auditorium, where the two discussed the early days of Voyager, JPL's achievements in technology development, and the Lab's plans for "faster, better, cheaper" projects.

The documentary is scheduled to be aired on PBS next spring.

News Briefs

Dr. Charles Elachi

Gael Squibb

Space and Earth Sciences Programs Director DR. CHARLES ELACHI and Telecommunications and Mission Operations Director GAEL SQUIBB have been elected to the International Academy of Astronautics. Elachi was chosen for his work in basic sciences, while Squibb was selected for his work in engineering sciences.

The academy's goals include fostering development of astronautics for peaceful purposes and recognizing individuals who have distinguished themselves in a related branch of science or technology. Its roster includes 1,100 members and corresponding members from 60 countries.

Elachi, a 28-year JPL veteran, and Squibb, who has worked at JPL for 35 years, will be inducted into the academy Oct. 3 in Amsterdam.

JPL Director DR. EDWARD STONE has appointed four JPL employees to the position of senior research scientist.

DR. DAVID CRISP of Element 3233 was recognized for his research specialty in atmospheric science and leadership in atmospheric radiative transfer modeling.

DR. DARIUSH DIVSALAR of Section 331 was selected for his international work in the development and application of error-correcting codes and modulation systems for telecommunications and significant contributions to deep-space telemetry and mobile data communications.

DR. JOAN FEYNMAN of Element 3239 was named for her research in space physics and producing a new model for high-energy proton fluences that has become the world standard in spacecraft design.

DR. WILLIAM MCGRATH of Section 386 was recognized for his world leadership in the field of cryogenic coherent detectors and the development of the superconducting hot-electron bolometer.

The senior research scientist grade was established in 1979 to give special recognition and promotion to outstanding individual research achievers. In addition to demonstrated research leadership, appointment also depends on the individual's active participation in programs related to JPL's institutional goals.

JON ADAMS of Section 336 and PETER GLUCK of Section 345 have been chosen for JPL's System Architect Development Program.

Administered by the Engineering and Science Directorate's Center for Space Mission Architecture and Design, the program is in its fourth year. Opportunities for system architects include working on mission proposal responses to announcements of opportunity, working with JPL's Advanced Projects Design Team, industrial partners and other NASA centers.

Program administrator DR. CLIFF ANDERSON said candidates are chosen based on their strong technical and problem-solving skills, leadership in technical innovation, an ability to be an effective team builder and facilitator, and skills in leading mentoring and helping others succeed. Flight systems experience, as well as broad-based experience in design and development, is also required.

JPL and several other NASA centers will co-host the Gossamer Spacecraft Initiative Workshop Oct. 12 and 13 in Oxnard's Mandalay Beach Hotel.

The workshop will include an overview of the Gossamer spacecraft initiative, a new NASA program to begin long-range development of enabling technologies for very large, ultra-lightweight structures and apertures. Topics will cover user needs for Gossamer technology, a review of preliminary technology roadmaps, and advanced concepts for Gossamer spacecraft, which includes giant telescopes and antennas, solar sails and highly integrated membrane spacecraft.

The workshop will be co-hosted by the Langley Research Center, Goddard Space Flight Center and Marshall Space Flight Center.

For technical information, call ARTUR CHMIELEWSKI, manager of the Gossamer Spacecraft Technology Program, at ext. 4-0255. For conference administration, contact PAT MCLANE at ext. 4-5556. For general information, call ANNA CHAVEZ at ext. 4-2090.

NASA's Occupational Health and Employee Assistance Office is providing all NASA centers an opportunity to participate in the National Depression Screening Project as part of an education program to prevent mental illness and help employees cope with potentially stressful situations.

All JPL employees, retirees and their families are eligible to participate by calling (800) 390-7302 through Dec. 31, 1999. All calls are confidential and anonymous.

Annual benefits enrollment begins Oct. 11

JPL's annual benefits enrollment period will be held from Monday, Oct. 11 through Monday, Nov. 1.

This is employees' opportunity to review their benefits and make changes for the upcoming year. Changes made during the enrollment will be effective Jan. 1, 2000. As an added bonus, JPL's Benefits Office has made the process easier than ever this year through the creation of an Oracle applications web site, the same system used for timekeeping.

If you don't wish to change any of your plans and you are not enrolled in a Health Care or Dependent Care Spending Account, there's no need to do anything during the enrollment period. Those who utilize the Health Care and/or Dependent Care Spending Accounts must re-enroll to continue coverage in 2000, since enrollment is not automatic year-to-year.

Detailed information on annual enrollment via the web site will be sent to all eligible employees the week of Oct. 4.

If you will be out of the area during the enrollment period, contact the Benefits Office at ext. 4-3760 or e-mail to *benefits@mail1.jpl.nasa.gov* to make special enrollment arrangements.

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. Call employee assistance counselor Cynthia Cooper at ext. 4-3680 or Randy Herrera at ext. 3-0664.

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

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

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

Tuesday, October 5

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

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

TMOD Lecture Series—Dr. Chad Edwards, manager of the Mars Network Project Office, will present "Mars Network: First Step on the Planetary Internet" at noon in von Karman Auditorium.

Wednesday, October 6

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

"Grocery Bags to Baseball Bats: Polymers and Us"—Caltech chemistry professor Dr. Robert Grubbs will discuss the role of catalysts in making new plastics and polymers. At 8 p.m. in the campus' Beckman Auditorium. Admission is free. Call (626) 395-4652.

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

Thursday, October 7

"Is There A Link Between Perfectionism and Depression?"—Dr. Charles Barr will present this talk at noon in von Kármán Auditorium. Sponsored by JPL's Employee Assistance Program, Occupational Health Services. For information, call ext. 4-3680.

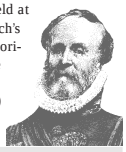
JPL Gun Club—Meeting at noon in Building 183-328.

Friday, October 8

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

Friday, Oct. 8–Sat., Oct. 9

"Reduced Shakespeare Company"—This ensemble takes a satirical and condensed looked at the last 1,000 years in its new musical "The Complete Millennium Musical (abridged)." Held at 8 p.m. in Caltech's Beckman Auditorium. Tickets are $29, $25 and $21. Call (626) 395-4652.



Tuesday, October 12

Improved Use of Online Information: A New Internet Standard—Jim U'Ren of Section 350 will speak about JPL's Knowledge Management Project's proposal for a JPL core metadata specification that promises significant improvement in searching, retrieving and reusing online information. At noon in von Karman Auditorium.

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

Wednesday, October 13

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

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. Call Mary Sue O'Brien at ext. 4-5090.

SESPD Lecture Series—Stardust Mission Director John Pensinger & Fengchuan Liu will discuss "Low Temperature Microgravity Physics Experiments on the International Space Station" at 11 a.m. in Building 180-101.

Thursday, October 14

"Breast Wellness and Wisdom"—JPL Occupational Health Services, in conjunction with the American Cancer Society, hosts this presentation at noon in von Kármán Auditorium by Dr. Christy Russell, chief of medicine at Norris Comprehensive Center, and director of the USC Norris Breast Center.

Friday, October 15

"The Emperor Jones"—A mixed company presents its production of Eugene O'Neill's play about a Pullman porter who catapults himself into the position of emperor of a small West Indies island. At 8 p.m. in Caltech's Beckman Auditorium. Tickets are $22, $18 and $14. Call (626) 395-4652.

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

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

ONE IN AN OCCASIONAL SERIES

FASTER, SMALLER, SMARTER

Can studying the brain structure of animals help make a better Mars rover? Can an entire flight computer that runs navigation, power and other systems be shrunk onto a chip the size of a dime? Those are among many questions that technologists are asking themselves as they strive to make intelligent spacecraft of the future smaller and lighter.

By Mark Whalen

At JPL, much of this work is going on at the Lab's Center for Integrated Space Microsystems, which develops highly miniaturized advanced avionics and computer systems for future deep-space applications. Dr. Leon Alkalai leads this JPL Center of Excellence, one of six areas of specialty on Lab designated by NASA.

QUESTION How did the center get started?

A Three years ago, NASA Administrator Daniel Goldin requested a series of briefings about the agency's role in the development of advanced microelectronics technologies for future missions. At that time, I was the co-lead for the New Millennium Program's microelectronics integrated product development team.

Initially, we presented a somewhat conservative vision; I told Mr. Goldin that the best NASA could do is to follow industry's lead, that it could not compete with companies that put billions of dollars into microelectronics products.

Fortunately for us, it turns out he didn't like what he heard. He responded in no uncertain terms that NASA and JPL should not follow, but indeed must lead, future development of these areas. Goldin asked to meet with us again in one month for a much more future-looking vision.

With the support of my JPL colleagues, I presented a new, forward-looking vision of NASA as a technology leader in microelectronics. We told the administrator about JPL's desire to develop highly intelligent, autonomous and miniaturized spacecraft systems, including how to use elements of biology to do computing.

QUESTION Was Goldin impressed?

A Yes; in fact, our second presentation really blew him away. He told Ed Stone, Charles Elachi and myself, "You don't understand how important this meeting really was. This is going to change NASA." And that has been happening. I believe Goldin's push for excellence in technical development, and JPL's response to it, was the driver for the creation of the Deep Space Systems Technology Program (also known by the nickname "X2000"). And this in turn was responsible for the creation of our center.

QUESTION What are the center's areas of focus?

A One of the center's virtues is that it holds JPL's vision for technology development within three time frames—near-, mid- and long-term. This approach allows lessons learned and valuable engineering experience to go from near-term to future technologies.

QUESTION How does the center's work fit in with X2000? What is the center working on for the near term?

A With its newly designed facilities, the center supports advanced design engineering, avionics integration and test, and chip-level testing for X2000's first-delivery project, a first-generation avionics system based on single-board computers connected in a network for distributed, highly reliable systems. The first user of this architecture is the Europa Orbiter mission, set to launch in 2003.

QUESTION What will these advanced flight computers be like?

A The Europa mission will carry the highest-performing radiation-hardened PowerPC processor chip set ever flown, with an order of magnitude (10 times) more capability than the computer flown on Mars Pathfinder. This computer can later be used by numerous flight projects—not only within NASA, but in the Department of Defense as well. Also, a radiation-hardened Pentium computer that is fully compatible with the PowerPC computer will also be available as a backup technology in the same time frame.

QUESTION What other technologies for the Europa mission are under development now?

A Actually, there are at least 15 advanced avionics technologies for deep-space exploration that are currently baselined for the Europa orbiter and will be delivered in the 2001-2001 timeframe.

One of the major technology developments here is that all of the interfaces between subsystems and components are based on commercial, off-the-shelf standards. This will result in huge cost savings, and will allow more efficient integration and test of these systems.

It's the first time JPL has procured these interfaces as intellectual properties and built them on radiation-hardened platforms. They have been adapted to survive Europa's high-radiation environment.

QUESTION What are the goals for the center's mid-term technology planning?

A Within three to five years, we are looking to develop "systems on a chip," which will miniaturize all spacecraft requirements for power, communications, computer and memory, and guidance and navigation from computer boards to single chips smaller than a dime. This technology development, led by Dr. Elizabeth Kolawa, is a new approach to building smaller systems and allows us to use them more frequently. For example, multiple systems on a chip might be applied to the skin of a spacecraft as environmental sensors. We might put thousands of them on the space station, where they could communicate with each other to track the flow of gases and other hazards onboard.

QUESTION What more would a system this small allow you to do?

A A huge part of any spacecraft is electronics, and the ability to make this somewhat transparent would give us much more capability than we have today. We could have, let's say, a "sensor web" on Mars, where we would sprinkle sensors throughout. The chips would be able to sense, communicate and process information.

QUESTION What's the time frame for your long-term goals?

A For the long term, which we think will take between five and 10 years, the goal is the development of revolutionary computing technologies. Dr. Benny Toomarian manages this program.

QUESTION Does this mean developing even smaller technologies than systems on a chip?

A Yes. The studies will attempt to develop technologies as small as the nano-level, or a billionth of a meter. An example is a collaboration we've recently begun with the National Cancer Institute to develop sensor systems that would identify biological signatures at the molecular scale for detecting cancerous cells in living organisms.

QUESTION Why would a system designed to study cancer help us with spacecraft?

A These systems could be used for identifying evidence of life in-situ on Mars or on an asteroid or comet. They could also aid "bioastronautics," where future astronauts, going months or years without getting help or supplies from Earth, might be monitored to detect health problems way in advance.

QUESTION You mentioned studying biology to develop microsystems. How is that seen as part of the long-term vision?

A We're going back to nature to study how living organisms, over billions of years of evolution, have solved very complex problems. By mimicking biology, we are looking at how to solve control functions in robotics, like navigation and mobility. Neurobiologist Chris Assad, a postdoctoral scholar at JPL, is studying how the cerebel-

Continued on page 4

Photo by Richard Hasegawa

"We're going back to nature to study how living organisms, over billions of years of evolution, have solved very complex problems."

Dr. Leon Alkalai, center leader

SMALLER *continued from page 3*

lum of fish controls complex motor functions and how that knowledge might be used to design, for example, better rovers for Mars.

QUESTION What is the center doing for the long term for new paradigms of computing?

A Researcher Adrian Stoica has pioneered "evolvable hardware," silicon hardware chips that can change over time based on genetic algorithms, which simulate evolution for the purpose of surviving failures due to extreme environments. It's an attempt to derive solutions over generations by developing systems that have redundancies built in at the material, device and circuit levels so that if certain elements fail, the chip would evolve and reconfigure around faulty areas.

We envision these types of technologies for missions such as interstellar exploration, where we need systems to adapt and survive for as much as a century. A few years ago, this was unimaginable.

QUESTION How does your center operate?

A We operate in a "soft project" mode—nobody changes organizational boundaries to do our work. As a research and development project, the center receives funding and facilities support from JPL's technical infrastructure burden. I report to Dr. Bill Weber, director for the Office of Engineering and Science.

QUESTION What do you consider your greatest accomplishments so far?

A This is our second year as a center, and I am proud that we've developed the right environment and culture to innovate and transfer advanced technologies into future flight projects. This year, center members have contributed more than 50 peer-reviewed publications and more than two dozen new technology reports, and about a half-dozen patents have been awarded and filed.

QUESTION What are your greatest challenges right now?

A The biggest challenge we face is to have new technologies inserted into flight projects in a timely manner. Often, flight projects are resistant to flying new technologies. I believe if we fly our missions with older technologies, we stand to lose. If we lead the world in technology-based space exploration, we will have a bright future. That's JPL's winning ticket, in my opinion.

Feedback sought on future of ads

Today's issue of Universe debuts a new format as designed by JPL's Design Services team in Section 644.

Under consideration for future issues of the newspaper is the relocation of classified advertising to an online system, where advertising deadlines would not be a factor for advertisers or readers.

An August survey on a new ad format received scant response, so readers again are offered an opportunity to provide Universe with feedback on the subject. Send comments to feedback@universe.jpl.nasa.gov.

http://www.jpl.nasa.gov/info/universe

Universe

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Notice to Advertisers

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

Ads must be submitted on ad cards, available at the ERC and the Universe office, Bldg. 186-118, or via e-mail to universe@jpl.nasa.gov. E-mail ads are limited to six lines.

Ads are due at 2 p.m. on the Monday after publication for the following issue.

Letters

I would like to thank the many friends here at JPL who expressed condolences after the recent death of my mother. Your warm expressions of sympathy were a welcome source of support.

Larry Dumas

My family and I would like to thank all of my friends at JPL and OAO for your expressions of sympathy in the loss of my brother. I am truly overwhelmed at your thoughtfulness and kindness during this difficult time. Also, thank you to the ERC and OAO for the beautiful plants we received.

Cozette Parker

Passings

JESSE CUNNINGHAM, 91, a retired senior administrative assistant in the former Section 292, died of stroke Aug. 5. Cunningham, who worked at the Lab from 1953-76, is survived by daughters Katherine James and Mariam Cunningham, and stepson Robert Brown.

Services were held at Ivy Lawn Memorial Park in Ventura.

JOSEPH SHAFFER JR., 73, retired group supervisor for propulsion launch vehicle integration, guidance and control design, died Aug. 10 of complications resulting from heart surgery.

Shaffer, who joined JPL in 1959, served as launch vehicle engineer on several missions, and was launch vehicle manager for the TOPEX/Poseidon mission. He retired in 1993. He is survived by his wife, Dolores; daughter Carolyn; sons Ronald, James, Michael, Patrick and Timothy; and 14 grandchildren.

Burial services were held Aug. 12 at San Fernando Mission.

Retirees

The following employees retired in September: Robert Niedzialek, 44 years, Section 644; John Casani, 43 years, Section 100; Joseph Plamondon, 40 years, Section 515; William Tyler, 38 years, Section 506; Steven Burks, 37 years, Section 334; William Peters, 36 years, Section 224; Ronald Wichelman, 23 years, Section 644; Mattie Green, 18 years, Section 335; Bert McKenna, 17 years, Section 387; Charles Crawford, 16 years, Section 215; George Alexander, 12 years, Section 180; Randy Ashway, 12 years, Section 223.

Classifieds

For Sale

AIRLINE TICKET, American Airlines, r/t, anywhere in the contiguous US, must be used by Feb. 2000, $450/obo. 714/903-8888.
APPLIANCES: vac. cleaner, Hoover, upright, w/attachments, gd cond., $50; steam iron, GEc Power Spray, vg cond., $20; floor lamp, black base & pole, off-white shade, gd cond., $15; indoor TV antenna (rabbit ears), rotating type, RCA, vg cond., $10. 626/577-8107.
BOMB HOIST, WWII vintage, portable, 1/2-ton capacity, gd. size for mounting in a truck bed, $60. 626/302-1927.
CAMERA, Nikon FE, fully auto. except focus, Nikon F 1.4.50mm, Kiron 28-70mm zoom, Kiron 70-150mm zoom electronic flashgun, exc. cond., instruction manual, $290. 626/351-6141.
CD WRITER, HP external SureStore, $139; Iomega SCSI Zip drive, $89; Iomega Zip SCSI card, $35; SOFTWARE: Jeopardy, $10; new '99 Yellow pg. USA, 14M listings, $5; Photo Studio, spec. ed., $7; Macafee anti-virus sec. suite, free updates, $19, orig. $79; Compton encyc., $5; Analyze Your Dreams CD, $5; X-men Apocalypse CD, $4; Bruderbund Applic. Bible CD, $10, orig. $59; Greeting Card Creator, $5; Premier Ed. Draw Print Studio, $15, orig. $49; You Don't Know Jack CDs, $15. 366-6134.
CHINA SET, 60 pc, $70/obo. 909/592-0780, Ana.
COMPUTER KEYBOARD, Microsoft Windows95 Natural, $15. 362-2003, Derek.
DICTATION/TRANSCRIBING MACHINE, Sony prof. model BM75 w/ft. pedal, $75. 323/221-8620, Richard.
DINING ROOM FURNITURE: cherry wood server from Ethan Allen (Georgian Court collection), 40" x 21" x 34", exc. cond., $800; matching wall-mounted shelf, $40. 626/577-8107.
DISHWASHER, portable, runs well, wooden top, will deliver locally for $5, $30. 626/457-8435.
EXERCISE EQUIPMENT, bicycle exerciser, Huffy $45; Back Revolution exerciser, never used, $350 new, sell $200. 909/594-4180, Ron.
EXERCISE EQUIPMENT, Nordic Track Pro, new, w/pulse monitor, $250. 626/798-8970.
EXERCISE EQUIPMENT, Voit SCX230P electronic aerobic stepper, picture in owner's manual, gd cond., 4 yrs. old, $50. 805/527-6834.
FOOTBALL CARD, 1 autographed Randy Moss 8" X 10", '98 rookie of yr. w/cert. of authenticity, $60; BASEBALL/FOOTBALL CARDS, assorted, 200 count w/major stars, rookies, inserts, favorite teams/players incl., $20. 626/914-6083.
FREEZER, 18.5 cu. ft., chest, Montgomery Wards signature, used 2 yrs., otherwise stored, good cond., $75. 626/798-8970.
FURNITURE, 3-pc. set, 7 ft. sofa, 5 ft. love seat, wingback chair, pur. 1 1/2 yrs. ago at Rob-May for $3,500, like new, beaut. hunter grn./beige plaid, accent pillows, $500. 701-0061.
GUITARS, Epiphone Dot 335, black, list $870, ask $325; Epiphone Riviera, cherry, both new w/hard case, list $1,200, sell $495. 249-2357.
GUITARS: '66 Fender super reverb, black face, no mods., grill cloth & spkrs. not orig., gone thru, new tubes, filter caps, great tone, $975; '66 Gibson EX-335, cherry red, trapeze bridge, all orig. w/orig. hse., $1,850; '64 Gretsch Chet Atkins 6120, orange, dbl. cutaway, bigsby, mute, thumbnail markes, $1850; '61 Gibson Les Paul/SG cherry red, great cond., great tone, $3,300; '57 Fender Telecaster, neck refinished, pots changed, body paint & pick-ups original, $3,500/obo; '55 Fender P-bass, blonde, bakelite pickguard, contour body, $3,750. 626/798-7339.
PHOTOGRAPHS, 40" x 30", color, framed; 2 tall-ship pics by prof. photog., vg cond., 1 of Span. ship in SF bay, one of German ship nr Puerto Rico, $70/each, $120/both obo. 626/568-8298.
PIANO, '62 Wurlitzer console w/bench, vg cond., $780/obo. 323/550-8139.
PIANO, Wurlitzer Spinet, w/bench, $875; SPEAKERS, Advent utility w/stands, gd cond., $80/pr.; BIKE, BMX-style, 20" tires, vg overall cond., $40. 952-8455.
PICTURE FRAMES, 3 made of brass, 22" x 28"; $6 each, $15 for all 3/obo. 626/568-8296.
POOL, Doughboy, 16-ft. diam. by 4 ft. deep, exc. cond., incl. ladder, pump, DE filter, accessories, $2,000. 249-9534.
PRINTER, Xerox Diablo 630 daisywheel w/print wheels/ribbons, exc. cond., works great, $10/obo. 626/568-8298.
PUPPIES: purebred Eng. Springer Spaniels, grt. hunters, championship bloodlines, $400/ea., see http://www.gundog.nu for info/pictures.
RABBIT HUTCH, lg. 4'. x 4'., $90; two smaller cages (1.5 x 2), $15/ea. 626/797-4758.
SKI MACHINE, NordicTrack, $200. 626/358-7480.
SOFA SLEEPER, 7', multi-colored, qn. sz., used once, pd. $655, sell $500/obo. 241-9232.
TABLES, glass, four 2-shelf tables w/brass ft., 3 make up a coffee table (1 round 2.5 ft. dia., 2 "half-moon"); 4th is a round end table, 2.5 ft. dia.; $125/obo. 909/592-0780, Ana.
TICKETS, 2, Bruce Springsteen, Oct. 17, sec 317, row 6, $100 ea. 323/259-8604.
TV CART, holds up to 27" TV, space for VCR & storage below, $50/obo. 626/398-4960.
TY BEANIE BABIES, current & retired, good prices, 626/963-0685, Lupe Medina, after 5:30.
TYPEWRITER, Underwood elect., portable, hardshell carry case, like new, $75/obo. 626/284-9664.
WATERBED FRAME, Cal. king firm mattr., 6-drwr underdresser, $150/obo. 818/249-4536, Steve.
WEDDING DRESS, exc. cond, used once, in garment bag, white, straight, long sleeves, bow in back, $40/obo. 626/568-8298.
WEIGHT BENCH SET, Competitor 1500 bench w/bench press bar & 330 lbs., std. weights, vg cond., $175. 626/798-8970.

Vehicles/Accessories

'95 ACURA Legend LS coupe, 2D, black, auto, 104,000 mi., mint cond., leather, sunroof, heated seats, alloy wheels, CD, remote keyless entry, $22,000/obo. 213/253-9279.
CAR KIT, Pinto Gazelle, compl., need Pinto only, was $7,000, sell $2,000. 909/594-4180, Ron.
'88 CHAMPION RV, 19 foot, Chev truck, self-contained, less than 30,000 miles, need paint, $14,000. 626/444-6691, Forrest Janes.
'96 FORD Escort LX, 4-dr., a/c, fm/cass., alarm, 5-spd., extended warr., $6,800/obo. 353-4725.
'97 GMC Safari van, exc. cond.; 32k mi., still under GMC 7-yr. 100,000- mi. warr., $19,000. 661/252-9183.
'90 HONDA 100 CR, exc. cond., runs great, current regist. 2001, $1,000. 661/251-7738.
'86 HONDA Accord shop manual; i70 DATSUN 240Z service manual. 952-8455.
'82 MERCEDES 300TD wagon, leather, sheepskins, gold color, sunroof, window tint, 157k miles, $4,500/obo. 626/584-4645.
'80 MECERDES BENZ 280 SL, gray mkt., black w/hard top & soft new top, 196K mi., recent engine work, exc. cond., $4,500. 626/301-9487.
'95 SATURN SL-2, 4-dr. sedan, a/c, AM/FM/tape, cruise, 5-spd., exc. shape, low mi. (28K), $8,900. 626/797-3310 eves./weekends.
'86 TOYOTA Camry, orig. owner, vg cond. clean in/out, air, auto alarm, 133M, $1,800. 626/305-6666.
'90 TOYOTA Corolla, good cond., 283K mi, $2,100; '85 TOYOTA Camry, new motor & smog, slight damage on rear door, otherwise mint, $2,800. 562/464-0446.
'90 VW Fox, gd. cond., great 1st car, low miles, CD, a/c, $2,950/obo. 542-4128.
'91 YAMAHA Virago 1100, black w/gray accent, lots of chrome, Jardine pipes & foot controls, $3,550/obo. 616/355-6350, Paul.
'86 YAMAHA Fz750, 37k mi., new tires, brakes, & chain, original owner, vg cond., runs great, many extras, see photo on ERC board, $1,600. 626/345-0079, Ron.
'71 YAMAHA Enduro motorcycle, 175cc CT3, needs TLC, $100/obo. 626/798-8970.

Wanted

CHIPPER/SHREDDER to rent (or buy) for garden cleaning and compost shredding. 626/794-8616.
GRADUATES, Belmont High School (LA) from 1957-62. 956-1744, Barbara.
SAILBOAT PARTNERS in a Santana 27 berthed in San Pedro. 626/797-6982.
SNOWBOARD w/bindings, snowboard boots, gloves for child abt. 54" tall, shoe sz. 3. 952-8455.
SPACE INFO/memorabilia from U.S./other countries, past & present. 790-8523, Marc Rayman.
TREADMILL exerciser, variable speed, gd working cond. 661/296-6260.
T-SHIRT, Cassini-Huygens Earth swingby, XL, flyby date is my birthday, so your sacrifice would mean a lot. 626/351-6964, Guy.
VACATION RENTAL in San Diego for Dec. 26 '99-Jan. 3, 2000. 626/683-9177, Laurence.
VOLLEYBALL PLAYERS, coed, all levels of play, every Tues. night 8-10, Eagle Rock High School, $3/nt. 956-1744, Barbara.

Free

DOG, beautiful female American mix, brown w/black tiger stripes, spayed & shots current, med. dog, a little over 2 yrs. old, indoor/outdoor, loves people, great friend. 909/396-0471.
DRAWERS from remodeled kitchen, several sizes. 341-1798.
EXERCISE BICYCLE, DP-1250, gd. cond. 626/798-8970.
FOAM PACKING PEANUTS, approx. 16 cu. ft., enough for full house move. 626/799-4478, Al.

For Rent

ALTADENA, spacious 2+1 home, prime neighbood, c/a, 2-car gar., hardwood floors, fenced yd. w/gardener, remodeled kitch., f/p, $1,500 + security. 949-5206.
EAGLE ROCK, furn. rm in single-fam. house, nice area, 10 min./JPL, priv. entr. and ba., share kitch./laundry privileges, $350 incl. util. 323/256-1785.
GLENDALE house, prime location, full privlgs, cent. courtyd. w/ftn., deck w/gazebo, util./cable incl., for 1 person to share w/1 other, no smoking/drinking. 246-4750.
LA CANADA, 1 bd., 1 ba., upstairs, $700. 790-7445.
LA CRESCENTA, 2 bd., high above Foothill, incl. pool w/service and gardener, $1,450. 952-6007.
PASADENA, rm. in 3-bd. apt. to share w/2 others, pool, parking, a/c, washer/dryer, $460. + 1/3 util. 626/564-1078.
WEST PASADENA, 2 bd., 1 ba, 2-car gar., detached studio. 626/441-3171, Tom Markey.

Real Estate

BIG BEAR, new cabin 2 blocks from lake, 2 bd., 2 ba., mud/laundry rm, $129,000. 909/585-9026.
MONROVIA, 3 bd., 1.75 ba., w/guest house, cnt. heat/air, cathedral ceilings, FP, updated kitch., cedar-lined closets, 2-car carport, detached laundry/utility rm., covered patio, $288,000. 626/358-7480.
MONROVIA panoramic vw. home, 3 bd., 1 3/4 ba., little bit of paradise, 2 f/p, walls of glass, 3 decks, recent updated gourm. kitch. w/prof. stove, c/a & forced air/heat, spa & bar on middle deck, 2-car garage, 64' X 200' lot, $319,000. 626/357-3230.
NORTHRIDGE townhouse in gated community, appx. 1,300 sq. ft., 2 bd., 2.5 ba., 2-car att. garage, immac. unit w/many upgrades, beautiful backyd., complex has pools, Jacuzzis, 2 tennis courts; 25 min./JPL, $205,000. 360-5235.
PASADENA, 1 bd. apt., exc. loc., furn., refrig., stove, wall installed a/c & heating units, easy access to public transport. & shops, nr. Victory Pk, 994 North Altadena Dr., $600. 242-3017, Armond.
PASADENA townhome, built '98, nr Rose Bowl, 3.5 mi/JPL, gated community, 1,450 sq. ft., 3 bd./2.5 ba, cent. heat/air, 2-car att. gar., prof. organized closets, tiled FP, alarm, ceiling fans w/lights in all bd., covered balcony off master, Pergo maple flrs, all Corian counters, lg enclosed backyd fully landscaped w/auto sprinklers, palm/fruit trees, pool, Jacz, basketball court, $255,000/obo. 626/568-8298.
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, completely furnished, F/P, TV/VCP, $75/night, 249-8515.
BIG BEAR, 7 mi./slopes, full kitchen, f/p, 2 bd., 1-ba., sleeps 6, reasonable rates, 2-night min., no smokers, no pets, exc. hiking, biking, fishing nearby. 909/585-9026, Pat & Mary Ann Carroll.
BIG BEAR LAKE cabin, near lake, shops, village, forest trails, 2-bd., sleeps up to 6, f/p, TV, VCR, phone, microwave, BBQ and more, JPL discount price from $65/night. 909/522-9874.
BIG BEAR LAKEFRONT, 1 bd., 1 ba., condo., sleeps 4, full kitch., gym, indoor pool, Jacz., BBQ areas, Oct. 22-29, $75/night. 323/296-6641.
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, excellent view. 248-8853.
DAYTONA BEACH, FL for Y2K, priv. beach access, 1 bd., 2 ba., cable TV/VCR, FM ster., full kitch. w/dishwasher & microwave, laundry w&d in-rm, veranda overlooking ocean, Jacz., sauna, pool, game rm, 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, Kona, priv. house & guest house on 166 ft. of ocean front on Keauhou Bay, restaur., golf courses, other attractions. 626/584-9632.
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.
HAWAII, Maui luxury condo. on west Maui beach w/ocean-front location, fully furnished lv. rm., 2 bd., kitchen, $140/day/2. 805/646-0810.
LAKE TAHOE, N. shore, 2 bd., 2 ba., sleeps 6-7, private sandy beach, pool, great location, all amenities, hiking, kayaking, river rafting, bike trails, 2 mi./casinos, JPL discount, 3-day min. 626/355-3886, Rosemary or Ed.
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.
MAMMOTH, Snowcreek, 2 bd., 2 ba., + loft, sleeps 6-8, fully equipped kitch. incl., microwave, D/W, cable TV, VCR, phone, balcony w/mtn. view, Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL discount. 626/798-9222 or 626/794-0455.
OCEANSIDE, on the sand, charming 1 bd. condo, panoramic view, walk to pier or harbor, pool, spa, game rm., sleeps 4. 949/786-6548.
ROSARITO BEACH condo, 2 bd., 2 ba., ocean view, pool, tennis, short walk to beach on priv. rd., 18-hole golf course 6 mi. away, priv., secure parking. 626/794-3906.
SOUTH LAKE TAHOE KEYS, waterfront, 4 bd., 3 ba., handicap access fair, sleeps 12+, frplc. on 2 levels, decks overlook priv. dock, & ski lifts, gourmet kitch., bikes, 20' sail/paddle boats, 3 color TVs, VCR, stereo, assn. indoor/outdoor 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.