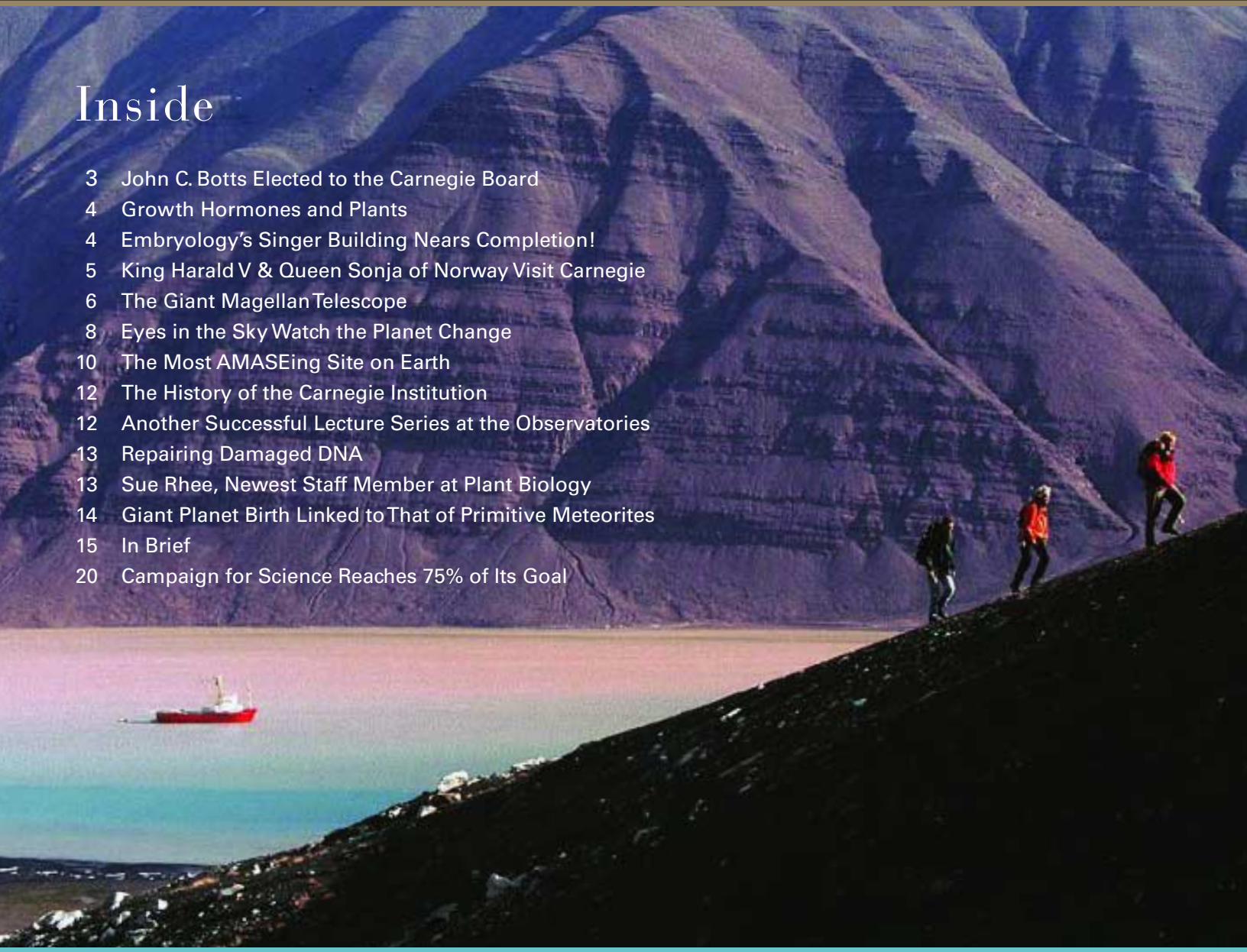
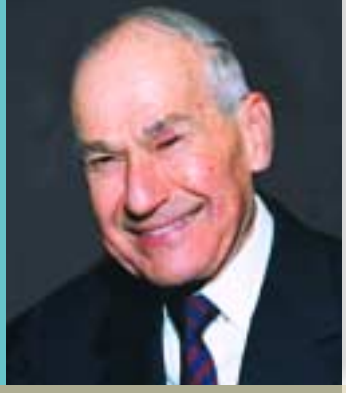
CarnegieScience

THE NEWSLETTER OF THE CARNEGIE INSTITUTION [SPRING 2005]



Inside



(Photo courtesy Richard Holden Photography.)

Our Global Reach

The recent visit to Carnegie by Their Majesties King Harald V and Queen Sonja of Norway (see page 5) brings to mind how important Carnegie's international connections have become. In 1902, when Andrew Carnegie presented his trust deed to the first board of trustees, he was concerned about the inferior status of science in the United States. At that first meeting he ventured to speculate on the future of research by prophesying "that . . . in cooperation with kindred organizations, our country's contributions through research and the higher science . . . will compare . . . not unfavorably with those of any other land." Science is inherently an international endeavor. And as it has turned out, the Carnegie Institution's collaborations and connections to individuals and institutions throughout the world have become a major source of our strength and are integral to our scientific leadership today.

From the very beginning Carnegie scientists have worked in or lived in other nations. One example is the Norwegian physicist Vilhelm Bjerknes. From 1906 until 1945, the Carnegie Institution supported Bjerknes's research. He became the father of modern meteorology by moving weather forecasting into the realm of atmospheric physics. He fostered concepts that are now familiar on every TV weather forecast, including the notion of weather fronts.

Scientists at the Geophysical Laboratory (GL) continue our connections to Norway. A team of GL researchers recently joined a Norwegian-led group to use a remote island north of mainland Norway as a proving ground for techniques and technology for future life-detecting missions to Mars (see page 10). Results from their work were on display for the recent visit by the king and queen.

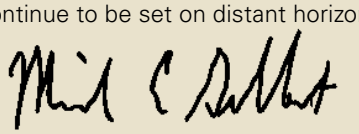
The Department of Terrestrial Magnetism (DTM) was founded with a global perspective. Its mission was to map the geomagnetic field over the entire Earth. Now, geophysicists, geochemists, and seismologists enjoy international collaborations with researchers in places as diverse as Iceland, Japan, and South Africa to study earthquakes, volcanoes, and the evolution of the planet. The department's planetary scientists and astronomers likewise venture to many parts of the globe as they explore the heavens.

Biologists at both the departments of Plant Biology and Embryology work within extensive international networks concerned with model organisms. These efforts are helping develop disease- and drought-resistant plants to feed a growing global population, and revealing some of the fundamental processes that lead to developmental problems and disease.

The wide scope of the Department of Global Ecology is evident by its name. To understand global ecological changes, these researchers investigate ecosystems in the United States, Latin America, and elsewhere. Although formed just a few years ago, the department and its accomplishments have already come to the attention of the U.S. government, foreign governments, and international agencies concerned with global climate change.

Perhaps the most obvious tie we have to the international community is our long-standing presence in Chile at Carnegie's Las Campanas Observatory. Over the past decades, our work there has had a profound effect on the world of astronomy. It has also helped bolster science education through the Andes-Carnegie Summer School. Chilean astronomers have additionally made significant contributions to the field using Carnegie telescopes. A recent visit to Las Campanas by the science attaché from the Chilean embassy has invigorated these already strong ties.

These are just a few examples of our international breadth. We also host scores of visiting investigators and postdoctoral fellows from many nations, and we have other friends abroad. As globalization shrinks the world, Carnegie's reach expands. A century of hindsight shows us how important it has been to our organization to look beyond our borders. As we move into the future, our sights will continue to be set on distant horizons.



—Michael E. Gellert, *Chairman*

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TRUSTEE News

John C. Botts
Elected to the Carnegie Board

The full board approved the appointment of London-based investor John C. Botts to the Carnegie board of trustees at the meetings held at the Observatories in Pasadena, California, on December 2 and 3, 2004. At that time the board also accepted the resignation of trustee Hatim A. Tyabji and passed a resolution to honor the memory of former Carnegie president and trustee Philip H. Abelson.

In addition to the full board, the Finance, Development, Research, and Nominating committees met. After the sessions on December 2, board members were treated to presentations by Observatories staff. Matt Johns and Pat McCarthy talked about the engineering challenges and science expectations for the Giant Magellan Telescope (page 6). Alan Dressler gave an overview of the performance of IMACS, the Inamori Magellan Areal Camera and Spectrograph on the Baade telescope. Carnegie Fellow Mike Gladders gave a talk on galaxy clusters, and staff astronomer Ian Thompson discussed charge-coupled devices (CCDs). Charlie Hull described work that goes on in the shop.

Global Ecology staff member Greg Asner spoke at the dinner that evening, focusing on some research breakthroughs he and his team have made probing the forest canopy using remote sensing. They have been able to determine chemical and ecological changes that are happening within forest canopies in a variety of environments, including a Hawaiian rain forest (see page 8).

After the board meeting on December 3, recently appointed Geophysical Laboratory staff member Viktor Struzhkin gave a nuts-and-bolts explanation of his high-pressure work probing the mechanisms behind superconductivity and magnetism. •

(Image courtesy Scott Rubel.)

Staff astronomer John Mulchaey (left) chats with trustee William Gayden at lunch during the trustee meetings in Pasadena.

(Image courtesy Scott Rubel.)

Trustees and guests enjoy dinner at the Ritz-Carlton Huntington December 2, 2005.

John C. Botts is chairman of Botts & Company Limited, a London-based private equity and investment management company. He is also chairman of LongAcre Partners Limited. LongAcre, also in London, is a midmarket corporate finance house that concentrates on the broad media and communications sectors.

From 1980 to 1986 Botts worked with Citicorp, running its investment banks in Europe, the Middle East, and Africa. Before coming to London in 1973 he was posted to New York, Johannesburg, Montreal, Brussels, and Casablanca.

Botts is a director of United Business Media Plc, Euromoney Institutional Investor Plc, and Glyndebourne Arts Trust Limited. He is also a trustee of the Tate Gallery and a member of the Council on Foreign Relations and the Grolier Club. In 2003 Botts was made an Honorary Commander of the Order of the British Empire in recognition of his work with the Tate and Glyndebourne. He is a graduate of Williams College.

John C. Botts (above), newest member of the Carnegie board of trustees.

Growth Hormones and Plants

Researcher Zhi-Yong Wang of Carnegie's Department of Plant Biology.

Growth in both plants and animals is controlled by steroid hormones—signaling molecules that tell specific genes in cells to begin the physiological process of increasing cell size. Although these molecular managers operate similarly in animals and plants, the chain of events in regulating cellular functions appears to be very different in the two kingdoms. In animals, hormone reception begins in the nucleus of the cell. In plants, steroid hormones known as brassinosteroids (BRs) start to work on the surface of the cell. A bucket brigade of activity then wends its way into the cell's nucleus to activate specific genes that tell the cell to grow. A paper coauthored by Zhi-Yong Wang of Carnegie's Department of Plant Biology and published in the January 27, 2005, *Science Express* describes an important new discovery about this process. "We found a key component in this complex chain reaction in the cell nucleus that promotes cell growth," said Wang. The research has important implications for the possibility of understanding how to manipulate the signaling machinery to increase plant growth and yield.

As Wang explained: "We've known for some time what happens at the cell's surface, so understanding what is happening in the nucleus is very important for unraveling this mystery of plant growth. We found that in the model plant *Arabidopsis*, a protein in the cell nucleus called BZR1, which is activated when the BR hormone is present, has a previously unknown segment where molecular binding occurs. Instead of stimulating an activity, the protein binds to a DNA sequence (named brassinosteriod-response element, or BRRE), which stops the process of transcription—the transfer of genetic information from the DNA template molecule to messenger RNA—for a gene named *CPD*. Because the *CPD* gene orders the production of an enzyme needed for BR synthesis, this suppression stops the production of BR, conferring a feedback regulation of BR production. When the BR steroid level is high, BZR1 is activated and BR synthesis is reduced. When the level is low, the synthesis is high. This feedback regulation is critical for maintaining an optimal steroid level for plant growth."

Using sophisticated microarray analyses of mutant *Arabidopsis* plants, which produce a more active version of BZR1, the scientists also found that in addition to coordinating equilibrium in plants, BZR1 also promotes growth, thus playing a dual role. The researchers further identified other genes controlled by BZR1. Studies of these genes will enhance the understanding of how steroid hormones regulate plant growth. •

(Image courtesy Carol Duke for Zimmer Gunsul Frasca Partnership.)

Embryology's Singer Building Nears Completion!

The Maxine F. Singer Building for the Department of Embryology will be ready for the staff to move in beginning in June. It is located around the corner from the old building, built in 1960, on the Homewood Campus of The Johns Hopkins University.

To mark this transition, the department is hosting a one-day symposium, "Biological Research for the 21st Century," on Friday, September 23, 2005, in the Singer Building's new Rose Auditorium. Invited speakers include Cornelia Bargmann, Andy Fire, David Kingsley, Steven McKnight, and Gerry Rubin.

The following day a second symposium will be held honoring former director of the department Donald Brown and his contributions to developmental biology.

Zimmer Gunsul Frasca Partnership designed the energy-efficient, state-of-the-art facility, and Clark Construction Group built it. The structure blends in beautifully with the surrounding natural environment while housing gleaming 21st century laboratories, auditorium, and gathering areas. •

The new Maxine F. Singer Building for the Department of Embryology is almost ready to house the staff.

THEIR MAJESTIES

King Harald V & Queen Sonja of Norway Visit Carnegie

In celebration of the centennial of Norway's independence from Sweden, Their Majesties King Harald V and Queen Sonja of Norway made an official visit to the United States. Part of the trip included their participation in two seminars on transatlantic relations held at the Carnegie Institution and hosted by the Royal Norwegian Embassy on March 4, 2005. President Richard Meserve welcomed the royal couple and their entourage as they arrived through the 16th Street entrance of the administration building in Washington, D.C., and escorted the royal couple throughout the day's events.

Queen Sonja opened the first seminar, "Transatlantic Symposium on Enhanced Cooperation in Research, Technology, and Higher Education," which emphasized the historically strong research and educational bonds between Norway and the United States. Seeking to broaden and revitalize these ties, the symposium highlighted Norway's recently adopted Strategy for Research and Technology Cooperation with North America. King Harald opened the second seminar, "Transatlantic Efforts for Peace and Security," which dealt with present-day challenges to the Euro-Atlantic region and the vital transatlantic ties that unite Europe and the United States.

To emphasize current research connections between Carnegie and Norwegian scientists, the Geophysical Laboratory's Arctic Mars Analogue Svalbard Expedition (AMASE) team, led by Andrew Steele, assembled a series of displays in the rotunda showing aspects of the scientific collaboration (see page 10).

After the seminars a press conference was held in the library, followed by a luncheon. The luncheon speaker was Fred Kavli, a Norwegian-born physicist who founded the Kavli Foundation in Santa Barbara, California, for the purposes of advancing science and increasing public understanding and support of it. Meserve, chairman of the Carnegie board Michael Gellert, Carnegie president emerita Maxine Singer, and Susanne Garvey, director of external affairs, attended the luncheon with dignitaries from both sides of the Atlantic.

(Image courtesy Jim Johnson.)

King Harald V (left) and Queen Sonja of Norway answer questions from reporters. Carnegie president Richard Meserve (middle) introduced them at the press conference.

(Image courtesy Jim Johnson.)

The Geophysical Laboratory's Andrew Steele (left) leads the Carnegie team in the international and interdisciplinary Arctic Mars Analogue Svalbard Expedition (AMASE). A series of displays about the research decorated the rotunda March 4. AMASE is headed by Norwegian Hans Amundsen of the University of Oslo.

The Giant Magellan Telescope

A Swirl of Discoveries

The last decade has seen a swirl of discoveries in astronomy that have turned what we thought we knew about the universe on its head. Well over 100 planets, many of them oddballs, have been found outside our solar system; old galaxies are now known to live in the young universe; a force called dark energy is making the universe expand at a faster and faster rate; and new populations of exotic black holes have been identified. These and other surprises have brought a cascade of new questions to the forefront: Is there a common way that planets and solar systems coalesce? How do galaxies *really* form? What is dark energy and what does it mean for the fate of the universe?

The Carnegie Observatories in Pasadena has been at the leading edge of discoveries that have led to these new questions, and in exploring the questions themselves. It also has a legacy of designing and building the tools that have probed each new generation of astronomical problems for more than a century. Today Carnegie and the astronomical community are preparing to grapple with this latest flurry of puzzles by combining the next generation of space-based telescopes with new, larger, ground-based telescopes. In keeping with tradition, Carnegie is leading the charge in this quest.

Off the Starting Block and into the Future

The recent successes of the twin Magellan telescopes—the 6.5-meter Baade and Clay reflectors—have provided a training ground for Carnegie and its partners in the design and construction of a giant Magellan offspring, a new 24.5-meter (83-foot) telescope appropriately christened the Giant Magellan Telescope (GMT). Both the technology used in the original Magellans and the partner support from the Magellan consortium have given the project a huge boost.

"We plan to complete the GMT so that it will work in tandem with the future generation of planned ground- and space-based telescopes," said Wendy Freedman, the Crawford H. Greenewalt director of the Observatories. "The real distinction of the GMT, however, is that it is building on a heritage of successful technology developed for the twin 6.5-meter Magellan telescopes at Las Campanas. Their performance has far exceeded our expectations. They have proven to be the best ground-based natural imaging telescopes in the world, due in large part to the genius of its project scientist, Carnegie's Stephen Shectman, and Roger Angel and his team at the University of Arizona, Steward Observatory Mirror Lab."

On December 13, 2004, the Carnegie Institution and its longtime Magellan partner, the University of Arizona mirror lab, signed an agreement to produce the first mirror for the GMT. This milestone marks the first mirror to be produced for any next-generation extremely large ground-based telescope (ELT). The telescope primary mirror, with a diameter of 24.5 meters, will have more than 4.5 times the collecting area of any current optical telescope—10 times the collecting area of the original Magellans and 10 times the resolution of the Hubble Space Telescope.

"This agreement is historic for the future of astronomy," stated Richard Meserve, Carnegie president. "It is the first of many milestones that we and our partners look forward to—both in constructing an enormous ground-based telescope and in the scientific discoveries that will result. Everyone in the GMT consortium is extremely excited by this step." The consortium currently includes the Carnegie Observatories, Harvard University, the Smithsonian Astrophysical Observatory, the University of Arizona, the University of Michigan, the Massachusetts Institute of Technology, the University of Texas at Austin, and Texas A&M University. Wendy Freedman is chair of the GMT board. Matt Johns, associate director of the Observatories and former project manager for the 6.5-meter Magellans, is now the GMT project manager, and staff astronomer Patrick McCarthy is the GMT Science Working Group chair. Other Observatories staff members heavily involved in the project include Steve Shectman, project scientist for Magellan and member of the GMT Project Scientists Working Group, and Mark Phillips, who is in charge of site testing and working with Joanna Thomas-Osip at Las Campanas.

▲ The Magellan consortium twin 6.5-meter telescopes, shown here at Carnegie's Las Campanas Observatory, provide a technical training ground for the upcoming Giant Magellan Telescope (GMT).

◀ The Giant Magellan Telescope is depicted next to one of the existing 6.5-meter Magellan telescopes for comparison. The GMT primary mirror will have a diameter of 24.5 meters (83 feet) with more than 4.5 times the collecting area of any current optical telescope.

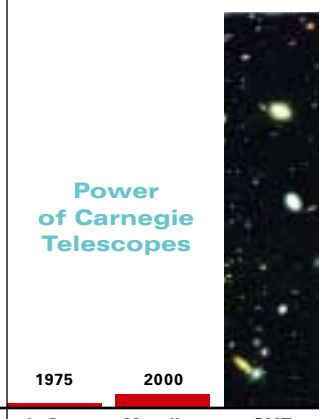
▼ Every member of the Carnegie Observatories staff is touched by the Giant Magellan Telescope (GMT) project. To keep their eyes on the mark, they painted a life-size schematic of the GMT in the Pasadena parking lot.

(Image courtesy Scott Rubel.)

Plans for the GMT

The GMT is slated for completion in 2016 at a site in northern Chile. Viewing conditions in Chile, such as those at Carnegie's Las Campanas Observatory, are some of the best in the world. With its powerful resolution and enormous collecting area, the GMT will be able to penetrate the secrets of planets that have formed around other stars in the Milky Way, peer back in time toward the Big Bang with unprecedented clarity, delve into the nature of dark energy and dark matter, and explore the formation of black holes—some of the hottest topics in astronomy for the foreseeable future.

The mirrors for the GMT will be made using the existing infrastructure at Steward that made the 6.5-meter Magellan mirrors and the 8.4-meter Large Binocular Telescope mirrors. The new telescope's primary mirror will be composed of seven 8.4-meter mirrors arranged in a floral pattern: six off-axis mirrors surrounding one on-axis mirror. One spare off-axis mirror will also be made. The off-axis mirrors will require new techniques in casting and polishing. The first off-axis mirror will be cast this coming summer. Site testing at the Las Campanas Observatory is also under way, along with many other aspects of the project. Detailed information about the design of the GMT and the science it will perform is located at http://www.gmto.org/.



▶ The light grasp of Carnegie telescopes at the Las Campanas Observatory in Chile is indicated by this graph. The light grasp is the product of the telescope collecting area and the field of view divided by the image size. The Giant Magellan Telescope will provide an even larger gain over the Magellan 6.5-meter telescopes than those instruments did over the 2.5-meter du Pont telescope.

Eyes in the Sky Watch the Planet Change

Anyone who has flown in an airplane knows how far the eye can see from that perspective. Greg Asner's group at the Department of Global Ecology is taking advantage of this wide-angle view by using remote sensing techniques from high-flying planes and coupling the data with intense field-work to study the planet in a new way. His results are startling. In one project his group determined, for the first time, large-scale interactions between ecosystems and the climate as lands in the American Southwest transition into unusable desert. In another study, his research revealed exotic invaders as they first started to disrupt the fragile ecology of a Hawaiian rain forest.

GRAZING LANDS TURNING TO DESERT—A TOP UNITED NATIONS WORRY

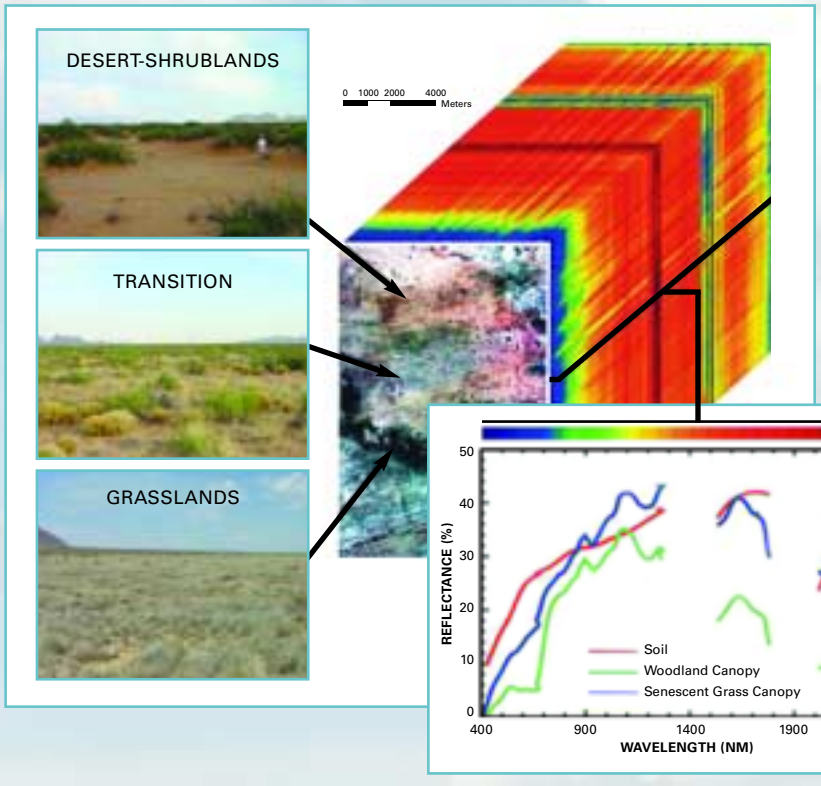
Grazing is the major form of land use on the planet, with the dry, semiarid, and subhumid regions supporting most of it throughout the world. "Some of these regions are turning into unusable desert so quickly that the United Nations has put the problem at the top of its environmental agenda," Asner explained. "The challenge for science—to understand what is happening to ecosystems during desertification—has been enormous because the areas are so vast it is impossible to study the processes at the field level alone." Asner's five-year project covered over 500 square miles in the Northern Chihuahua region of New Mexico and successfully showed how the NASA Airborne Visible/Infrared Imaging Spectrometer (AVIRIS), mounted aboard a NASA U-2, can be used to analyze the vegetation and soil changes in response to rain variation over large areas. "I believe this technique could become a standard for future global desertification studies," Asner remarked.

Asner and Kathleen Heidebrecht published the study in the January 2005 issue of ***Global Change Biology***. It is a milestone both for the new methods employed and for understanding what is happening as agricultural and grazing lands change into desert.

Typically, remote sensing for ecological research looks at the greenness of the top layer of vegetation, which is used to determine the amount of plant growth, or net primary production (NPP). NPP data are useful for understanding the global carbon cycle as plants breathe in and lock up the greenhouse gas CO_2. NPP data, though, are not always as important as the changes in the type and distribution of vegetation that occur as an area transitions into desert. Using AVIRIS, the scientists were able to analyze the physical structure of ecosystems, including the live and dead plants. The data are viewed in three dimensions at very high resolution and can give a much broader picture of the processes at work, including carbon cycling and other chemical and biological activities.

Each data pixel represents a square 62 feet by 62 feet (19 meters). The researchers looked at the ecosystem-climate interactions of grasslands, transitional terrain, and desert-shrub landscape. They made their measurements after wintertime and summer monsoonal rains, which varied in intensity by more than 300%. "We found that a long-term decrease in litter cover is the most evident sign when an area begins to change to desert," stated Asner. "More bare soil areas and changes in green vegetation are also apparent, but they are secondary." Up to now the scientific community has focused on bare soil much more than the loss of natural litter as dry areas become desert. The scientists also noted how the different vegetation types changed in response to the variation in rain. As areas exhibited more desertlike vegetation, there was a shift in plant responses from summer to winter precipitation events.

This research was funded by the NASA New Investigator Program and the Carnegie Institution.



(Image used with permission from Global Change Biology.)

FINDING HIDDEN INVADERS IN A HAWAIIAN RAIN FOREST

By applying the novel high-flying measurement techniques to another problem, Asner, with Peter Vitousek from Stanford University, detected two species of invading plants that are changing the ecology of the rain forest near the Kilauea Volcano in the Hawaii Volcanoes National Park. "We found chemical fingerprints from the plant leaves and used them to tell which species dominated specific areas," Asner commented.

On Kilauea Volcano, the native 'ohi'a (*Metrosideros polymorpha*) tree typically has a low concentration of nitrogen in its leaves (0.6% to 0.8%), while the invading Canary Islands tree, *Myrica faya*, has relatively high nitrogen concentration (1.5% to 1.8%) because it can acquire nitrogen from the atmosphere. This time the investigators used a recently upgraded AVIRIS to measure leaf nitrogen and water content and corroborated the data on the ground. The fingerprints showed where the native dominant tree, *Metrosideros*, has been taken over by the invading Canary Islands tree and, more important, identified areas where *Myrica* invasion is in its early stages. The aircraft imagery also showed how the forest canopy chemistry is changing as a result of the invader.

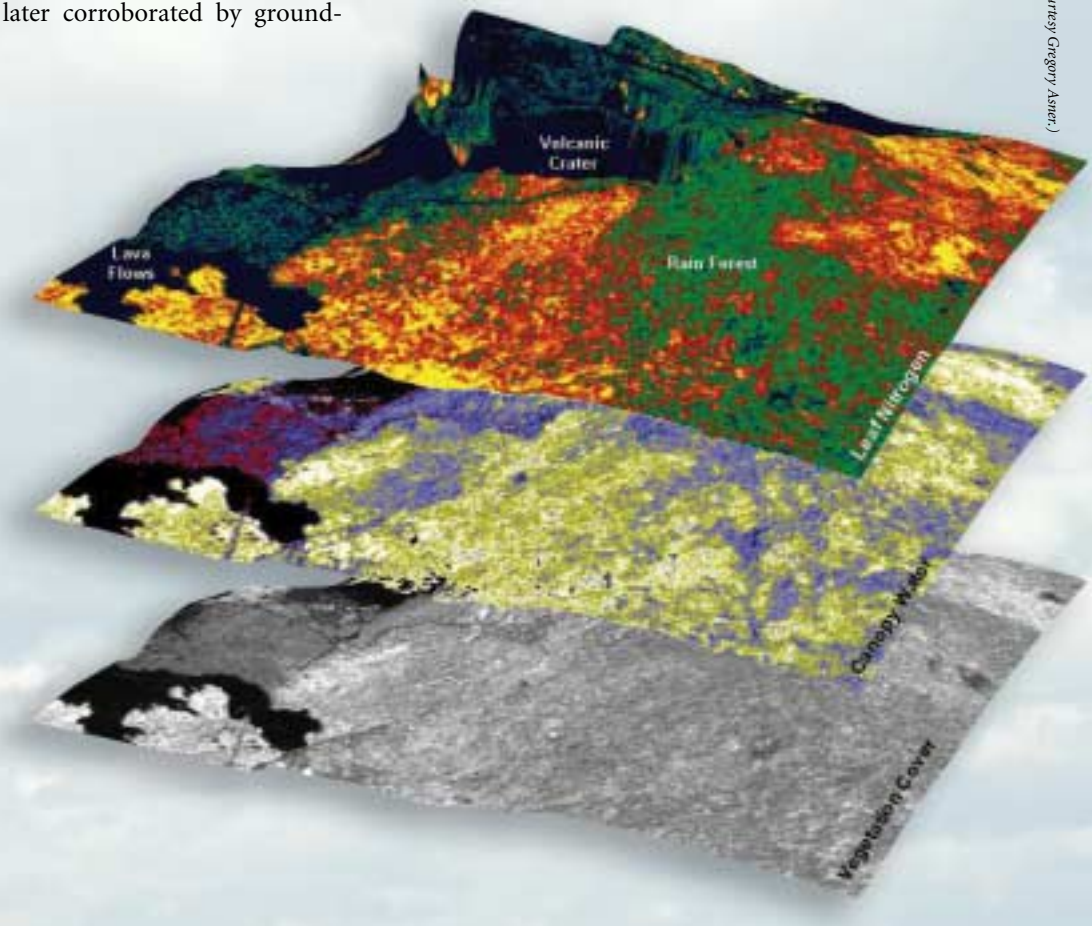
The scientists also had a big surprise: they located another invader, the Kahili ginger plant (*Hedychium gardnerianum*), growing under the forest canopy. Ginger cannot be detected from above the forest canopy using traditional aircraft or satellite approaches, but the new methods are sensitive to its high water content. In addition, the aircraft-based analysis discovered that ginger reduces the amount of nitrogen in the *Metrosideros* forest canopy—a discovery that was later corroborated by ground-based sampling.

The Hawaiian study was published in the March 7-11, 2005, early online edition of the ***Proceedings of the National Academy of Sciences*** and made the cover of the print version March 22. It was also widely reported in the ***New York Times***, the ***L.A. Times***, ***Scientific American.com***, various Hawaiian news outlets, and elsewhere. Asner was featured hunting these invasives in the ***National Geographic*** TV special ***Strange Days on Planet Earth***.

The fact that the new techniques allowed the scientists to detect an invader before it dominated the landscape is important to future management strategies. As a result of the findings, the group has expanded to include collaborators from federal, state, and private organizations. Scientists and resource managers from Carnegie, Stanford University, the U.S. National Park Service, NASA, and the Nature Conservancy have teamed up with an unprecedented plan to map the chemical and structural composition of Hawaiian ecosystems and find invasive species and track their ecological impacts.

"Because Hawaii contains so many different types of ecosystems, from desert grasslands to tropical rain forests, Carnegie's ecological remote sensing program has focused on the area as the ideal outdoor research laboratory for devising the next generation of aircraft and spacecraft observations," Asner said. "Now we've added a major focus on the application of our techniques to invasive species problems in the Hawaiian Islands. It is a win-win combination for all involved." •

Funding for this study was provided by the National Science Foundation, the NASA New Investigator Program, the Mellon Foundation, and the Carnegie Institution.



(Image courtesy Gregory Asner.)

The left image shows how spectral data—information contained in reflected light—obtained from the NASA Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) is organized into "data cubes." It also shows what the reflecting light reveals as the sensor collects data from the canopy to the soil. The different types of vegetation are grasslands, transition areas, and desert shrublands in the Northern Chihuahua region of New Mexico.

In the image at right, traditional remote sensing of the forest canopy is shown at the bottom. The middle and top images are the outputs from the new analytical techniques used in the study. They show canopy water content and leaf nitrogen concentration detected by high-altitude airborne imaging spectroscopy in Hawaii.

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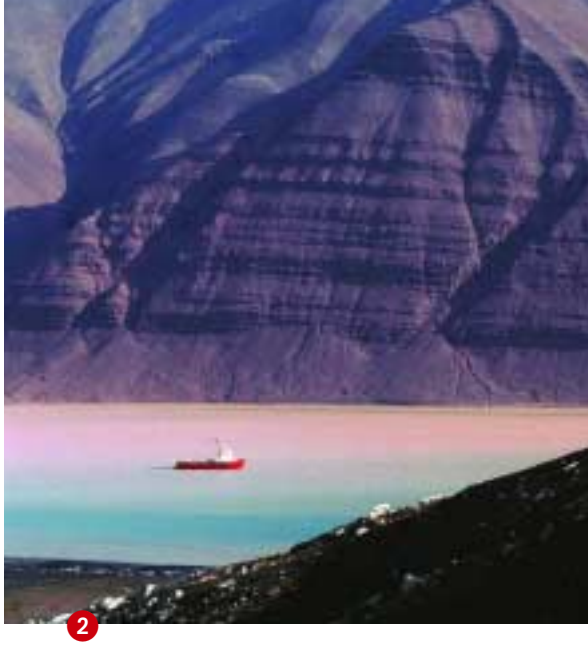

2

The Most AMASEing Site on

Some stark, rugged, and very remote Arctic islands have an uncanny resemblance to Mars. That's why a team of researchers from Carnegie's Geophysical Laboratory (GL) have trekked to the area twice and are planning to go back this summer. Last August GL's Andrew Steele, Marilyn Fogel, Jan Toporski, Jake Maule, and intern Maia Schweizer took part in the second Arctic Mars Analogue Svalbard Expedition (AMASE)—an international scientific collaboration to devise and test instruments for real-time sampling and analysis of Martian material to find evidence of life on the Red Planet. The two-week expedition was replete with scientists, engineers, two artists, a photographer, and plenty of challenges. Hans Amundsen, from the department of Physics of Geological Processes of the University of Oslo, Norway, led the way.

The destination was Bockfjorden on the island of Svalbard north of mainland Norway. At close to 80°N, the area is home to the world's northernmost hot springs above sea level and in August boasts sunlight around the clock. What drew the team to the harsh environment is the Mars-like geology and mineralogy, which includes tiny carbonate spheres with alternating black and white layers similar to those in the well-known Martian meteorite ALH84001.

The GL scientists lugged hundreds of pounds of equipment to run their specially adapted off-the-shelf instruments, which are typically used in sparkling clean biomedical labs. Their objective was to detect and characterize even tiny levels of microbiota using standard genetic techniques—the polymerase chain reaction, or PCR; an instrument that measures cellular activity by looking at the flux of the energy-storing molecule ATP; a device that detects cell-wall components (developed by Charles River and Norm Wainwright); and antibody microarrays. In addition to the lab equipment, the group had to carry heavy generators, batteries, and attendant devices to power their experiments.

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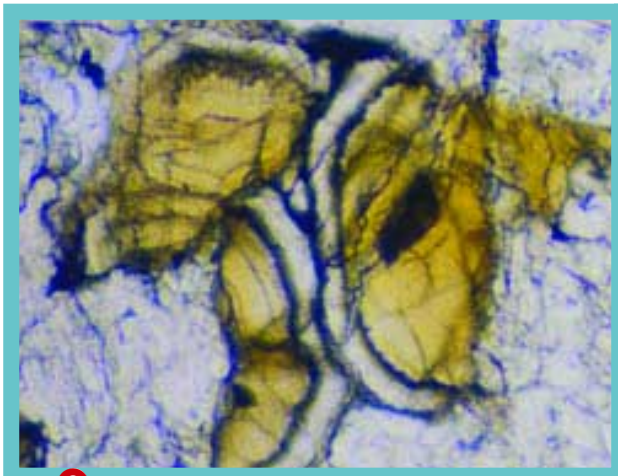
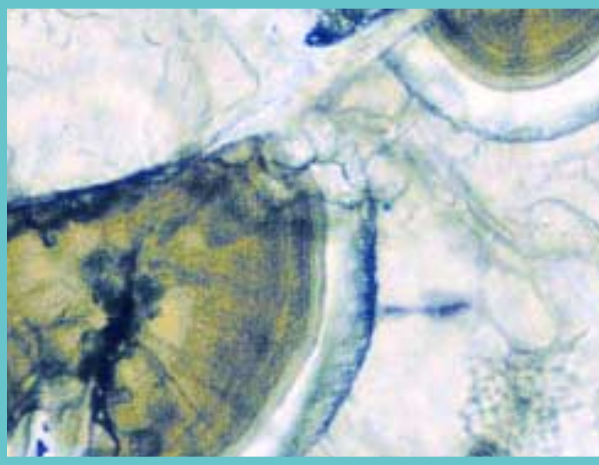




3

Earth

The crew set up their outdoor facility in a land of Lilliputian trees—1-centimeter-tall dwarf willows— large rocks, and constantly blowing dust. Instead of the 10 minutes an analysis would normally take, the cold stretched the tasks to between 2 and 4 hours each. Polar bear scouts were on constant alert, and team members had to fend off aerial attacks by arctic terns as they walked through the birds' territory. The dust was particularly vexing and a constant threat to essential sterility. Despite the severe conditions, the team was especially productive, with the ceaseless Sun helping to combat fatigue.

The goal for last summer's trip was to test the suite of instruments to see how quickly and well they could process samples. The GL team investigated nitrogen, carbon, and sulfur cycles, and correlated their findings with organic geochemistry and microbiology analysis. "To detect life on Mars, we have to devise instruments to recognize it and design them in such a way to get them to the planet most efficiently," said Andrew Steele, the Carnegie team leader. "We passed a major milestone. It was the first time an integrated Mars life-detection strategy was successfully tested. If life on Mars resembles life on Earth at all, we'll be able to find even a single cell," he stated. The successful tests were on hot-spring-deposited carbonate terraces where rock-dwelling (endolithic) bacteria live, and within lava conduits on the Sverrefjell volcano, which is currently the nearest terrestrial analogue to the processes that produced the carbonate spheres in the meteorite from Mars.

Antibody microarrays can test for the presence of many hundreds or even thousands of molecules simultaneously

(continued on page 12)

1 Scientists on the first Arctic Mars Analogue Svalbard Expedition (AMASE) in 2003 disembark on the stark shores of Bockfjorden, Svalbard.
(Image courtesy Kjell Ove Storvik.)

2 AMASE researchers trek the Sverrefjell volcano. Their goal is to sample lava conduits to detect rock-dwelling bacteria, testing the equipment they have adapted to the harsh field environment.
(Image courtesy Kjell Ove Storvik.)

3 The same processes that formed the carbonate spherules in the Martian meteorite ALH84001 (left) are believed to have formed the spherules in the volcanic rock in the Sverrefjell volcano (right). The similarity makes the geology of the Svalbard region a close analogue to that of Mars.
(Image courtesy Allan Treiman/LPI.)

4 Andrew Steele (second from left, sitting at portable lab) conducts a PCR analysis. Marilyn Fogel, on the ground in the blue hat and yellow pants, assays for ammonia. Jake Maule (right) conducts antibody microarrays as Ivar Midtkandal from the University of Oslo stands alert for polar bears (far left).
(Image courtesy Kjell Ove Storvik.)

5

(continued from page 11)

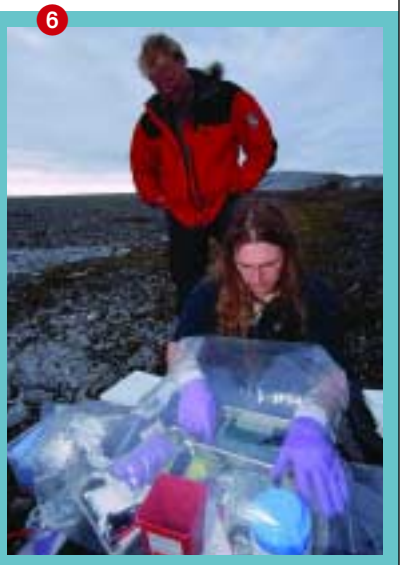
and are not limited to large proteins or cells. They can find smaller molecules, particularly the building blocks of life on Earth—amino acids and nucleotides. "This expedition marks the first time these arrays have been used in the field," commented Jake Maule, who was responsible for this part of the research.

The instrumentation also included two spectroscopic instruments deployed by Pamela Conrad of JPL and a Carnegie visiting investigator, and Arthur Lane of JPL. They are highly sensitive to certain organic and mineral fingerprints, and have the capacity to identify local "hot spots," which are likely to be good targets for finding life.

The researchers hope to fully characterize the geology and biology of the Bockfjorden area, and understand the role of biology in the formation and weathering of the carbonate deposits—the only known terrestrial analogue to those found in Martian meteorites. Their work will also be used in simulations at Svalbard to verify sample collection and analysis for future life-search missions to Mars and potentially the Jovian moon Europa. •

5 The Geophysical Laboratory's Andrew Steele (black hat) and intern Maia Schweizer (red hood) conduct PCR tests in 2003 at Trollosen Springs, in Svalbard. Polar bears are kept at bay by gun-toting Hans Amundsen (left), who leads the AMASE expeditions, and Allan Treiman (right).
(Image courtesy Kjell Ove Storvik.)

6 Expedition leader Hans Amundsen of the University of Oslo looks on while Carnegie's Andrew Steele manipulates sterile lab equipment encased in plastic at Trollosen, Svalbard.
(Image courtesy Kjell Ove Storvik.)



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The AMASE team comes from the following institutions: Physics of Geological Processes, University of Oslo, Norway; Geophysical Laboratory, Carnegie Institution of Washington; University of Leeds, England; Universidad de Burgos, Spain; GEMOC, Macquarie University, Australia; NASA Jet Propulsion Laboratory (JPL); Lunar and Planetary Institute (LPI); and Penn State University. The expedition photographer was Kjell Ove Storvik. Funding for this project was provided by the Carnegie Institution, with additional support from NASA ASTEP, JPL, and the NASA Astrobiology Institute.

The History of the Carnegie Institution

The Cambridge University Press is publishing a history of the Carnegie Institution of Washington. The five-volume set covers the histories of all the departments except the newest, the Department of Global Ecology. Pat Craig, former editor at Carnegie, wrote the history of Plant Biology due out later this summer. A number of authors, including Donald Brown and Allan Spradling of the Department of Embryology, collaborated on the Embryology history. Staff Member Emeritus Allan Sandage wrote the history of the Mount Wilson Observatory, and the late Hatten Yoder, department director from 1971 to 1986, wrote the history of the Geophysical Laboratory. The history of the Department of Terrestrial Magnetism was authored by the late Louis Brown, staff member emeritus. •

Another Successful Lecture Series at the Observatories

Observatories astronomer Luis Ho kicked off the third season of the Observatories Astronomy Lecture Series at the Huntington Library in San Marino, California, on March 15. He spoke about the powerhouses of the universe, massive black holes. Alan Boss of the Department of Terrestrial Magnetism was second in the lecture lineup on March 29 with his account of the status of the search for other Earths. Observatories' Andy McWilliam showcased the role of stars in the origin of elements and dis-

Repairing Damaged DNA

Toxins constantly bombard the cells in our bodies. These invaders can cause breaks in the cells' DNA—the molecules in the nucleus that make up our genes and chromosomes and determine who we are. **In healthy cells, a DNA break activates a signaling chain reaction that marshals proteins to repair the damage. If the cell is not able to repair DNA breaks correctly, cell division can be adversely affected and diseases such as cancer can result.**

Elçin Ünal and Doug Koshland at the Department of Embryology and colleagues recently conducted a study using baker's yeast that found that the repair process involves more than just activity at the local site of damage. They showed that a DNA break, which damages a very small region of a chromosome, induces the signaling system to recruit a protein complex that stimulates large-scale architectural changes in the chromosome itself. The purpose of the complex is to restrict the broken ends so that they can "glue" back perfectly to restore the original chromosome. Without this gluelike activity, the broken ends could randomly join with other chromosome parts, causing translocation and deletions. This new finding is important to understanding fundamental processes of cell aging and to identifying new ways to prevent and treat a number of diseases, especially some cancers. The research was published in the December 22, 2004, issue of *Molecular Cell*.

(Image courtesy Scott Rubel.)

cussed other stellar mysteries on April 5. In the final lecture of the season, on April 26, Hubble postdoctoral fellow Marla Geha discussed one of the most baffling questions facing astronomy—dark matter—the invisible stuff that makes up most of our universe.

Luis Ho, shown above at the Huntington Library on March 15, lectured on the search for massive black holes.

Sue Rhee, Newest Staff Member at Plant Biology

Seung Y. (Sue) Rhee, staff associate at the Department of Plant Biology since 1999, will become a staff member as of July 1, 2005. Rhee completed her Ph.D. in 1997 at the Department of Biological Sciences at Stanford University, studying pollen formation in the model plant *Arabidopsis*. She then studied bioinformatics with Michael Cherry in the Department of Genetics at Stanford before joining Carnegie as a staff associate. Since joining Plant Biology she has led the development of The *Arabidopsis* Information Resource (TAIR) database (www.Arabidopsis.org). The TAIR Web site now provides more than 9 million page downloads per year to the *Arabidopsis* research community, making it one of the most intensively used biological databases. More than 13,000 scientists have registered as users. In her new position Rhee will expand her interests beyond database development toward the use of bioinformatics tools to develop hypotheses about the biological function of anonymous components of plant genomes and systems properties of the *Arabidopsis* genome.

Sue Rhee is the newest staff member at Plant Biology.

Giant Planet Birth Linked to That of Primitive Meteorites

Scientists now believe that the formation of Jupiter, the heavyweight planet champion in our solar system, may have spawned some of the tiniest and oldest constituents in the system—millimeter-size spheres called chondrules, the major component of primitive meteorites. The study, by theorists Alan Boss of the Department of Terrestrial Magnetism and Richard H. Durisen of Indiana University, was published in the March 10, 2005, issue of the *Astrophysical Journal (Letters)*.

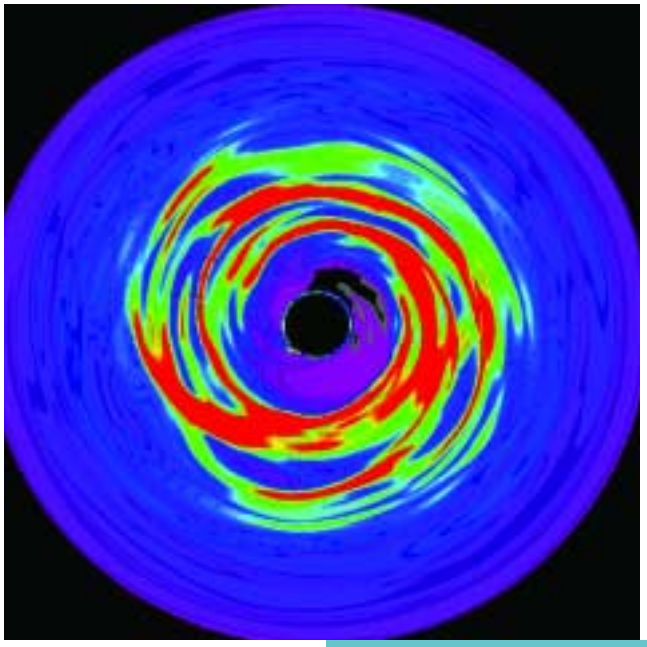
"Understanding what formed the chondrules has been one of the biggest problems in the field for over a century," said Boss. "Scientists realized several years ago that a shock wave was probably responsible for generating the heat that cooked these meteoritic components. But no one could explain convincingly how the shock front was generated in the solar nebula some 4.6 billion years ago. These latest calculations show how a shock front could have formed as a result of spiral arms roiling the solar nebula at Jupiter's orbit. The shock front extended into the inner solar nebula, where the compressed gas and radiation heated the dust particles as they struck the shock front at 20,000 mph, thereby creating chondrules," he explained.

"This calculation has probably removed the last obstacle to acceptance of how chondrules were melted," remarked theorist Steven Desch, a former Carnegie Fellow now with Arizona State University. Desch showed several years ago that shock waves could do the job. "The work of Boss and Durisen demonstrates that our early solar nebula experienced the right types of shocks, at the right times, and at the right places in the nebula to melt chondrules. I think for many meteoriticists, this closes the deal. With nebular shocks identified as the culprit, we can finally begin to understand what the chondrules are telling us about the earliest stages of our solar system's evolution," he concluded.

According to Boss, the calculation shows how the three-dimensional gravitational forces associated with spiral arms in a gravitationally unstable disk at Jupiter's distance from the Sun (5 times the distance from the Earth to the Sun) would produce a shock wave in the inner solar system (2.5 times the Earth-Sun distance; i.e., in the asteroid belt). It would have heated dust aggregates to the temperature required to melt them and form tiny droplets. Durisen and his research group at Indiana have made independent calculations of gravitationally unstable disks that also support this picture.

While Boss is well known as a proponent of the rapid formation of gas giant planets by the disk instability process, the same argument for chondrule formation works for the slower process of core accretion. In order to create Jupiter by either process, the solar nebula had to have been at least marginally gravitationally unstable, so that it would have developed spiral arms early on and resembled a spiral galaxy. Once Jupiter had formed by either mechanism, it would have continued to drive shock fronts at asteroidal distances, at least so long as the solar nebula was still around. In both cases, chondrules would have been formed at the very earliest times and continued to form for a few million years, until the solar nebula disappeared. Late-forming chondrules are thus the last grin of the Cheshire Cat that formed our planetary system.

"Understanding what formed the chondrules has been one of the biggest problems in the field for over a century."



This image uses colors to represent high (red) and low (purple and black) densities in the equatorial plane (midplane) of a gravitationally unstable disk after 252 years of evolution from an initially nearly uniform state. A strong shock front (sharp edge of black region) has formed at about 12 o'clock, just outside the inner boundary of the disk at a radius of 2 astronomical units (2 AU; 1 AU is the Earth-Sun distance = 93 million miles). The radius of the entire region shown is 20 AU. A solar-mass protostar is located at the disk's center. Dust particles rotating in the counterclockwise direction between 2 and 3 AU encounter the shock front at about 20,000 mph.

(Image courtesy Alan Boss.)

Boss's research is supported in part by the NASA Planetary Geology and Geophysics Program and the NASA Origins of Solar Systems Program. The calculations were performed on the Carnegie Alpha Cluster, the purchase of which was supported in part by the NSF Major Research Instrumentation Program. Durisen's research was also supported in part by the NASA Origins of Solar Systems Program.

IN Brief

❶ Inés Cifuentes works with First Light children.

Trustees and Administration

Trustee emeritus and Nobel laureate **Charles Townes** was awarded the Templeton Prize for advocating the "convergence of science and religion."

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Sidney Weinberg, Jr., senior trustee, was elected a fellow of the American Academy of Arts and Sciences.

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Trustee **David Swensen** received one of *Institutional Investor* magazine's inaugural Awards for Excellence in Investment Management.

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In Feb., Carnegie president emerita and trustee **Maxine Singer** was named the 2004 AAAS Philip Hauge Abelson Prize winner for her "exceptional service to science and society."

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Carnegie president **Richard Meserve** was named a top Washington environmental lawyer by the Dec. 2004 *Washingtonian* magazine. On Apr. 12, he gave a lecture at the Williams College Class of 1960 Scholars Program entitled "Nuclear Power in an Age of Terrorism." On May 1, he also presented a talk at the NAS annual meeting on "Nuclear Power and Non-Proliferation."

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CASE was chosen by the Bethesda chapter of the Association for Women in Science as the joint recipient of the 2005 Award for Excellence in Mentoring.

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❶ **Inés Cifuentes** stepped down as director of CASE Jan. 31, 2005, to pursue other interests. She first came to the institution in June 1984 and worked with Paul Silver at DTM on her Ph.D. thesis about the great 1960 Chilean earthquake.

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❷❸ **Lloyd Allen** retired on Apr. 1, 2005, after 47 years as the administration's building maintenance specialist. Allen worked in the administration under four Carnegie presidents and two acting presidents.

Embryology

Director Emeritus **Donald Brown** gave one of the plenary lectures at the first workshop of the JSPS Core-to-Core Program Jan. 7-8, 2005, at the Okazaki Conference Center, Japan.

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In Sept. **Joseph Gall** presented the Wenner-Gren Distinguished Lecture at the Karolinska Institute in Stockholm. Gall was also interviewed for the TV series *100 Greatest Discoveries*, which aired in late Jan. and early Feb. 2005 on the Discovery Science channel. Bill Nye, "The Science Guy," interviewed Gall in his laboratory at Embryology.

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Jim Wilhelm gave a talk at the 46th Annual *Drosophila* Research Conference in San Diego Mar. 30-Apr. 3, 2005.

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Alice Chen, a graduate student in Chen-Ming Fan's lab, has been selected to receive a Weintraub Graduate Student Award to recognize outstanding achievement in graduate studies.

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Joining the Zheng lab are Johns Hopkins Ph.D. candidate **Dan Ducat** and **Shilpa Mehta** (Ph.D., Penn. State U.-State College).

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Johns Hopkins graduate student **Lori Orosco** joined the Halpern lab for her Ph.D. research.

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JHU graduate students **David Martinelli** and **Christoph Lepper** have joined the Fan lab.

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Postdoctoral fellow **Joshua Gamse** moved to start his own laboratory at Vanderbilt U. in Nashville.

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Kan Cao has taken a postdoc position at NIH.

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Postdoc **Hoi Li** is now assistant professor in the School of Biological Sciences at Nanyang Technological U., Singapore.

Geophysical Laboratory

GL director **Wesley Huntress** was made an associate member of the Royal Astronomical Society in Feb. 2005. He is participating in NASA's Strategic Roadmap activity to define the agency's plans for implementing President Bush's new policy for space exploration.

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George Cody chaired the Gordon Research Conference, "Origins of Life," in Ventura, CA, Jan. 16-21. **Jennifer Eigenbrode, Marilyn Fogel, Robert Hazen, Shuhei Ono, Penny Morrill,** and **James Scott** were among the presenters at the meeting, which was also attended by **Wes Huntress.**

—

Ronald Cohen organized two related town meetings at the fall AGU meeting in San Francisco, one on "Petascale Computing in the Earth Sciences" and one on "Computational Geoinformatics for Solid Earth Sciences." He also coorganized the Mineral and Rock Physics Reception at AGU and attended the 2005 Workshop on Fundamental Physics of Ferroelectrics, Feb. 6-9, 2005, in Williamsburg, VA.

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Russell Hemley gave numerous invited talks in 2004 including the following: the IUCr-COMPRES Workshop on High Pressure Structure and Reactivity, The Science of Change, Dec. 7; the Los

❷ Left image, President Richard Meserve (left) talked about Lloyd Allen (right) and his many productive years at Allen's retirement party March 21.

❸ Right image, Lloyd Allen (center), his wife, and many family members enjoy Allen's retirement luncheon at a nearby Washington, D.C., restaurant March 21.

Ho-kwang (Dave) Mao

has won the Mineralogical Society of America's Roebling Medal for 2005. This is the highest award of the MSA, and is given for "scientific eminence as represented primarily by scientific publication of outstanding original research in mineralogy." This is the third winner in a row from the lab; Joe Boyd won it in 2004, Charles Prewitt in 2003, and Hatten Yoder in 1992.

❹ Director of the Department of Global Ecology Chris Field.

Alamos National Laboratory on Apr. 7 and Oct. 9; the Microscopy Society of America, Aug. 6; the Workshop on Infrared Microscopy and Spectroscopy, July 10; the Carnegie/DOE Alliance Center (CDAC) First Year Review at GL, May 7; the Third Annual COMPRES Meeting, June 21; DARPA, Aug. 9; the HEDM-NANO Program Review at DARPA, June 3; NSF Site Visit, Apr. 1; the NSF, Apr. 22; Future Directions in Materials for Electro-mechanical Transducers, July 12-13; U. Edinburgh, Apr. 30; Brijuni, Croatia, Sept. 2; the opening plenary lecture at Diamond 2004 in Riva del Garda, Italy, Sept. 13; the Multiscale Modeling of Strength and Fracture: Linking throughout the Mesoscale, 2nd International Workshop in Berkeley, CA, Jan. 2004; the Program of the American Conference on Neutron Scattering, June 8; the First Annual SSAAP Symposium in Albuquerque, Mar. 29-31; the Second International Workshop on Water Dynamics at the Sendai International Center in Sendai, Japan, Nov. 11-12; the Institute for Shock Physics, Washington State U., Nov. 1; and the Lawrence Livermore National Laboratory, Dec. 9.

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The Jan. 26, 2005, meeting of the Geological Society of Washington was dedicated to the memory of three distinguished GL scientists, **Philip Abelson, Joseph Boyd,** and **Hatten Yoder.** Presentations were given by Carnegie's **Marilyn Fogel, Dean Presnall,** and **Robert Hazen.**

—

Przemyslaw Dera presented invited plenary talks at the Gordon Research Conference on High Pressure in Meriden, NH, and at the Denver X-ray Conference in Steamboat Springs, CO. He also gave an invited seminar for the Earth Science Division of NSF. With GL's former director **Charles Prewitt,** Dera organized and chaired an international workshop, "Structure Determination by Single Crystal X-ray Diffraction (SXD) at Megabar Pressures," held at the Argonne National Lab in Chicago on Nov. 12-14. Among the invited speakers were GL's **Ho-kwang Mao, Steven Jacobsen, Jung-fu Lin, Olga Degtyareva,** and GL visitor **Valentina Degtyareva.** Dera was also nominated as a director of the International School on High-Pressure Crystallography, to be held in Erice, Italy.

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Former postdoc **Jan Toporski** is now a research scientist at the Institute for Geosciences, Kiel U., Germany. Jan will co-manage a project on effects of bacterial leaching/etching on Fe sulfides and continue to collaborate with Andrew Steele and his lab.

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Hanns-Peter Liermann (Ph.D., U. Arizona-Tucson) was appointed beamline scientist at HPCAT.

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Postdoc **Shuhei Ono** gave the IGPP colloquium talk at UCLA in Nov., and a keynote talk at the Gordon Conference "Origins of Life" in Jan. 2005. He is currently involved with the Agouron Griqualand Paleoproterozoic Drilling Project.

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Olga Degtyareva, a postdoctoral fellow in the High-Pressure Group, attended the VIII International School on Problems in Solid State Physics and High Pressures in Sept. in Russia, where she gave a talk. **Valentina Degtyareva**, Olga's mother and colleague, from the Institute of Solid State Physics in Chernogolovka, Russia, visited GL in Oct.-Nov. 2004 to work on "Phase Stability and Crystal Structure of Binary Alloys under High Pressure."

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Tianfu Li (Chinese Academy of Geological Sciences, Beijing) is working in Doug Rumble's lab for two months to analyze drill core samples from the 5 km-deep Chinese Continental Scientific Drill Hole for oxygen isotopes.

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Razvan Caracas presented a poster at the Twelfth International Workshop on Computational Physics and Materials Science: Total Energy and Force Methods, Jan. 13-15, 2005, Miramare-Trieste, Italy. The results were obtained at GL in collaboration with Ron Cohen.

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Muhetaer Aihaiti, Aravind Asthagiri, Razvan Caracas, Ron Cohen, Russell Hemley, and **Zhigang Wu** attended the 2005 Workshop on Fundamental Physics of Ferroelectrics, held in Williamsburg, VA, Feb. 6-9. Cohen presented a talk; Aihaiti, Asthagiri, Caracas, and Wu presented posters.

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Penny Morrill (Ph.D., U. Toronto) has been appointed postdoctoral research associate and arrived in Jan. 2005. She has an NAI Fellowship.

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GL has three new predoctoral research associates: **Shih-Shian Ho** (M.S., National Central University, Taiwan); **Verena Starke** (M.S., Philipps-University, Marburg, Germany); and **Rebecca Martin** (B.S., George Mason U.).

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Shantanu Keshav, visiting investigator at GL, has been appointed a postdoctoral fellow.

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Garret Huntress has been appointed system administrator/system developer at Carnegie. Garret has extensive knowledge of the GL, DTM, and HQ Information Systems.

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Haiyun Shu has been appointed a part-time lab technician in the CVD laboratory.

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Lora Armstrong, a recently appointed student intern, will be working in Yingwei Fei's lab.

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Former postdoc **Michael R. Furlanetto** has taken a position at Los Alamos National Laboratory.

Global Ecology

❹ **Chris Field** has been made a regular voting member of the Stanford faculty. Most Carnegie faculty members are Stanford faculty "by courtesy," so this change will further strengthen the Stanford/Carnegie relationship. He was also was appointed professor of biological sciences at Stanford beginning Feb. 1. Chris spent a large part of 2004 in New Delhi, where he contributed to the deliberations of SCOPE.

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Greg Asner assembled a team from NASA JPL, the U.S. National Park Service, the U.S. Forest Service, the Nature Conservancy, U. Hawaii, and Stanford U. for a 12-week intensive study of Hawaiian ecosystems and invasive species. Technicians **Robin Martin, Kim Carlson**, and **David Knapp** endured long days of Hawaiian privation to help make the studies a success. Greg could be seen in the first episode of the National Geographic special *Strange Days on Planet Earth*, which premiered Apr. 20 on PBS. The series won the 2005 International Wildlife Film Festival Award for Best Television Series.

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The Asner lab, with technicians **David Knapp, Eben Broadbent, Paulo Oliveira**, and **April Villagomez,** recently unveiled the Carnegie Landsat Analysis System (CLAS), a powerful system to map logging and deforestation at 30-meter resolution for the Amazon region.

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The Berry lab completed the installation of a new stable isotope mass spectrometer and updated an existing instrument. **Larry Giles** is the magician who keeps both instruments humming.

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Elsa Cleland presented her thesis defense on mechanisms that aggravate nutrient limitation in ecosystems exposed to simulated global changes. She has begun a postdoctoral position at UC-Irvine.

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Natalie Boelman (Ph.D., Columbia U.) joined the Asner and Field labs as a postdoctoral fellow. She will be using spectrometer data to study plant and biogeochemical dynamics in the Jasper Ridge Global Change Experiment.

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Noel Gurwick (Cornell U.) joined the Field lab as a postdoctoral research associate. Noel will be research coordinator for the Jasper Ridge Global Change Experiment.

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David Lobell, who is preparing to defend his Ph.D. dissertation, accepted a Lawrence Postdoctoral Fellowship at Lawrence Livermore National Laboratory.

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Lars Hedin ended his sabbatical at GE and returned to Princeton U.

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Guanghui Lin ended his tenure as a visiting investigator to take up a new position with a biotech firm in Silicon Valley.

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Hugh Henry returned to Canada to start a position as an assistant professor at U. Western Ontario.

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The Field lab bid good-bye to technician **Kathleen Brizgys,** who has been working on the Jasper Ridge Project, and welcomed technician **Alison Appling,** a recent Stanford graduate and veteran of Jasper Ridge.

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Steve Allison and Karen Mclaughlin were married in Oct. Steve successfully defended his thesis and moved to UC-Irvine, where he is starting a postdoctoral fellowship.

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Lydia Olander, a recent alum of the Asner lab, married John Fay in Oct.

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The Global Ecology Center at Stanford was awarded top honors by the local chapter of the American Institute of Architects in the Energy & Sustainability category. The building also won a special mention in *R&D Magazine*'s 2005 Laboratory of the Year competition.

Staff astronomer Steve Shectman won the 2005 American Astronomical Society's Weber Prize, given in honor of outstanding contributions to astronomical instrumentation. He gave an astronomy seminar on "Extremely Metal Poor Stars" at UC-Santa Barbara. On Dec. 14 he participated in the design review for the X-shooter instrument for the Very Large Telescope at the headquarters of the European Southern Observatory in Garching, Germany.

Observatories

❺ Senior research associate **Barry Madore** received a Group Achievement Award from NASA administrator Sean O'Keefe for his role as science co-investigator on the Galaxy Evolution Explorer (GALEX), launched two years ago to survey the extragalactic sky.

❺ Observatories senior research associate Barry Madore.

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On Oct. 7, at the 5th International Heidelberg Conference on Dark Matter in Astro and Particle Physics (DARK 2004), **Wendy Freedman** gave a review talk on current observational projects using type Ia supernovae to understand dark energy. On Nov. 3 she gave a public lecture, "The Runaway Universe," at the Santa Barbara Museum of Natural History. She visited Las Campanas Observatory with Carnegie president **Richard Meserve** and others Jan. 23-28 and presented the Great Lecture, "A New Century of Astronomy," at U. Texas-Austin on Feb. 5.

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The First Symposium on Magellan Science, with more than 70 astronomer participants, was held at the Observatories on Jan. 7-8, 2005. The presentations covered the full range of current astronomical research from the solar system to the most distant galaxies known. A recurring theme of the meeting was the spectacular performance of the Magellan telescopes. **Wendy Freedman** gave a talk on the Carnegie Supernova Project and measurement at high redshift. The symposium was organized by Observatories staff astronomer **John Mulchaey**, with help from **Mario Mateo** (U. Michigan) and **Jill Bechtold** (U. Arizona).

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At the Jan. 2005 meeting of the American Astronomical Society in San Diego, the Historical Astronomy Division convened a symposium about the founding of the Mount Wilson Observatory. Director Emeritus **George Preston** delivered an invited lecture on the impact of Los Angeles city lights on the research of Carnegie astronomers.

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Staff astronomer **Luis Ho** gave NOVA Lectures at Leiden U. and at the Kapteyn Institute in the Netherlands, an IPAC seminar at Caltech, and an invited talk in Germany at the 2004 Ringberg Workshop on AGN Physics.

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Staff astronomer **Andrew McWilliam** gave a talk at the ESO conference in Sept. He also spoke at the Space Interferometry Mission team meeting at the Smithsonian Astrophysical Observatory in Cambridge, MA, in Nov. In Jan. 2005 he gave a talk at the Space Interferometry Mission team meeting in San Diego and a talk at the Magellan Science meeting held at the Observatories.

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Staff associate **Dan Kelson** was asked by Scholastic Publishing to check the accuracy for a forthcoming set of 12 books on the solar system.

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Carnegie Fellow **Jeremy Darling** gave a colloquium at the National Radio Astronomy Observatory in Oct. and a colloquium at UC-Santa Barbara in Nov.

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Carnegie Fellow **Michael Gladders** presented talks at the AAS winter meeting 2005 in San Diego, Jan. 12; at the conference "Gravitational Lensing, Dark Matter, and Dark Energy," Ohio State Center for Theoretical Science, Jan. 6, 2005; and at the conference "Fundamental Physics from Galaxy Clusters," Fermi National Labs, Dec. 11. He presented invited colloquia at UC-Santa Cruz on Oct. 6 and UC-Irvine on Nov. 23. He also participated in The First Symposium on Magellan Science workshop in Jan. at the Observatories.

Carnegie Fellow **Kurt Adelberger** gave an invited talk at Ringberg Castle, Germany, in early Nov., and a colloquium at U. Waterloo, Canada, in mid-Nov. In Jan. 2005 he gave a colloquium at Ohio State U.

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Hubble Fellow **Marla Geha** gave invited talks at U. British Columbia and at the Dominion Astrophysical Observatory, Canada.

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Hubble Fellow **Edo Berger** gave invited talks at the Gamma-Ray Bursts in the Afterglow Era: 4th Workshop conference in Rome on Oct. 18-22 and at the 22nd Texas Symposium on Relativistic Astrophysics conference at Stanford, Dec. 13-17. He also gave a colloquium at the astronomy dept. at Princeton U. in Nov.

The Gold Medal is the highest and most prestigious award of the Royal Astronomical Society (London). It has been awarded jointly to E. Margaret Burbidge and Geoffrey R. Burbidge, renowned longtime wife-and-husband team in astrophysics. The Burbidges have been continuous friends of Carnegie astronomy. Geoffrey Burbidge held a Carnegie Fellowship at the Observatories in the 1950s. A theoretician, he was named to the post because the antiquated policies of that time did not permit women to work on Mount Wilson, although behind the scenes it was known that Margaret, rather than her husband, would actually carry out the observational research with the Mount Wilson telescopes.

The fellowship resulted in the publication of one of the most important papers in physics and astronomy in the 20th century, on the origin of the chemical elements. The paper, written jointly with Fred Hoyle and W. A. Fowler from Caltech, later led to the awarding of the Nobel Prize in physics to Fowler.

Over the past 50 years, the Burbidges have been leaders in many epoch-changing discoveries in astronomy and high-energy astrophysics. They returned to England after their Pasadena fellowships and then emigrated to the U.S. to work at the Yerkes Observatory of the University of Chicago. They then went on to hold professorships at the University of California, San Diego, where they continue to do research. Margaret served as the only woman director of the Royal Greenwich Observatory in the 1980s and was the first woman president of the American Astronomical Society. Geoffrey was director of the Kitt Peak National Optical Observatory in the 1980s. He has also been editor of the highly successful *Annual Reviews of Astronomy and Astrophysics* for the past 30 years.

Plant Biology

In Nov. **Chris Somerville** received the Mendel Medal from the Genetics Society and the Hopkins Medal from the Biochemical Society. On Nov. 12 he gave a talk at a meeting of the Biochemical Society in Glasgow. He repeated this talk at UC-Riverside on Jan. 12, 2005. On Nov. 19 he gave a talk at a meeting of the Royal Society in London.

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Winslow Briggs was an invited speaker at the American Society of Agronomists annual meeting in Seattle Nov. 1.

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Shauna Somerville gave a seminar at UC-Davis on Jan. 7, 2005.

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Wolf Frommer was a coordinator of a seminar in Sorrento, Italy, at the EU Associoport final project meeting Oct. 7-9. He gave talks at the San Diego Center for Molecular Agriculture 2004 Symposium and Biotechnology Showcase in La Jolla, CA, on Oct. 23-26 and at the Dept. of Biology, NYU, on Nov. 29; and at U. Illinois-Champaign/Urbana on Dec. 1. On Dec. 3 he gave the departmental colloquium at U. Maryland-Baltimore. On Jan. 25, 2005, Frommer went to Baltimore to attend the NIH Roadmap: Metabolomics Technology Development Meeting for the NIH Joint Project on "Genetically Engineered Nanosensors." He presented a talk at the Keystone Symposium in Santa Fe Feb. 1-6, 2005.

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Devaki Bhaya was invited to give the John Ingraham Lectures in Microbial Physiology at the West Coast Bacterial Physiologists annual meeting in Pacific Grove, CA, Dec. 10-12. Also in Dec. Devaki gave a seminar at UC-Berkeley.

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On Nov. 4 **Natalie Khitrov** joined the Chris Somerville lab as a lab technician.

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Two new postdocs arrived in Jan. to join Shauna Somerville's lab: **José Estevez** (U. Buenos Aires) and **Yu Guan** (UC-Riverside). Also joining the lab for his six-month sabbatical from Riso National Research Centre, Riso, Denmark, is **Torben Gjetting.**

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Matthew Jobin (Stanford U.) joined the Grossman lab as a research technician.

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The Wang lab welcomed postdoc **Tae-Wuk Kim** (Chung-Ang University, South Korea) to the lab.

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On Jan. 24 **Deborah Tausch** joined the staff of Plant Biology and Global Ecology as the new financial officer.

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In Oct. **Diane Chermak** left her position at Stanford U. to join the Frommer lab as a lab technician. Two new postdocs joined the lab in Nov., **Totte Niittyla** (John Innes Center, U. East Anglia, U.K.) and **Bhavna Chaudhuri** (Dept. of Biotechnology, Government of India).

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In Oct. **Yigong Lou** left Sue Rhee's group to take a position at LBL in Berkeley.

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In Jan. 2005 **Marta Berrocal-Lobo** left Shauna Somerville's lab to join the Centro Nacional de Biotechnologia, CNB-CSIC, in Madrid.

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Departures from the Wang lab included **Ying Sun**, in Dec., to resume her position at Hebei Normal University, Heibei, China, and **Soo-Hwan Kim**, in Jan., to take up his new position at Yonsei U., South Korea. December also saw the departure of **Claire Simpson** from the Bhaya lab.

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Postdocs **Dominique Bergmann** and **Ted Raab** left Chris Somerville's lab in Dec. to start their new positions at Stanford U. **Rene Wuttke**, a predoc, left to return to U. Potsdam, Germany, to complete his degree.

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Visiting investigator **Laurent Zimmerli** departed from Shauna Somerville's lab to take up his new position in Switzerland.

Terrestrial Magnetism

Sean Solomon delivered seminars on the MESSENGER mission to Mercury at the Carnegie Observatories in Dec. and the NASA Goddard Space Flight Center in Jan. During the winter he served on NASA's Strategic Roadmap Committee for Earth Science and Applications from Space and the Advisory Board of the Max Planck Institute for Chemistry in Mainz, Germany.

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In Nov. **Alan Boss** gave the overview for the Chondrites and the Protoplanetary Disk meeting, held in Kauai, HI, and presented a review on the origin of shock waves in protoplanetary disks. Also in Nov., Boss spoke about giant planet formation and astrobiology at the NASA Goddard Space Flight Center. In Dec. he lectured on giant planet formation at U. Penn. and reviewed how theories of giant planet formation confront observations at the Ringberg Workshop on Planet Formation, held in Bavaria, Germany. In Feb. Boss gave two lectures at U. Hawaii, one on the formation of giant planets and one on the formation of sub-brown dwarfs. In Apr. he gave a colloquium on a new approach to solar system formation at Arizona State U.

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Paul Butler and DTM postdoctoral associate **Magaret Turnbull** were two of five panelists participating in the 2005 Isaac Asimov Memorial Debate at the American Museum of Natural History's Hayden Planetarium in Mar. This year's debate was on "The Enigma of Alien Solar Systems." Turnbull's work with

NASA's Terrestrial Planet Finder mission and the SETI Institute's Allen Telescope Array is featured at the Lawrence Hall of Science in Berkeley, CA, in the Space Science Institute's "Alien Earths" exhibit, on display Feb. 5-May 5, 2005.

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Paul Silver presented at the Earthscope National Meeting held in Mar. at the Santa Ana Pueblo, NM. C. V. Starr Fellow **Taka'aki Taira** also presented a paper. Silver gave a seminar at U. Maryland in Apr.

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Alycia Weinberger was one of four scientific organizers of the 2005 Aspen Center for Physics Winter Conference on Astrophysics, on "Planet Formation and Detection," held in Feb. **John Chambers** gave a talk at this conference. Others presenting papers included **James Cho, Hannah Jang-Condell, Mercedes López-Morales, Aki Roberge, Scott Sheppard,** and **Kaspar von Braun.**

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John Graham, currently serving as the secretary of the American Astronomical Society (AAS), attended that organization's annual meeting held in San Diego. Also attending were **Alan Boss, Saavik Ford, Mercedes López-Morales, Aki Roberge,** and **Alycia Weinberger,** as well as former DTM summer research interns **Alicia Aarnio** and **Abby Fraeman.**

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Erik Hauri, with postdoctoral associate **Alison Shaw,** attended the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) meeting in Pucon, Chile, in Nov.

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David James gave an IRIS/SSA Distinguished Lecture at Arizona State U. in Jan.

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Larry Nittler gave a public lecture on "The NEAR mission to Eros" at U. Arkansas-Fayetteville in Feb. In Mar. he delivered a paper at the 36th Lunar and Planetary Science Conference in Houston. Others presenting at this meeting included **Conel Alexander, Alan Boss, Henner Busemann, Mary Horan,** and **Sean Solomon.**

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In Apr. **John Chambers** gave a seminar at Saint Mary's University in Halifax. He also gave an invited talk at the Apr. 2005 AAS/Division on Dynamical Astronomy meeting in Santa Barbara.

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In Apr. C. V. Starr Fellow **Taka'aki Taira** presented a paper at the Seismological Society of America annual meeting, held in Incline Village, NV.

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Postdoctoral fellow **K. E. Saavik Ford** was featured in the Northeast Public Radio's program "Women in Science, Technology, Engineering and Mathematics: Their Role Models and Mentors." She departed in Mar., concluding her work on the dynamics of cometary systems and other projects, including work with Sara Seager on the capabilities of the Atacama Large Millimeter Array. Together with former postdoctoral associate **Nader Haghighipour,** Ford was a mentor for 2004 intern Abby Fraeman, whose work reached the finals of the 2005 Intel Science Talent Search.

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In Mar. postdoctoral fellow **Hannah Jang-Condell** attended a conference, "From Disks to Planets: New Observations, Models and Theory," organized by the Michelson Science Center and held in Pasadena. She also gave the Astronomy Department Seminar at Northwestern U.

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In Jan. postdoctoral fellow **Kaspar von Braun** attended the Magellan Science Symposium held at the Observatories. In Mar. von Braun gave a seminar at the U.S. Naval Research Laboratory in Washington, DC.

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Dayanthie Weeraratne, an NSF postdoctoral associate, arrived in Dec. from Brown U. Her work employs both fluid dynamics and seismology to investigate the dynamics of the Earth's interior. In Jan. Weeraratne joined the research vessel *Melville* to undertake the next phase of work on the multi-institutional PLUME project to construct seismic images of the mantle beneath Hawaii.

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Sonali Shukla, a research intern at DTM during the summer of 2004 and currently a junior at New York U., received an Outstanding Student Paper Award for her presentation in the Planetary Sciences Section at AGU's fall meeting in San Francisco in Dec.

DTM/GL

NASA has chosen DTM's **Larry Nittler** and **Conel Alexander,** and GL's **George Cody, Marc Fries** and **Andrew Steele,** to be on the scientific group to examine returned samples of comet dust. They will receive samples collected by the *Stardust* spacecraft in Jan. 2004 from the coma of comet Wild 2. The campus will have the NanoSIMS ion probe operating in time for sample delivery.

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In Feb. visiting investigator **Kevin Burke** was elected a fellow of the AAAS at the association's annual meeting in Washington, DC.

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Among those from DTM attending the fall AGU meeting were **Maud Boyet, Richard Carlson, James Cho, Lucy Flesch, Saad Haq, Alan Linde, Katie Kelley, Brian Savage, Paul Silver, Steve Shirey, Sean Solomon, Taka'aki Taira, Linda Warren,** and **Dayanthie Weeraratne.** Those from GL included **Razvan Caracas, Ron Cohen, Alexandre Corgne, Olga Degtyareva, Yingwei Fei, Stephen Gramsch, Eugene Gregoryanz, Russell Hemley, Steven Jacobsen, Shantanu Keshav, Jun-Fu Lin, Ho-kwang Mao,** and **Takuo Okuchi.**

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Shaun Hardy, Charles Hargrove, Jennifer Snyder, and **John Strom** represented the Carnegie Legacy Project at the 2004 Archives Fair at Washington's City Museum in Oct. Multimedia presentations and a literature display introduced visitors to Carnegie's rich history. The annual fair showcases archives and historical collections in the D.C. metropolitan area.

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Ann Mulfort returned to Broad Branch Road in Jan. as Legacy Project archivist, filling a position vacated by **Charles Hargrove.**

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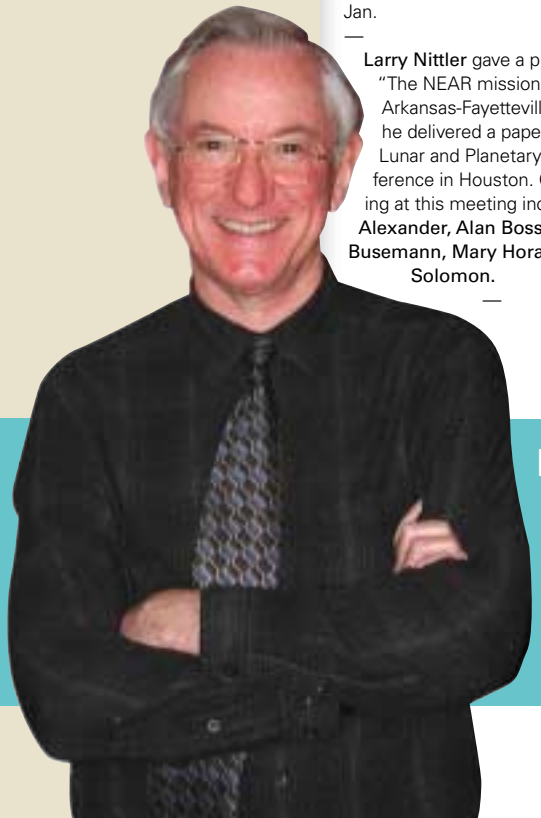
In Nov. **Shaun Hardy** attended the Geoscience Information Society annual meeting in Denver. ◐



Director Sean Solomon has been awarded the American Geophysical Union's 2005 Harry H. Hess Medal "for his outstanding and influential scientific achievements in planetary science, seismology, and marine tectonics." Among the former recipients of the Hess Medal is DTM Director Emeritus **George Wetherill,** who received the award in 1991.

Campaign for Science Reaches **75%** of Its Goal

The *Carnegie Campaign for Science* has raised $56 million of the $75 million campaign target. With more than a year left to raise the additional funds, one state-of-the art building has already been completed, a second is on the verge of occupancy, and a third is near groundbreaking. A variety of scientific instruments are already in design, and a newly endowed fellow will be joining the staff this summer.

"Our campaign goal is firmly in sight," stated Carnegie president Richard A. Meserve. "We can all see the future of the institution taking shape. Our new facilities, instruments, and support will allow our scientists to carry on the work that has put Carnegie on the cutting edge for more than a century."

Carnegie's environmental scientists moved into the new home for the Department of Global Ecology on the campus of Stanford University last spring. The building, constructed with a $1 million grant from the Packard Foundation and general campaign funds, has received glowing reviews. *R&D Magazine* gave the new Carnegie building a "special mention" in their national Laboratory of the Year award contest. The American Institute of Architects local chapter also gave the project top honors in its Energy and Sustainability category. Donations are still needed to create a dedicated endowment fund for the department.

The Maxine F. Singer Building, the new home for the Department of Embryology in Baltimore, is expected to be ready for the staff this summer. The Kresge Foundation awarded Carnegie a challenge grant of $1.5 million for the building, conditional upon the successful attainment of the $20 million goal for the project by July 1, 2005. "We are all optimistic about meeting the challenge," said Michael Gellert, chairman of Carnegie's board of trustees. "The Kresge Foundation has provided us a wonderful opportunity, and our supporters want to be part of this project. The Singer Building is symbolic of the kind of work our developmental biologists do and a fitting tribute to our former president Maxine Singer."

The Global Ecology building on the Stanford University campus. *(Image courtesy Wenqiang Tang.)*

The Vera Rubin Postdoctoral Fellowship Fund, newly established by a gift from Carnegie trustee Jaylee Mead, will begin supporting a young astronomer in fiscal year 2005-2006. Other campaign accomplishments will include new instruments for the Observatories' Baade and Clay telescopes and a prototype ground-layer adaptive optics system. Funds are also being sought to create new scientific staff positions in theoretical astrophysics. Seed money for the Giant Magellan Telescope project—a 24.5-meter optical telescope composed of seven 8.4-meter mirrors—is also needed.

The third and final construction project of the campaign is the transformation of the 80-year-old "Experiment Building" on the Broad Branch Road campus in Washington D.C., the home of both the Geophysical Laboratory and the Department of Terrestrial Magnetism. The building will be used for lectures and conferences and will house the historic "lunch club." It will be named the David Greenewalt Building in memory of the late trustee and longtime supporter. Approximately $1.5 million is still needed for this project.

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