

## THE DAWN OF TIME

### JPL-Caltech technology views the first moments of the universe

Technology developed at JPL and Caltech has brought humanity closer to understanding how the universe was created 13.8 billion years ago.

When astronomers announced March 17 that they had discovered ripples in space from the very beginning of time, they used a telescope at the South Pole equipped with detectors conceived and developed in a close collaboration between JPL and campus.

The signal they detected—faint spiral patterns in the polarization of microwave radiation left over from the Big Bang—could solve one of cosmology's oldest mysteries. What powered "inflation," a period just moments after the Big Bang when a repulsive force caused space to rapidly expand? Did that inflation originate from a time when three of the four fundamental forces of nature—electromagnetism, and the strong and weak nuclear forces—were originally unified, as scientists believe they must have been?

Many in the science community view the announcement as one of the most important science discoveries of the past two decades.

The team believes their finding is connected to a long-sought union in physics—Einstein's theory of gravitation, which usually applies to large objects over long distances, and quantum mechanics, which usually governs the realm of the very small. In the earliest moments of the universe, they say, tiny quantum-gravitational noise was blown up to enormous sizes during the period of inflation. This has left a telltale background of gravitational waves that stretch and squeeze space—producing a distinctive swirly polarization pattern in the cosmic microwave background detected by the Antarctic telescope.

Jamie Bock, who serves a joint appointment as a JPL researcher and Caltech physics professor, is one of four principal investigators for the Antarctic telescope experiment, called BICEP2. He led the team that developed the detector technology at JPL and Caltech.

The late Caltech physics professor Andrew Lange, a pioneer in the field, was a mentor to Bock and many others, including two of the other BICEP2 principal investigators—former Caltech postdoc John Kovac, now on the faculty at Harvard, and JPL National Research

Council postdoc Chao-Lin Kuo, who now teaches at Stanford.

Lange and Bock had big success with a balloon experiment named BOOMERANG 15 years ago, which used instruments called bolometers that measure electromagnetic radiation by turning it into heat and measuring the temperature. They later developed an experiment called BICEP1 at the South Pole, using detectors similar to those that Lange and Bock developed for the European Space Agency's Planck mission.

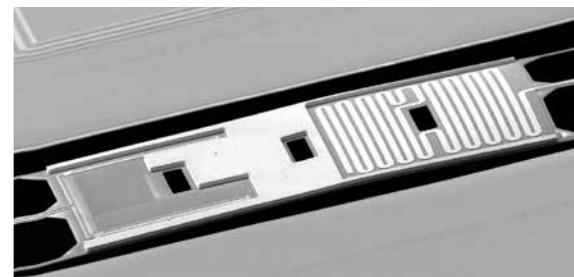
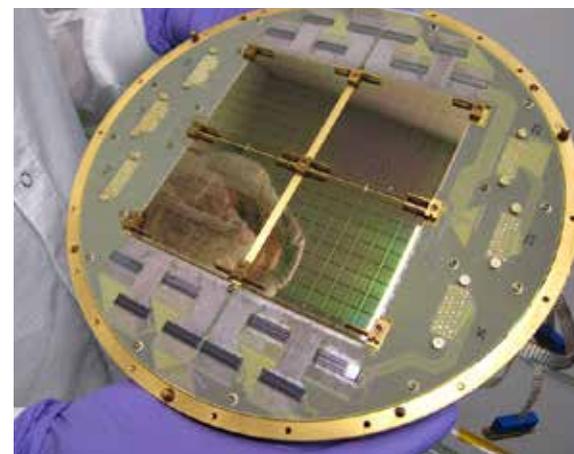
BICEP2 upgraded the existing BICEP1 cooling and optical systems with new technology to gain the sensitivity that turned out to be crucial for their discovery. The BICEP2 detectors are based on a radically new approach, inspired by JPL Chief Technologist Jonas Zmuidzinas, that collects and filters light, and analyzes its polarization, with a fully lithographed antenna. The light is then dissipated into heat and measured with a superconducting thermometer. According to Bock, this was a bigger jump than "the familiar analogy of replacing conventional film with CCDs in photography. Instead it is more like building a whole camera from a circuit board."

Anthony Turner of JPL's Microdevices Laboratory said the detector uses a micromachined island of free-standing material that is key to detecting the minute temperature rise from absorbed light.

With the new detector technology, "BICEP2 gets to the same sensitivity as BICEP1 in a tenth of the time," Bock told Caltech News in an interview. "It would have taken BICEP1 30 years to get to where we are with the BICEP2 results that just came out. I really like working at the South Pole, but 30 years? That's a bit much."

Follow-up experiments are underway, including a new stage of the program called BICEP3 that is scheduled to deploy to the South Pole this October.

BICEP2 is funded by the National Science Foundation, which also runs the South Pole station where BICEP2 and the other telescopes used in this work are located.



From top, the lab housing the BICEP2 telescope three-fourths of a mile from the South Pole; the telescope's focal plane, developed and produced at JPL; detectors that work by converting light into heat; JPL's focal plane being examined at the Microdevices Laboratory.

# Elachi, Bolden celebrate network's 50 years



In Canberra, Australia, JPL Director Charles Elachi, left, joins Commonwealth Science & Industry Research Organization CEO Megan Clark and NASA Administrator Charles Bolden in celebration of the Deep Space Network's 50th anniversary.

The team in charge of JPL's Dawn mission, history's first detailed exploration of a celestial body inside the main asteroid belt, received the Smithsonian National Air and Space Museum's highest group honor at a dinner in Washington on March 26. Dawn received the 2014 Trophy for Current Achievement, which honors outstanding achievements in the fields of aerospace science and technology.

Having explored the giant asteroid Vesta and on its way to the dwarf planet Ceres, the Dawn spacecraft is designed to conduct an in-depth and up-close study of these two celestial bodies formed early in the history of the solar

system. In 50 years of space exploration, no other spacecraft has orbited a distant solar system body, then left to travel to—and eventually orbit—another extraterrestrial body.

Several NASA planetary mission teams have won the award in previous years, including last year, when JPL's Curiosity rover picked up the trophy. The year before that, the Cassini mission to Saturn, also managed by JPL, took the honor.

For a full listing of previous awardees, along with a video about Dawn's award, visit <http://airandspace.si.edu/events/trophy>.

NASA Administrator Charles Bolden joined JPL Director Charles Elachi and local dignitaries March 19 to celebrate 50 years of the JPL-managed Deep Space Network and Australia's part in it.

The event marked the beginning of the 50th year of the Australian station, the Canberra Deep Space Communication Complex, which is managed by the Commonwealth Science & Industry Research Organization and operates on behalf of NASA.

"We look forward to our ongoing collaboration as we reach higher in air and space, sending humans deeper into the solar system, including a mission to retrieve and visit an asteroid and a human mission to Mars in the 2030s, and peering beyond it," Bolden said.

"The Canberra station carried the prime signals confirming the landing of the Curiosity rover on Mars in August 2012," said Elachi. "In 2015 it will have another starring role, receiving the first images of Pluto from the New Horizons spacecraft."

"To bring back those images from Pluto, NASA is investing in this station's future, building two more antennas at a cost of \$110 million," added Commonwealth Science & Industry Research Organization chief executive Megan Clark.

There are currently three antennas in operation in Canberra: two of 34 meters in diameter and one 70 meters in diameter. Other Deep Space Network stations are at Goldstone, Calif. and Madrid, Spain.

## Dawn team receives Smithsonian honor



From left: Dawn flight team members Grant Faris, Carol Polanskey, Chris Russell, Steve Joy, Greg Whiffen, Marc Rayman, Robert Mase, Tim Weise, Brett Smith, Nick Mastrodemos, Paul Fieseler, Carol Raymond and Don Han.



Dedicating the Earth Orbiting Missions Operations Center are, from left, Mark Fujishin, Earth Science Missions Office manager; Diane Evans, Director for Earth Science and Technology; JPL Director Charles Elachi; Earth Science and Technology Associate Director Jim Graf and Ben Jai, Integrated Earth Mission System Office manager.

## New Earth-orbiting center dedicated

A new facility to provide cost-efficient flight operations functions for smaller satellite missions and International Space Station payloads was officially dedicated March 31.

The Earth Orbiting Missions Operations Center, located on the first floor of Building 264, will serve as an institutional resource for Earth science, astrophysics, and select deep-space missions between lower Earth and Lagrangian point orbits. The facility will also enable project teams to integrate low-cost flight support options into their future baseline proposals.

Activities currently being conducted in the center include preparations for launch and flight operations for the Soil

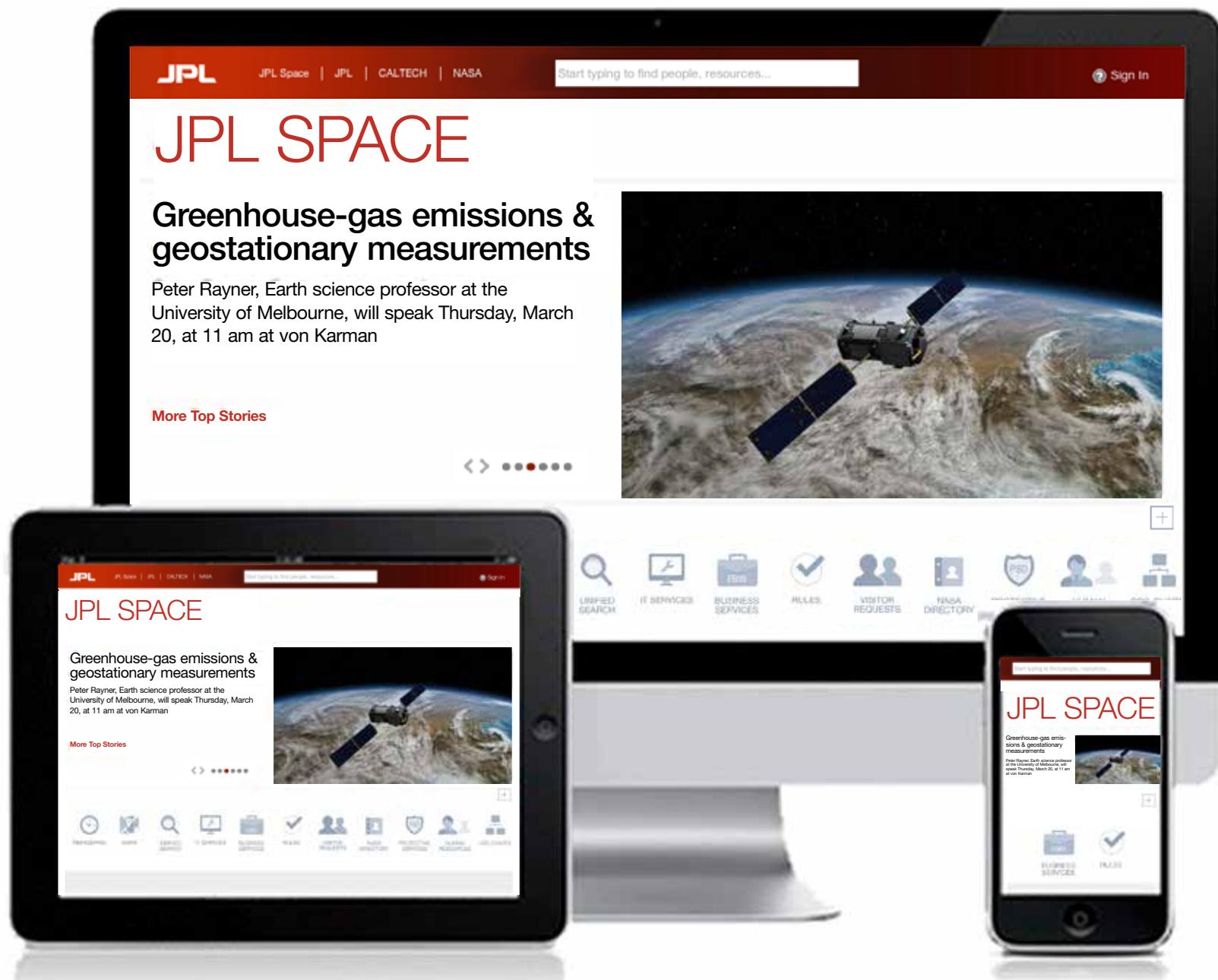
Moisture Active Passive and RapidScat/International Space Station missions, with near-term plans for an Orbiting Carbon Observatory 2 backup flight operations area and CubeSat command/control center. Real-time transfer of data from airborne instrument flights is also planned, which will greatly increase operational efficiencies given their often-dynamic flight schedules.

For additional information on the center's capabilities and support options, please contact Mark Fujishin in the Earth Science Missions Office or Ben Jai in the Integrated Earth Mission System Office.

# Less is more

JPL's communications products go to a more functional design

By Mark Whalen



More and more, Internet users are ditching the desktop for the mobile device. It's a trend JPL is working to keep up with in its efforts to inform employees—and the public—about the Lab's ongoing achievements.

The plan entails improved design of JPL's communications products. But looks aren't everything. New, sleek layouts for many of the organization's websites—both internal and external—are accompanied by increased functionality, providing a more efficient way to find information easily.

"Making things more efficient means making things simpler, with greater clarity," noted Communications and Education Director Blaine Baggett. "In the words of Thoreau: Simplify, simplify."

A JPL style guide is being developed to help employees produce a consistent look on websites and printed material, both internal and external, said Carolyn Stolze, recently hired as creative designer in the Office of Communications and Education. The guide will show required font styles and sizes as well as appropriate usage of the JPL logo.

The style guide will also include templates to help JPLers produce PowerPoint documents as well as other printed

material such as stationery and letterhead. Publications distributed outside of JPL, such as posters, are covered in the guide as well.

"Our goal is to provide templates for visual design, so that JPLers can concentrate on content and get their jobs done more easily," said Stolze.

The overriding goals are to emphasize JPL and its strong relationship to NASA and Caltech while providing more efficiency and improved aesthetics.

The newest example in the initiative is the March 31 launch of a redesigned JPL Space, the internal news and information portal for employees. "It's clean, it's simple, it's easy to find the information," said Baggett. The JPL Space redesign is a joint effort of the Office of Communications and Education and the Office of the CIO.

The site follows the recent rollout of an updated JPL Rules, the Lab's official document repository site. A leaner, cleaner look on the home page (<http://rules.jpl.nasa.gov>) accompanies links to provide both users and document owners easier access to documents. This is

where design meets functionality.

"This is going to result in a huge improvement on how to find information to do your work internally," said Baggett, who added that it's JPL's goal to also match the improved design and functionality for its public websites.

One example, launched in concert with Women's History Month in March, is the Women at JPL website (<http://www.jpl.nasa.gov/women/>), which features profiles and success stories of the Lab's highest achievers and leaders. Another recent website launch, <http://deepspace.jpl.nasa.gov>, profiles this year's 50th anniversary of the Deep Space Network.

The "Eyes on the Solar System," "Eyes on Exoplanets" and "Eyes on Earth" sites are also undergoing facelifts that will improve search functionality.

Baggett said JPL's public communications should strive for excellence at a level rivaling the Lab's engineering and science feats. "Fundamentally the imparting of that information includes design—not just how something looks, but how it works."

# News Briefs



Yoseph Bar-Cohen



Jeffrey Umland

## Engineers' Council honors JPLers

More than a dozen JPLers received honors of achievement at a recent gathering of the Engineers' Council, a nonprofit group that advocates for the advancement of science and engineering.

At the group's awards banquet in Universal City, the Voyager team received the *Distinguished Engineering Project Achievement Award* "for significant engineering achievement, careful stewardship and dedication, resulting in Voyager 1's successful transition into interstellar space 35 years after launch."

Here are other JPLers who received individual honors:

### Leonardo DaVinci Award

Ed Stone: In honor of his many decades of service and scientific exploration as well as leadership of JPL.

### Distinguished Achievement Award

Blaine Baggett: In recognition of bringing engineering and scientific achievements and education to the public's awareness and engagement.

### Distinguished Engineering Award

Douglas Bernard: For outstanding achievement leading to the design, development and delivery of the Juno spacecraft.

James Donaldson: For exceptional initiative and contributions as Mars Science Laboratory's avionics chief engineer.

Carl Guernsey: For excellence in space propulsion design and program management, culminating in the Mars Science Laboratory propulsion system architecture.

### Outstanding Engineering Achievement

### Merit Award

Steven Lee: For management and technical contributions to the delivery of the Mars Science Laboratory guidance, navigation and control subsystems.

Robert Manning: In honor of service as Mars Science Laboratory chief engineer and for technical leadership in the design, development and delivery of the fault-protection system.

Michael Sierchio: For exceptional achievement in the design, construction and testing of the Mars Science Laboratory avionics subsystem.

Jeffrey Umland: For exceptional achievement as Mars Science Laboratory's chief mechanical systems engineer, resulting in the Curiosity rover's successful landing.

### Alumni honor for Umland

Jeffrey Umland, a JPL Fellow, has received an award of excellence from his alma mater, the University at Buffalo in New York.

The college bestowed the *Clifford C. Furnas Memorial Award* to Umland March 28. The annual honor goes to graduates of the university's School of Engineering and Applied Sciences or College of Arts and Sciences who distinguish themselves in a field of science. Umland earned a Ph.D. from the college in 1990.

Umland oversaw Curiosity's mechanical engineering technical development, including its surface, sampling, thermal and propulsion systems. He was also instrumental in the development of Mars

Science Laboratory's entry, descent and landing systems.

Previously, he led development of flight hardware for Mars Pathfinder and the Mars Exploration Rovers.

### Bar-Cohen pens eighth book

Yoseph Bar-Cohen, supervisor of the Advanced Technologies Group and a senior research scientist, is the editor and co-author of "High Temperature Materials and Mechanisms," his eighth book.

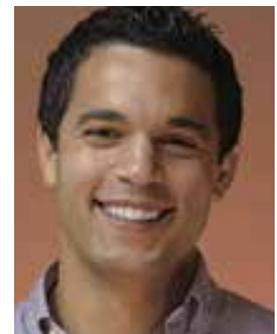
Topics include materials, processes, adhesive bonding, energy harvesters, characterization methods and electronics, as well as the nondestructive evaluation and health of high-temperature materials and structures. The book considers the multidisciplinary nature of high-temperature materials and mechanisms, and covers technology related to space, aerospace, electronics, energy and metallurgy.

Bar-Cohen, a physicist, joined JPL in 1991. That year, he established the Nondestructive Evaluation and Advance Actuators Lab (<http://ndea.jpl.nasa.gov>), which has been responsible for numerous innovative concepts and mechanisms for planetary exploration, medical, commercial and other applications.

Information about the 551-page book is available at <http://www.crcpress.com/product/isbn/9781466566453>.

### Thesis honors for Chahat

Nacer Chahat of the Spacecraft Antennas Group was recently awarded the Airbus Group Foundation's Best Thesis



Nacer Chahat

Prize, an honor that rewards outstanding doctoral research work.

The winning thesis must have contributed to significant progress by exploring options that are likely to lead to technological and conceptual breakthroughs, and by suggesting new paradigms or new bridges between disciplines.

Chahat's Ph.D. thesis received six national and international awards, including the Institute of Electrical and Electronics Engineers' Antennas and Propagation Society Doctoral Research Award, as well as France's best Ph.D. electrical engineering thesis from that country's electrical engineering association. He is the youngest Ph.D. to have won these six awards.

Prior joining to joining Group 337B, Chahat was a post-doctoral fellow under a French government defense procurement agency fellowship with the Submillimeter-Wave Advanced Technology Group (389A).

## Passings

**James "Mike" Stewart**, 73, a retired engineer and manager, died Jan. 2.

Stewart worked at JPL from 1978 to 2000, contributing to such projects as Voyager, Galileo and Magellan. He managed the Magellan Operations Monitor and Control Office, for which he earned the NASA Exceptional Service Medal. He also served as the project's mission director and deputy project manager. He was instrumental in the radar mapping of Venus and was a primary leader of the aerobraking effort at the planet, a first for any mission. He moved to the



Mike Stewart

Deep Space Network in 1994, working with the Goldstone-Apple Valley Radio Telescope System Development Team and the Lunar Prospector Team.

Stewart is survived by his daughter Nancy Brewington and husband James, sister Kathy Odorizzi and husband Don, sister Alice Schill and husband Jerry, four nephews and five nieces. Services were held Jan. 18 in Mt Vernon, Ill.

**Mardith "Mardy" Wilkins**, 73, a retired secretary, died Feb. 6.



Mardy Wilkins

Wilkins worked at JPL from 1980 to 2005. In 1993 she was honored by NASA's Space Flight Awareness Program, which included a visit to Kennedy Space Center for a space shuttle launch.

She is survived by her husband, Bob, daughter Lynette, sister Jean, and grandchildren Alyssa and Trent. Memorial services were held Feb. 18 at Crippen's Mortuary in La Crescenta.

Retiree **Fred Tomey**, 79, died Feb. 20.

Tomey worked at JPL from 1961 to 2006. He supervised engineering groups that developed ground support equipment to simulate spacecraft systems and testing and development of software in support of planetary missions from the Ranger program in the 1960s through Cassini and the extended Voyager mission.

He is survived by his wife, Marian, daughter Jennifer Austen, son Greg Tomey, five grandchildren and one great-granddaughter. Services were held March 8 at Our Lady of Mt. Lebanon-St. Peter Cathedral. In lieu of flowers, donations may be made in Tomey's name to [www.carouselranch.org](http://www.carouselranch.org).

## Letters

My family and I would like to thank our friends and colleagues at JPL for the condolences and blessings we received following the passing of my dear father. He loved JPL and would have loved the beautiful plant we received in his honor; my mother was very touched. I'd like to give a special thank you to Section 398 for their wonderful kindness and support; it is greatly appreciated.

Karen Boggs

We would like to thank our wonderful JPL family for all their prayers, kind thoughts and support that they gave us during my mother's illness and her subsequent passing away last month. All the messages of condolences in the form of cards, telephone calls and e-mails brought us a lot of comfort and strength to bear the loss. Thank you to the ERC for the beautiful plant, and also to the members of the Interplanetary Network for the plant for my office and also for their generous donation to my mother's favorite charity.

Al and Shehenaz Bhanji

We would like to thank the JPL family for the cards, condolences, support and donations after the passing of Fred Tomey. Your support through this difficult time has been a comfort to our family. Fred loved JPL and all of you. Your sympathies are greatly appreciated.

The Tomey family

My 86-year-old dad recently passed away and I wanted to thank everyone on the Juno team who contributed to the beautiful floral arrangement for his services and to others on lab for your kind words and thoughts. I'd also like to thank JPL for the beautiful plant that arrived at our home. It all meant a great deal to me and my family.

Rick Nybakken

I am very touched and grateful for the beautiful "Lemon Lime Dracena" plant that arrived at my home last Friday from JPL. My dearest mom from heaven, and my family, sincerely thank everyone for their condolences, kind words and prayers. Special thanks to Nancy Kapell, who had met my mom and offered me her beautiful thoughts and kind expressions of sympathy. Most sincerely,

Olivia Tyler

## Retirees

The following employees retired in March: **M Kathy O'Hara**, 44 years, Section 2672; **Sheryl Bergstrom**, 41 years, Section 1661; **Wayne Zimmerman**, 37 years, Section 3800; **Aaron Fishman**, 35 years, Section 352H; **Iain McDermid**, 33 years, Section 3287; **Duc Vu**, 32 years, Section 5140; **Paul Pangburn**, 27 years, Section 352H; **Roger Diehl**, 24 years, Section 3101; **Keith Anderson**, 13 years, Section 393F.



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