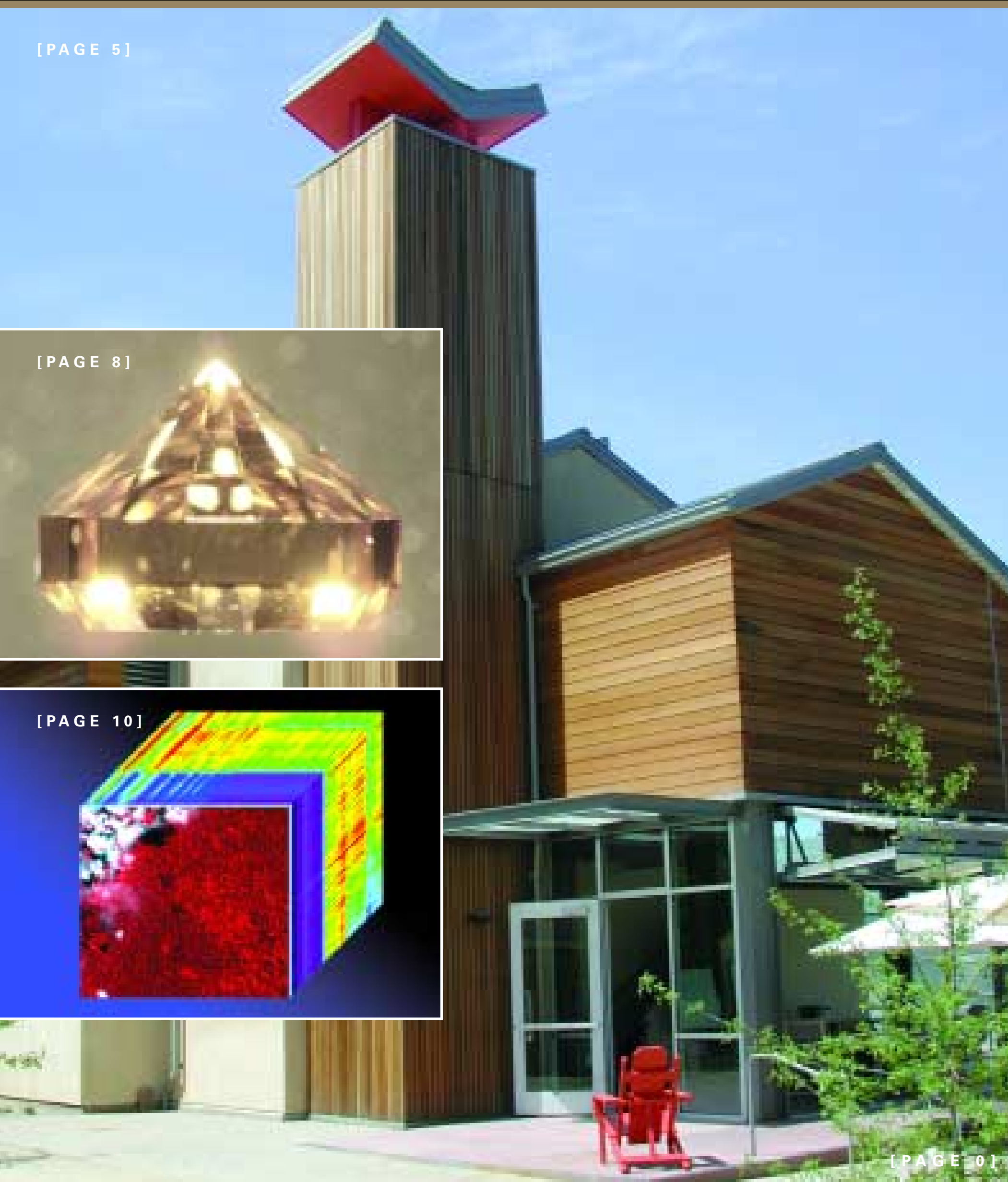
SPECTRA

THE NEWSLETTER OF THE CARNEGIE INSTITUTION (SUMMER 2004

New Horizons for Science



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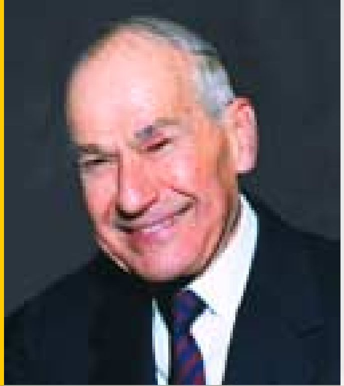

(Photo courtesy Richard Holden Photography.)

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During the successful visiting committee meetings at the Department of Embryology in May, I was struck by how well the Maxine F. Singer Building, under construction since 2003, is evolving into a first-rate biomedical research facility. Our state-of-the-art center on the Johns Hopkins campus, exciting by itself, has helped strengthen our century-old ties to the university and has garnered support from an expanding network of individuals around the country.

Even people who know Carnegie probably do not know that our connection to Baltimore began over 100 years ago in 1902 when Daniel Gilman, then president of the Johns Hopkins University, was appointed president of the newly formed Carnegie Institution. In 1914, the Department of Embryology was then founded in affiliation with the Department of Anatomy of the Hopkins School of Medicine. Through the decades, Carnegie's association with the university has been one of intense scientific collaboration and mutual enhancement. Today, young Hopkins scientists are trained at Embryology, Hopkins faculty work side by side with Carnegie researchers, and our staff members teach at the university. Many advancements in genetics and developmental biology have come from this dynamic union, and many of the scientists who have moved on to other universities and research labs, or who have founded their own companies, look back on their experience with Carnegie as a key to their success. Several of these individuals are now helping us broaden our support network.

A couple of examples illustrate how important the Carnegie experience can be. In 1979 Steven McKnight joined the Department of Embryology as staff associate; he became a staff member in 1984 and went on to cofound the biotechnology firm Tularik, Inc. in 1991. Later he joined the faculty at the University of Texas Southwestern Medical Center, where he is now chairman of the biochemistry department. He has actively maintained his connection to Carnegie throughout his career and in 2000 joined our board of trustees, where his unique experience is highly valued.

The other example also involves Dr. McKnight. In 1988 he invited Hopkins faculty member Peter Agre to spend his sabbatical year working in the McKnight lab. Fifteen years later, Agre was awarded the Nobel Prize for Chemistry for his discovery concerning water channels in cell membranes. Agre, another enthusiastic Carnegie alumnus, will be the featured speaker at a Carnegie Baltimore dinner this fall where civic leaders, philanthropists, and other guests will learn about Carnegie's catalytic role in stimulating research.

As the Maxine F. Singer Building moves toward completion in early 2005, the *Embryology Facility Fund* of *The Carnegie Campaign for Science* is gaining momentum. Last year the Kresge Foundation generously awarded Carnegie a $1.5 million challenge grant for the construction of the Singer Building. The grant requires that the institution raise an additional $7.2 million by July 1, 2005. Although we are making headway in meeting this challenge, a lot of work remains to be done. However, I am confident that our goal will be reached as our network broadens and more people learn about the important research conducted at the department and its role as a prominent training ground for the larger biomedical community. The Maxine F. Singer Building is destined to become a renowned center for the next generation of biomedical scientists.

—**Michael E. Gellert**, *Chairman*

Trustee News

Deborah Rose Elected Secretary to the Board

Deborah Rose was elected secretary to the Carnegie board of trustees at the board meeting held on Thursday, May 6, and Friday, May 7, at the administration building in Washington, D.C. Rose, a trustee since 2001, is an epidemiologist for the Division of Health Interview Statistics at the National Center for Health Statistics, Centers for Disease Control. She received her Ph.D. from the Yale University Department of Epidemiology and Public Health. Among her many affiliations she serves as vice chair of the board of directors, Dwight Hall, at Yale; she is a trustee of Yale's Jonathan Edwards Trust; she is a member of the Leadership Council, Harvard School of Public Health; and she is on the board of directors of the National Bonsai Foundation. Rose also holds memberships in the American Public Health Association and the Society for Epidemiologic Research.

Bruce Ferguson, a trustee since 1993, stepped down as Audit Committee chairman but will remain an active committee member and will continue to chair the Development Committee. Hatim Tyabji, a board member since 2002, will succeed Ferguson as chairman of the Audit Committee. Burton McMurtry was elected a senior Carnegie trustee. McMurtry was a member of the Finance and Research committees and has been on the board since 1996.

In addition to the full board, the Employee Affairs, Finance, and Development committees also met on Thursday. Later that day Sean Solomon, director of the Department of Terrestrial Magnetism (DTM) and principal investigator of the MESSENGER mission to Mercury, presented a talk to the board about the mission, which is due to launch this summer. That evening trustees and guests attended the Carnegie Evening lecture by DTM staff scientist Alan Boss.

On Friday, May 7, the Nominating Committee met followed by a meeting of the full board. Sara Seager, staff member at DTM, then presented a talk about characterizing extrasolar planets, concluding the sessions.

(Courtesy Stone Photography.)

Deborah Rose, the newly elected secretary to the Carnegie board of trustees.

(Image by Digital Art, courtesy NASA.)

(Artwork courtesy William K. Hartmann.)

"Planets are hard to find," stated Alan Boss as he introduced his engaging Carnegie Evening lecture, "The Search for New Solar Systems." An astrophysicist with the Department of Terrestrial Magnetism (DTM), Boss presented a comprehensive survey on the state of the science for detecting and analyzing planets outside our solar system.

His chronicle began with planet-hunting pioneer Peter van de Kamp, who, beginning in 1938, looked for telltale wobbles of nearby Barnard's star. Stellar wobbles, Boss explained, result from the gravitational tug exerted by a large orbiting body such as Jupiter. Although van de Kamp measured Barnard's wobble for 25 years, no evidence ever confirmed his claim that a giant planet was in orbit.

THE SEARCH FOR NEW SOLAR SYSTEMS

Carnegie Evening May 6, 2004

Despite this early beginning, Boss continued, the field of planet hunting did not take off until 1995, when the Swiss team of Michel Mayor and Didier Queloz first announced the detection of an extrasolar planet around Sun-like star 51 Pegasi. They found it by measuring stellar wobble using the Doppler method, which takes advantage of the observed shift in the spectrum detected from a moving object. As a star moves toward the Earth, the wavelengths shift to the shorter, blue end of the spectrum, and as it moves away they shift to longer, red wavelengths.

One of the surprises from the Swiss discovery, Boss said, was that the planet was extremely close to its parent star; it takes only 4.23 days to orbit. Several groups verified the find, including one co-led by Paul Butler of DTM using the precision Doppler velocity method.

Butler, with partner Geoffrey Marcy, had started looking for extrasolar planets in 1987. But, said Boss, they had expected such objects to have orbital periods on par with Jupiter's—about 12 years. With the Swiss find, the two sifted through their accumulated data to look for evidence of shorter-period planets, and the explosion of "exoplanet" planet discoveries began. Currently there are over 100 of these bodies confirmed, and most have been found by the Butler/Marcy team.

Boss stated that presently there are three techniques used to find exoplanets. Each is an indirect method, and all are limited to detecting large, Jupiter- and Saturn-massed objects. In addition to the Doppler method, there is the transit method and, most recently, a technique using gravitational microlensing.

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The transit method detects a planet as it crosses the bright face of its star, causing the star to blink. This method has an added advantage—spectral information can be obtained about the planet, which can then be used to learn more about it, including its atmospheric composition. DTM's Sara Seager's prediction of sodium in an exoplanet atmosphere was borne out with observations using this method, Boss said.

The first planet discovery made using the microlensing technique was recently announced by a team of Polish astronomers at the Warsaw University telescope at Carnegie's Las Campanas Observatory. This technique relies on a lensing or magnifying effect that comes from the bending of space by the mass of a foreground object in front of a background object. In this case, a planet and its companion star both affected the background star's brightness. One advantage of this technique is that it may be able to find objects of lower mass than that of Jupiter.

Most of the planetary systems thus far found are very different from our own solar system, with its orderly orbits on nearly the same plane. And these new cases have brought greater

Alan Boss gives the Carnegie Evening lecture on May 6, 2004.

(Image courtesy Margot Schulman.)

attention to the question of just how planets form. Boss, a planetary- and stellar-formation theorist, described the traditional model of planet formation via core accretion and a more recent model, which he champions, the disk instability theory.

Core accretion is just as it sounds: small bodies of ice and rock gradually accumulate to form a massive, solid planetary core, which eventually gains a gaseous atmosphere. The theory is riddled with problems, not the least of which is that it takes longer to form a protoplanet than the lifetime of typical planet-forming disks.

"There has to be a faster way," declared Boss, who then talked about his work. Using a suite of fast computers, Boss models the transport of mass and angular momentum in planet-forming disks. The models show that spiral arm features tend to intersect and form dense, self-gravitating clumps with masses similar to that of Jupiter. This formation process is fast enough to create gas giant planets in even the shortest-lived planetary disks—a clump could form in as little as 1,000 years.

Boss, DTM director emeritus George Wetherill, and postdoctoral fellow Nader Haghighipour recently extended the disk instability concept to include the formation of ice giant planets, similar to Uranus and Neptune. These bodies could form via disk instability in a disk that is evaporated by strong ultraviolet (UV) light from a nearby massive star. The radiation would strip the gas from the outermost gas giants, turning them into ice giants.

Boss then described the work of other planetary-formation theorists including that of the newest DTM staff member, John Chambers, who looks at the effect of the formation of a Jupiter-massed object on forming Earth-like planets in addition to other aspects of habitable planet formation.

After giving his summary of current ground-based projects dedicated to exoplanet research—including his own using the du Pont telescope at Las Campanas—Boss talked about the advantages of planned space-based efforts to look for smaller, Earth-like planets. Among the upcoming missions he described were NASA's Kepler Mission, scheduled for launch in 2007, which will look for planets using the transit method; the Space Interferometry Mission, scheduled for launch in 2010, to detect stellar wobbles; and the Terrestrial Planet Finder Mission, which will blast off around 2014 and will finally be able to see these far-off worlds optically.

Boss concluded his lecture by thanking Carnegie for supporting his work over the years. He expressed particular appreciation for his association with longtime colleague at DTM George Wetherill.

(The Boss talk can be viewed in its entirety at http: //www.carnegieinstitution.org/boss_carn_even.html/.)

A Building That Proclaims Its Mission

The Global Ecology building features north-south windows designed to reduce heat buildup. It also takes advantage of natural cooling. The cooling tower captures breezes, humidifies the air, and funnels the cooled air into the indoor/outdoor lobby area.

At every turn one can find a resource-saving surprise at Global Ecology's new building. The redwood siding is crafted from old wine vats; desks and worktables are fashioned from former doors; a wind catcher is used in the cooling system; salvaged faucets are installed as lab fixtures; and conference-room furniture is constructed from fallen urban trees. These are just some of the features that make the handsome new Global Ecology building emblematic of the department's mission toward enhancing a sustainable future. It is estimated that the 11,000-square-foot research center will use only 57% of the energy consumed by similar, standard structures and release only one-quarter of the carbon.

"It is a well-articulated vision of what the building should be," said chairman of the Carnegie board of trustees Michael Gellert, who spoke at the building's dedication ceremony. The "green" building made its debut on April 12, 2004, at Stanford University, where the Department of Global Ecology shares a 7.4-acre campus with the Department of Plant Biology. About 100 Carnegie researchers, trustees, friends, and colleagues attended the event.

Department director Chris Field presided over the dedication, which was preceded by a symposium on the research to date at the department. Donald Kennedy, president emeritus of Stanford and editor in chief of *Science* magazine, was the ceremony's first speaker. He talked about the origins of the new department under the direction of Carnegie president emerita Maxine Singer, how important Carnegie is to Stanford, and how the mission of the new department converges with other new environmental initiatives at the university. Sharon Long, dean of Stanford's School of Humanities and Sciences, began with a personal thanks to Carnegie—a Plant Biology seminar that she attended years ago led to her job at Stanford, she said. She then reiterated the importance of the long-term relationship between Carnegie and the university.

Michael Gellert followed by congratulating the architects, construction team, and Carnegie staff who were involved in the creative thinking and planning for the "remarkable new facility." After a statement by Carnegie president Richard Meserve on the importance of the structure and the department, Chris Field, in keeping with the "greenness" of the building, presented him with gardening shears for the ribbon cutting. Inviting Gellert and Field to participate, Meserve led the trio to cut an appropriately colored green ribbon around the indoor/outdoor lobby. Building tours and a reception followed.

What Makes a "Green" Building Green?

The Global Ecology building was designed by EHDD of San Francisco and constructed by DPR Construction. Maximizing energy efficiency and minimizing waste were the guiding principles of the project. The building was planned to accommodate the needs of its two major areas: the high-energy-consuming labs and the lower-energy-consuming offices and related spaces. The second-floor office area is ventilated exclusively by nature; heat-

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Carnegie staff and guests gather to dedicate the new Global Ecology building on April 12, 2004. The bifold windows are open, turning the lobby area into a porch.

reflecting coatings are used throughout the facility; and, where new wood is used, it is U.S. certified sustainably harvested. In addition to the overall increased energy efficiency of the building, the water-miserly bathrooms and cooling system and the landscaping with all-native, drought-resistant plants reduce water consumption by 40% over typical structures.

Nature-Assisted Cooling

Several techniques have been employed to reduce energy expenditure on lighting and cooling, both of which require a lot of energy. First of all, the dimensions and orientation of the facility work in favor of conservation. The structure is long and narrow and is oriented on an east-west axis, with windows on the north and south sides. Direct sunlight is a particular villain in warm weather because it heats the building, which in turn requires cooling. To reduce the amount of heat absorbed, windows and sunshades were specially designed to keep direct light out while admitting indirect light, thus also reducing the dependence on electrical illumination.

In addition to natural ventilation, the building also has a cooling system that takes advantage of Mother Nature. In warm weather, water is sprayed over the roof at night. After it cools naturally to 55°-60°F, it is collected in an insulated tank. The cooled water is then pumped through the building via tubing installed in the floors and ceiling panels and is conveyed to the forced-air system in the labs. A larger-than-normal duct system lowers the amount of energy needed by the fans to move the air. This system design reduces water consumption by about half that required by a standard system and limits the need to use a chiller to condition the air to only the very hottest days.

The lower lobby is an indoor/outdoor space. Open the large bifold windows, and it becomes a porch. A cooling tower augments temperature control for this area. At the top of the tower, a wind catcher snags a breeze, then funnels it down the tower and into the lobby. As the air flows through the tower, a fine mist is sprayed, humidifying and cooling the air.

Heating Less Gives More

By heating water to 110°F instead of the standard, higher temperature of 180°F, the high-efficiency condensing gas boiler operates at 93% efficiency—a 13% increase over normal systems. Once heated, the water is pumped through the floor and ceiling tubing to produce radiant heat in the office areas, and is channeled to the forced-air system in the labs.

Outside air is circulated through the labs. To capitalize on already heated air, the system captures it, then redirects it through a heat exchanger to condition the next incoming wave of fresh air.

An Example to Follow

These and myriad other features make the Global Ecology building truly innovative, and its novelty has caught the eye of the Stanford community. The *Stanford Report*, the *Stanford Daily*, and the *Mercury News* each described the research center as an example to follow. "The building," stated the *Daily*, "is a monument to forward-thinking construction and design." Built to last 100 years, the Department of Global Ecology now has a sustainable home that proclaims its mission and is a testament to the Carnegie tradition of pioneering uncharted territory for the benefit of humankind. •

Carnegie president Richard Meserve prepares to cut the green ribbon with garden shears.

Star Plates: An Enduring Legacy

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The archive of thousands of historic and irreplaceable photographic and spectroscopic plates—the basis for much of 20th century astronomical discovery—is being expanded in the Carnegie Observatories plate vaults in Pasadena, where the artifacts have been stored for many years. These remarkable plates will eventually be available to astronomers and the public on the Carnegie Web site. The work is supported in part by the Ahmanson Foundation, which recently awarded Carnegie a $150,000 grant for archiving and preserving the plates as an important historic resource.

Astronomical plates record light that travels across the universe to Earth from a given celestial object. They contain information about the object's distance and velocity and other important data.

The Observatories' plates document observations from dozens of telescopes around the world over the past century. Two years ago, researchers began the painstaking process of archiving and preserving the most significant and useful plates in the collection. Called The Star Plates Archival Project, the effort is expected to cost about $300,000 over four years. The work will help upgrade and catalog into a database the existing plate archive to make it more readily accessible online. The Ahmanson grant will be used to create the computer database, which will contain all the known information about each plate coupled with a scanned image.

The Carnegie plate collection includes work by such distinguished astronomers as Alfred Joy, Milton Humason, Edwin Hubble, Walter Baade, and Allan Sandage. Among the most prized plates are those used by Hubble and Humason in the discovery of the expanding universe, by Walter Baade to understand and define stellar populations, and by many other astronomers to understand stellar evolution and age.

Work on the project is being carried out by George Carlson, a retired astronomy professor, and Donna Kirkpatrick, a former science instructor and librarian. Since June 2002, they have worked under the direction of staff member emeritus Allan Sandage to stabilize, organize, and catalog the objects.

Out and About at **the Observatories**

(Above left) Carnegie's Steve Shectman answers questions about large telescopes after his March 30 talk at the Huntington Library.

(Above right) Staff astronomer John Mulchaey works with third graders at Longfellow Elementary to construct solar system models.

Huntington Lectures a Huge Success

Each of the Observatories spring lectures, held at the Huntington Library in San Marino, California, drew a large and enthusiastic crowd. In March, Carnegie staff astronomer Steve Shectman spoke about building large telescopes. Patrick McCarthy lectured on the birth of galaxies in early April, followed by George Preston, who spoke on the biological aspects of stardust in late April. The final lecture on May 11, by Michael Gladders, was a cosmological look through time.

Adopting Longfellow Elementary

The Observatories has formally adopted neighboring Longfellow Elementary School in Pasadena. Part of this effort is to develop a "discovery room," which will be dedicated to science. Staff astronomer John Mulchaey is organizing the project. The Pasadena Society has generously donated funds to help update the room, which will be ready for a fall dedication. Thus far Mulchaey has purchased an interactive whiteboard, computers, posters, globes, and other assorted science supplies.

Mulchaey is also working with the third and fifth graders on astronomy projects. The third graders built solar system models, and the fifth grade will "create an alien." Fellows Jeremy Darling and Marla Geha helped Mulchaey with these projects.

About 100 kids and parents attended an Observatories-hosted star party on April 23, at which they looked at Venus, Mars, Saturn, and Jupiter through small telescopes.

Symposium Honoring Horace Babcock

Some 75 people gathered at Caltech's Beckman Institute Auditorium on May 21 for an all-day symposium honoring Horace Babcock for his contributions to astronomy and to the Carnegie Institution. The presentations followed welcoming remarks by Observatories director Wendy Freedman. Donald Osterbrock (UCSC) spoke about Babcock's early years, and George Preston of the Observatories discussed the importance of Babcock's contributions to the understanding of stellar magnetism. Robert Howard, former Carnegie staff member, described Babcock's influence on solar physics. Carnegie's Patrick McCarthy talked about Babcock's role in adaptive optics—a discipline that is playing a prominent role in the design of future large telescopes.

After lunch the talks turned to Babcock's role in championing the Las Campanas Observatory. Arthur Vaughan, a former Carnegie staff member who recently retired from the Jet Propulsion Laboratory, recalled Babcock's site testing, acquisition of the Las Campanas land, and stewardship of the designs of the Swope and du Pont telescopes. Robert Hoggan, a structural engineer on the telescope projects, described the mountain surveys and the travails of the early engineering trips to Chile. Robert Brucato, the first manager of scientific operations, spoke of his experiences in devising operating procedures and training the first generation of support personnel.

The final speaker was the renowned Guido Munch, who recounted his discussions with Babcock about sundry astronomical experiments and instrumentation.

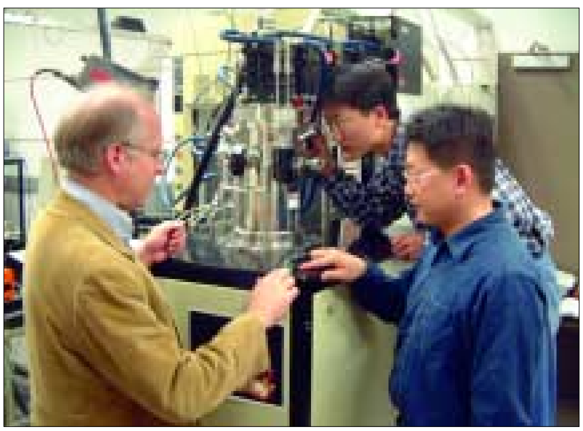
Following the symposium, Director Wendy Freedman hosted an elegant dinner for the speakers and honored guests, including members of the Babcock family, Caltech faculty, Carnegie staff, and distinguished visitors.

It's Raining Gems: Large Ultrahard Diamonds Made Super Fast at GL

"Not only were the diamonds so hard they broke the measuring equipment, we were able to grow gem-size crystals in about a day," stated Chih-Shiue Yan of Carnegie's Geophysical Laboratory (GL). Yan is the lead author of a study published in the February 20, 2004, online *Physica Status Solidi,* which reported on his group's production of gem-size diamonds that are harder than any other crystals. The diamonds were grown directly from a gas mixture by the chemical vapor deposition (CVD) process at a rate that is up to 100 times faster than other methods used to date.

Producing a material that is harder than natural diamond has been a goal of materials science for decades. Now the GL group has figured out how to do it as a by-product of its principal goal—to create the next generation of high-pressure devices based on large single-crystal diamond anvils grown by CVD. "Making diamonds has not been the primary purpose of our research," explained Russell Hemley of GL's high-pressure group. "Our team is interested in the behavior of materials at extreme pressures and temperatures. We need large, perfectly faceted diamond crystals to create new devices and therefore decided to explore whether we could make these crystals by CVD processes." The group's first single-crystal diamonds were produced in 1998. Now the crystals can be used to exert extreme pressures (pressures at least as high as those exerted by natural diamonds, so far up to 200 GPa—almost 2 million times the pressure at sea level). The small team leads the world in producing large single-crystal diamonds by CVD.

More than seven years ago, interest in the CVD process led Hemley and GL's Dave Mao to join forces with Professor Yogesh Vohra at the University of Alabama, Birmingham (UAB), where Yan was a graduate student. Yan subsequently came to Carnegie in 2002 as a postdoctoral fellow. Yu-Chun (Brad) Chen, a Ph.D. student at Auburn University interested in using the diamonds for engineering purposes, also joined the GL diamond-making project after meeting Yan at a conference in 2001.



▲ The CVD diamond-making team at GL stands with its one-of-a-kind diamond maker. Staff member Russell Hemley (left), Brad Chen (middle), and Chih-Shiue Yan (right) are examining the chamber where the diamonds grow.

The group's recently acquired ability to make these ultrahard crystals very fast has opened up an entirely new way of producing single-crystal diamonds for a variety of applications. Beyond romance, diamonds are appealing for their extraordinary strength, transparency, insulating, and thermal powers. Different types of diamonds are sought after to use as electronics semiconductors, cutting tools, and for other purposes. The team's work will likely benefit many such applications.

Two Roads to Synthetic Diamonds

The traditional means for making the hardest of gems is to mimic nature by subjecting carbon to high pressures and temperatures. This approach has been around for decades and in fact has been used at GL, but it is limited to producing generally very small diamonds. Very special processes are required to create single crystals as large as several carats. It is the goal of Carnegie's CVD group to produce diamonds in the 10-carat range, and ultimately as large as 100 carats, for scientific and technological applications—most immediately for high-pressure experiments. Producing diamonds this big can only be done by chemical vapor deposition.

Besides producing larger diamonds, the CVD process has other advantages. It is highly flexible and can more easily control impurities in the crystal. Impurities in diamonds are important. They are responsible for

▶ This CVD diamond is fresh out of the growth chamber; it has not yet been polished. It is about 5 x 5 x 2.7 mm^3. The original seed, approximately 1.5 mm thick, is underneath. The crystal was grown in about 12 hours.

their color, strength, and other properties. The strongest diamonds are transparent and impurity-free. But a diamond needed for semiconducting, for example, needs a dash of boron, or another so-called dopant, to transform the material from an insulator into a semiconductor. The CVD process also permits the production of diamonds with a variety of shapes, with electrical or magnetic circuits embedded in them, and micromechanical devices made of the material.

Sow Seed, Add Gas, and Heat

The Carnegie researchers grow the crystals using a special apparatus and process they developed. The apparatus has several parts—a cylindrical chamber where a flat, synthetic seed diamond, typically 4 millimeters (mm) x 4 mm x 1.5 mm, is placed; a standard microwave; and an infrared detector for determining the temperature inside the growing chamber. The device has two unique features—a special holder for the seed diamond and the infrared temperature gauge. Patent applications have been filed in the U.S. and in a number of other countries for this one-of-a-kind diamond maker.

Once the seed is placed in the chamber, the microwave is turned on and a mixture of methane, nitrogen, and hydrogen gas flows into the unit. The gas is bombarded with charged particles, or plasma, generated by the microwave, which prompts a complex chemical reaction resulting in a "carbon rain" that falls on the seed. The carbon atoms then arrange themselves in the same crystalline structure as the seed. Using this method, the group has grown single crystals of diamonds up to 8 millimeters across and up to 4.5 millimeters thick. Soon it will also start growing its own seed stock.

The crystals are then subjected to high temperatures and pressures, which further harden the material. Although this annealing process has been used on synthetic diamonds made by high-pressure, high-temperature processes, the Carnegie scientists are the first to anneal single-crystal diamonds made by CVD. The diamonds, annealed off-site, are heated to 2000°C and put under pressures of between 50,000 and 70,000 times atmospheric pressure (5-7 GPa) for 10 minutes. This final process renders the diamonds at least 50% harder than conventional crystals, as measured by collaborators at Los Alamos National Laboratory. "These diamonds are real diamonds made of carbon and identical in structure to those formed in nature and by high-pressure and high-temperature methods," Yan emphasized.

▲ To polish a diamond destined for characterization studies, a new crystal is placed in the gem holder and diamond powder is sprinkled onto the polishing wheel. The diamond is maneuvered to a specific position for the desired surface and the wheel is turned on. The researcher checks the progress about every 30 minutes by examining the diamond with a jeweler's loupe. When the surface looks good, the crystal is further examined under a microscope to determine its smoothness.

(Image courtesy *Physica Status Solidi* http://www.pss-rapid.com/.)

◄ This synthetic brilliant-cut single-crystal diamond, grown by chemical vapor deposition (CVD), is 2.5 mm high and was made in about one day at Carnegie.

Cut 'n' Polish

The group uses several methods to cut and polish the diamonds. One method is for diamonds needed for the diamond-anvil cell. Another is for making diamond plates or windows. Diamonds used for characterization studies also require cutting and polishing.

Crystals destined for the diamond-anvil cell have to be more precisely cut and polished (e.g., faceted) than diamonds intended for jewelry so that they can withstand maximum pressures at the tips without fracturing during experiments. Appropriately, these gems are sent to a variety of highly skilled diamond cutters in New York and Europe. It takes much longer to cut and polish a CVD single crystal than a mined diamond because CVD gems are much tougher. Yan and Chen polish crystals that are used for analysis and characterization at GL.

World Standing

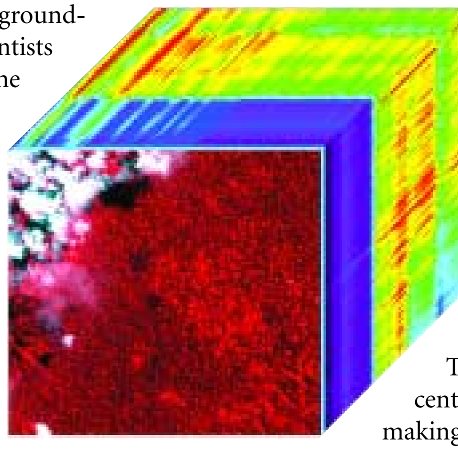
This small cadre of GL scientists, which is smaller than any other such group, leads the world in the development of the biggest, strongest, and fastest-growing CVD single-crystal diamonds yet produced. Its accomplishments have come from systematic hard work and Carnegie's long-term commitment to the project. Not surprisingly, word of its results has prompted a flurry of interest in the diamond industry. But despite such distractions, the team is tightly focused on its goal: to produce very large single-crystal diamonds for science and technology. This effort will allow the investigators to maintain their leadership in high-pressure, high-temperature research in materials science, planetary science, and fundamental physics.

This research was supported by the National Science Foundation, the U.S. Department of Energy through the Carnegie/DOE Alliance Center (CDAC), the W. M. Keck Foundation, and the G. Unger Vetlesen Foundation. It was conducted in collaboration with researchers at the Phoenix Crystal Corporation and Los Alamos National Laboratory.

Amazon Drought Now Measured from Space

"Understanding the Amazon environment is an essential puzzle piece needed to understand how the biosphere interacts with the climate system."

Using a unique combination of ground-based and space-based tools, scientists have determined for the first time how drought conditions, and possibly carbon uptake, in the Amazon rain forest can be quantified over large forest areas from space. The results were published in the online early edition of the *Proceedings of the National Academy of Sciences*, April 5-9.



This "data cube" from the EO-1 satellite shows the Amazon forest canopy in the near-infrared on the front of the cube. Uniquely, the shortwave spectrum of every pixel is also shown, in the "z direction." The red on the front indicates the intensity of near-infrared radiation scattering, which is related to the water content of the forest canopy. Each pixel of the image contains a spectral signature that the scientists are analyzing for water, pigments, nitrogen, and other constituents.

(Data courtesy NASA; processing and analysis done at Carnegie.)

"Understanding the Amazon environment is an essential puzzle piece needed to understand how the biosphere interacts with the climate system," said lead author Gregory Asner of Carnegie's Department of Global Ecology. "The Amazon is simply too big and complex to study on the ground alone," he continued. "Thus far it's been impossible to determine some of the most basic properties of the forest that we need in order to understand what happens during common climatic events—such as the El Niño dry periods—and what that means to forest growth and the amount of carbon that is locked up in the forest via photosynthesis. Without these measurements we will fall short in understanding how large a role tropical forests play in mediating the effects of fossil-fuel emissions from human activities."

Amazonia, the world's largest rain forest, experiences a big range in rainfall from the rainy to the dry season and during global climatic events such as El Niño. The amount of precipitation affects forest dynamics, land use, and fire susceptibility. To evaluate drought conditions the researchers conducted the first forest canopy experiment in the region. They covered over 10,000 square meters of the central Brazilian Amazon forest with plastic, making a "drydown" site, and then measured rainfall, soil moisture, and leaf and canopy characteristics over time. They coupled these data with data obtained by the NASA Earth Observing-1 (EO-1) satellite launched in November 2000, which uses a new space-based technology called imaging spectroscopy. They found that the spectra collected by the satellite from reflected sunlight correlates with on-ground measurements indicating a decrease in soil water and dehydrated leaves.

"The fact that we confirmed that satellite imaging can be used to measure something as detailed as the physiology of the rain forest canopy means that this technique might be useful for understanding other types of ecological phenomena at both large and small scales," Asner remarked. "We believe that space-based technology like this is the wave of the future for analyzing our planet," he concluded.

This study was supported by NASA, the Mellon Foundation, and the Carnegie Institution.

DTM's Alycia Weinberger is with students at the Sally Ride Science Festival produced by Imaginary Lines. The organization is dedicated to supporting middle school girls interested in science careers.

ALYCIA WEINBERGER

Leads Workshop at Sally Ride Science Festival By Jenét Dechary

DTM astrophysicist Alycia Weinberger has been constructing amateur spectrographs most of her life. On Saturday, April 17, assisted by Carnegie research fellow Saavik Ford, she shared her rainbow-making process with more than 40 middle school girls in two hands-on workshops at the Sally Ride Science Festival at George Mason University in Fairfax, Virginia.

Under Weinberger's guidance, the girls made their instruments, then tested them by peering through them at sunlight and fluorescent light. Weinberger brings tinfoil, tape, diffraction grating, cardboard tubes, and her passion for astronomy to workshops often. "All kids need a spark to keep them interested. I like engaging children's natural curiosity," she said. And girls in Weinberger's workshops go away with more than a spectrograph; they see a woman scientist in action. Weinberger reflected, "It's good to catch girls at a transition age so they can see women are scientists, and carry away the picture of women doing science."

Weinberger has her own role models. "Vera Rubin had a large influence on me," she said. "She was the first woman astronomer I met. She cares passionately about advancing women in science. I care about it, too."

Tissue Cells Can Revert to Stem Cells

Scientists at Carnegie's Department of Embryology in Baltimore have found that certain cells involved in egg development in the fruit fly can be stimulated to revert to fully functioning stem cells. "This finding could lead to new sources of stem cells from other tissues and other animals," said Allan Spradling, director of the department and coauthor of the study published in the March 14 online issue of *Nature*.

The research conducted by Spradling and colleague Toshie Kai involved so-called germline stem cells of the female fruit fly. These cells are precursors to eggs and begin their journey as stem cells living in a special environment called a niche. In the niche, a stem cell splits into two daughter cells, one of which leaves the niche to begin its transformation. Through a series of four divisions a cluster of 16 cells forms—an immature egg with 15 accompanying nurse cells. The researchers discovered that the cells in clusters of 4 and 8 cells can still return to the stem-cell state under appropriate conditions. Moreover, the reverted stem cells worked as well as normal stem cells. Flies with only reverted stem cells were as fertile as normal flies throughout adult life.

"For most stem cells, it has not been possible yet to determine how quickly their progeny cells lose the ability to function again as stem cells," Spradling noted. "In the fruit fly (*Drosophila*) ovary we could directly test this and found conditions where the cluster cells reverted to a stem-cell state and functioned throughout the entire life of the adult." However, cautioned Kai, "We don't know yet if this will be a general result that applies to other stem cells. The progeny of germline stem cells might develop relatively slowly compared with other stem cell progeny, and thus retain their 'stemness' longer."

The scientists made their discovery by placing the cell clusters in an unusual environment, the immature ovary of a developing *Drosophila* larva. "We think that two factors present in the larval ovary may have helped cause the cells to revert back to stem cells," Kai said. "First, the larval ovary has an abundant supply of the fruit fly protein that is analogous to a protein (BMP4) involved in germ-cell development in developing mammalian embryos. It is required by fruit fly germline stem cells and maintains them in the niche. Second, the cells in the larval ovary are unlikely to block reversion, in contrast to the cells that cluster cells encounter normally." Providing the proper conditions for reversion is likely to be a major issue in future attempts to change differentiating cells back into stem cells.

"Differentiated or partially differentiated cells are much more common in the body than stem cells," Spradling explained. "So harnessing them could be a valuable strategy in efforts to enhance tissue repair. Some animals that can regenerate lost parts seem to utilize differentiated cells as a source of progenitors, and not just preexisting stem cells. We are very excited about what further studies in the fruit fly and other animals might show us," he concluded.

(Photo courtesy Russell Hemley.)

Pioneering **Extreme** Science

One of the Geophysical Laboratory's (GL) greatest scientists from the early part of the last century was honored on April 30 in Edinburgh, Scotland. The Centre for Science at Extreme Conditions at the University of Edinburgh dedicated a new facility named in honor of the pioneering researcher Erskine Williamson. Russell Hemley, staff member at GL, was a featured speaker at the opening ceremony.

Hemley talked about Williamson's groundbreaking work, which helped make the science of extreme conditions what it is today. Williamson joined the fledgling Carnegie Institution's Geophysical Lab in 1914, and in just nine years, before his death in 1923, he made a major impact in a variety of areas. Among his most notable achievements was the first high-pressure experimentation on a series of materials to measure electrical conductivity, elasticity, viscosity, and compressibility. His last paper, "Density distribution in the Earth," was his most famous. It contained classic calculations to determine the pressure-density distribution of a self-gravitating body.

A new building at the Centre for Science at Extreme Conditions at the University of Edinburgh was named for Geophysical Laboratory (GL) great Erskine Williamson. The facility was dedicated in a ceremony on April 30 that featured remarks by GL's Russell Hemley. Williamson's portrait was etched onto the interior glass of the center.

IN Brief

Trustees and Administration

Trustee **Burton McMurtry** has been elected chairman of the Stanford U. board of trustees.

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David Swensen, chairman of the Finance Committee, was elected a trustee of the Teachers Insurance and Annuity Association.

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President **Richard Meserve** delivered the Rose lecture at MIT on Apr. 28 and the Jones Seminar at Dartmouth College on May 28. Both talks were on nuclear power in an age of terrorism.

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The National Academies asked **Meserve** to serve on a committee to ensure the best presidential and federal advisory committee appointments. Other committee members include Carnegie trustees **Edward E. David** and **Frank Press**. The committee will provide advice concerning the recruitment of exceptionally able scientists and engineers to fill the most important science and technology leadership positions.

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The Carnegie Academy for Science Education (CASE) Summer Institute was held at P Street June 28-July 23. CASE accepted 40 elementary teachers from D.C. Public Schools (DCPS) and, for the first time, D.C. charter schools. CASE also ran a science and literacy summer school program with In2Books at two D.C. elementary schools. The Center for Artistry in Teaching held its summer workshops for teachers at P Street as part of a partnership with CASE that is hoped to lead to a professional development center.

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Julie Edmonds of CASE will attend the MESSENGER launch as part of the education component of the project.

Embryology

Staff associate **Jim Wilhelm** presented a talk, "Coupling of *oskar* mRNA Localization and Translational Control by the eIF4E Binding Protein Cup," at the 45th Annual *Drosophila* Research Conference in Washington, D.C., Mar. 26.

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Staff associate **Alex Schreiber** spoke on "Bones, Brains, and Behavior: a Flounder's Asymmetric Perspective on Development" at Johns Hopkins U. annual Center for Talented Youth symposium, for middle and high school students.

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Johns Hopkins U. undergraduates **Melissa Lee** and **Cindy Wang** joined the Schreiber lab to study flatfish craniofacial and neural development during metamorphosis. **Arnau Villalbi i Espinos**, a Park High School senior and exchange student from Spain, is doing an internship studying the mechanism of eye migration during flatfish metamorphosis. **Yan Tan** will be lab technician and is identifying thyroid hormone-responsive genes regulated during flatfish metamorphosis. **Aja Campbell** joined the lab as a fish technician.

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Queenie Vong joins the Yixian Zheng lab. Vong plans to study how p97-Ufd1-Npl4 regulates chromosome segregation in mitosis. Also joining the lab are **Liang Liang**, who will study spindle assembly, and **Shilpa Metha**, who is interested in understanding the mechanism of G-protein regulated spindle assembly.

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Postdoctoral fellow **Joshua Gamse**, in Marnie Halpern's lab, married Stephanie Shapiro on May 30 in Boston.

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Cynthia Wagner joined Judy Yanowitz's lab in May as a research scientist. She most recently taught biology at Goucher College and comes to the lab to study the effects of chromatin on meiotic recombination.

Geophysical Laboratory

Wes Huntress was a panelist in a Centennial of Flight Commission event on the next century of flight in space and participated in a second National Research Council workshop in Feb., responding to President Bush's new initiative on space exploration.

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In Mar. staff member **George Cody** presented an invited talk at the George A. Olah Award symposium honoring Michael Siskin at the American Chemical Society annual meeting. **Elena Chung**, a summer intern in Cody's laboratory, was named a semifinalist in the Intel Science Talent Search competition.

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Ronald Cohen organized a workshop on computational geoinformatics in Washington at the Radisson Barcelo on May 2-4 (see http://www.gl.ciw.edu/~cohen/meetings/geoinf2004/). There were about 45 participants in the solid Earth geosciences. The group convened at the request of the Division of Earth Sciences at NSF. Five groups made presentations and discussed hardware, software, visualization and large-scale data analysis, network and grid computing, and scientific frontiers. They decided to pursue three fronts: to improve access to high-end computing in the short term; to plan for Web services to provide high-end computation, software, and visualization services; and to push for a large-scale computational facility for solid Earth sciences. The group plans to establish a nonprofit organization called Center for Solid Earth Computation and elected Cohen from Carnegie and Geoffrey Fox from Indiana U. as cochairs.

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Russell Hemley was interviewed on two *Science Update* radio shows: one on Apr. 8, about diamonds, and the other on Apr. 14, about iron in the Earth's interior. The shows can be heard at http://www.scienceupdate.com. On Apr. 22 he presented a talk, "Diamond Windows on a New Science," at the Division of Earth Sciences of the Geoscience Directorate of NSF in recognition of Earth Day.

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Jennifer L. Eigenbrode (Penn State U.) has been appointed a Carnegie and NAI postdoctoral fellow. Her interests lie in the organic, stable isotopic, and sedimentologic records of microbial ecosystems and the evolution of the Precambrian biosphere.

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Penny L. Morrill (U. Toronto) has been appointed a Carnegie and NAI postdoctoral fellow. Her thesis topic is determining the extent of chlorinated ethane degradation in groundwater systems during bioremediation using stable carbon compound specific isotope analysis.

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Razvan Caracas (U. Minnesota) has been appointed a Carnegie postdoctoral fellow. He is well known in the field of electronic structure calculations.

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Mathieu Roskoz (CRPG, CNRS, Nancy, France) has been appointed a Carnegie postdoctoral fellow. He will study the crystallization of silicate melts just above their glass transition.

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Heather C. Watson (RPI) has been appointed a Carnegie postdoctoral fellow. Her research involves oxygen diffusion in Al-bearing perovskites.

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In Apr. **James Hall**, Carnegie postdoc-

Carnegie president emerita Maxine Singer

Minisymposium in Honor of Maxine Singer

The Department of Embryology hosted its 26th annual minisymposium on April 22 and 23. The symposium, titled "Evolution," was held in honor of Carnegie president emerita Maxine Singer. A generous contribution by the Carnegie Corporation of New York helped support the session.

Department director Allan Spradling kicked off the event Thursday evening with opening remarks and an introduction to keynote speaker Sean Carroll, Howard Hughes Medical Institute investigator at the University of Wisconsin-Madison.

Carroll's talk, "Molecular Genetics and the Evolution of Animal Form," discussed current trends in evolutionary developmental biology. This field, known as evo-devo, unites two disciplines and studies the evolutionary changes of species form over time and the genetic mechanisms that control the growth and development of individual organisms. The goal is to understand what processes are behind changes in body patterning and shape. A dinner at the Inn at The Colonnade followed Carroll's talk. The symposium continued on Friday with seven other presentations.

❶ Devaki Bhaya and Arthur Grossman took their daughter, Ilina, with them during their trip to China's Beijing and Zhengzhou universities.

toral fellow, accepted a position in Houston at ExxonMobil.

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Takuo Okuchi, an assistant professor from U. Nagoya, has been appointed visiting scientist. Okuchi is an outstanding researcher in high-pressure science in Japan. He will be working with George Cody, Rus Hemley, Dave Mao, Viktor Struzhkin, and others to further develop high-pressure NMR spectroscopy.

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On Mar. 30 **Sung Keun** welcomed son Min Ghee. Hannah Sakura Ono was born to **Shuhei Ono** on Mar. 31.

Global Ecology

Chris Field was among the signatories of a letter written by scientists and religious leaders about the need for action on global climate change. It was reported in the May 19 *Wall Street Journal*.

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Yingping Wang of CSIRO Atmospheric Research in Melbourne, Australia, was a visiting investigator in the Field lab in May.

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Alison Appling, Nathan Hamm, Olivia Sinaiko, and **Tawni Tidwell** joined the Field lab for the summer harvest at Jasper Ridge.

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Ulli Seibt of Germany is a visiting fellow in the Berry lab this June. She received her Ph.D. from the Max Planck Institute in Vienna and is the recipient of a Marie Curie Fellowship from the E.U.

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Postdoctoral research associate **Brent Helliker** left the Berry lab to work for one year at the International Atomic Energy Commission in Vienna. He will then join the faculty at U. Pennsylvania.

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David Knapp joined the Asner lab as a senior lab technician, and **Amy Cooper** and **April Villagomez** are working as lab interns.

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Sarah Robinson has joined the Asner lab as a technician for the summer to work on remote sensing for the Hawaii Project.

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David Lobell, a predoctoral research associate in the Asner lab, is continuing his research on remote sensing of regional crop production in the Yaqui Valley, Mexico.

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Staff member **Joe Berry**'s first grandchild, Theodore Justin Berry Rode, was born on Apr. 25.

Observatories

Wendy Freedman gave a Capital Science Lecture, "Exploring the Universe in the New Millennium," on Feb. 5 at Carnegie's Washington, D.C., headquarters. On Feb. 15 she gave a talk, "The New Cosmology," at the AAAS 2004 Symposium in Seattle.

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On Mar. 2 Freedman was the featured speaker at Scripps College in Claremont, CA, as part of the Women in Science and Trailblazers series. On Mar. 4-7 she attended the CIAR Conference in Banff, speaking on the Giant Magellan Telescope (GMT). At the Observing Dark Energy Workshop in Tucson, Mar. 18, she gave a presentation on the Carnegie Supernova Project.

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Freedman was the invited Regents' Lecturer at UC-Berkeley, speaking on "Taking the Measure of the Universe" on Apr. 7. On Apr. 9 she gave a presentation on the GMT, and on Apr. 12 a presentation, "Measuring Cosmological Parameters," at the Dept. of Physics Colloquium. She was also noted in the Apr. 18 *Los Angeles Times* article, "Rad scientists: a new wave defies stodgy stereotypes." On May 3 she was the invited speaker at the Birnam Wood Golf Club in Santa Barbara, where she spoke on "Taking the Measure of the Universe" to an audience of retired engineers and scientists. On May 13 she gave the presentation "Supernovae and Dark Energy" at the Beyond Einstein: From the Big Bang to Black Holes meeting at Stanford U.

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On Mar. 30 staff astronomer **Stephen Shectman** gave a public lecture on building big telescopes at the Observatories Centennial Lecture Series at the Huntington Library.

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Staff astronomer **François Schweizer** presented a colloquium, "Formation of Globular Clusters in Merging Galaxies," at U. Maryland in Apr.

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On Apr. 22 at the Magellan SAC meeting in Tucson, staff astronomer **Andrew McWilliam** presented an outline on the IMACS multiobject echellette—a special mode of IMACS that can obtain high-resolution spectra of 10 to 100 objects simultaneously.

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Staff astronomer **Luis Ho** coorganized IAU Symposium 222, "Interplay among Black Holes, Stars, and ISM in Galactic Nuclei," in Gramado, Brazil. He was also the summarizing speaker.

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Senior research associate **Barry Madore** presented a case for the continued funding of the NASA Extragalactic Database (NED) at NASA headquarters in Washington, D.C., on Apr. 27.

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In Feb. Carnegie fellow **Kurt Adelberger** gave an invited talk at a meeting on the science potential of a 10-30m UV/optical space telescope at the Space Telescope Science Institute in Baltimore.

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Carnegie fellow **Jeremy Darling** participated in colloquia at UC-Berkeley, U. Washington, U. Colorado, and the Lawrence Livermore National Laboratory. He gave a talk at NRAL Green Bank and an invited talk at the Arecibo 40^{th} Anniversary Science Symposium. As part of the Observatories outreach program, students from Longfellow Elementary School attended his solar system presentation in conjunction with the centennial lecture series at the Huntington Library. He is also serving on the NRAO users' committee.

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Rachel Somerville (Space Telescope Science Institute) was a scientific visitor during Mar. and presented a colloquium, "Excavating the Mass Assembly History of Galaxies from Panchromatic Surveys." Her husband, **Leonidas Moustakas** (also STScI), visited the Observatories for a few days and gave a colloquium, "GOODS —Early Multiwavelength Glimpses of Galaxy Formation."

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Christopher Sneden (U. Texas) was a scientific visitor in May and continued his collaboration with George Preston, Steve Shectman, and Ian Thompson on the metallicities of red horizontal-branch stars.

Plant Biology

Chris Somerville gave a seminar at U. Minnesota on Mar. 19, "Genetic Dissection of Cell Wall Structure and Function." On Mar. 29 he gave a talk, "Genetic Analysis of Cellulose Synthesis," at the annual meeting of the American Chemical Society.

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On Jan. 26 staff member **Wolf Frommer** gave a seminar at UC-Berkeley, "FRET Imaging of Sugar Transport and Metabolism." On Feb. 19 he presented a seminar, "Can Metabolites Serve as Signals in Long Distance Communication?" at Purdue U. He gave another seminar, "Interorgan Transport of Sugars," on Feb. 20 at Dow AgroSciences (DAS), Indianapolis, and presented the opening lecture, "Pumping the Optimal Amount of Iron," for the XII International Symposium on Iron Nutrition and Interactions in Plants (ISINIP) in Tokyo on Apr. 12.

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Staff member **Shauna Somerville** participated in the Risø Fellows Advisory Committee meeting and presented a seminar, "Plant Biotechnology," at the Risø National Laboratory, Roskilde, Denmark, in Mar. In Apr. she participated in the Interdepartmental Plant Physiology Major (IPPM) Symposium and gave a talk, "Susceptibility Mutants Suggest a Role for the Cell Wall in Plant-Pathogen Interactions," at Iowa State U., Ames. Earlier in the year she gave a seminar at U. Arizona-Tucson on the same subject.

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Staff member **Arthur Grossman** gave a seminar on *Chlamydomonas* genomics in Amherst, MA, on Apr. 15.

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❶ Devaki Bhaya, adjunct staff member, gave a seminar at the Plant Research Labs and Plant Biology joint seminar series at Michigan State U. on Apr. 19. Grossman and Bhaya were in China between Apr. 22 and May 2 and presented seminars at Beijing U., Zhengzhou U., and had several discussions with members of the Key Lab at Zhengzhou U. While on the trip they visited a primary school with their daughter, Ilina.

DTM welcomed a new staff member in mid-April, astrophysicist John Chambers, a leading theorist on the formation of the Earth and other terrestrial planets. He was formerly with the SETI Institute and brings considerable experience in the numerical simulation of planetary accretion, including work based on an approach developed by DTM's George Wetherill, a pioneer in the field. Chambers uses his models to understand the influence of the giant planets on inner planet formation, the origin of the heavy bombardment of the inner solar system, and the sources of water and other volatiles on Earth and other terrestrial planets. Chambers's work is important for determining the likelihood of Earth-like extrasolar planets as well as for understanding the conditions necessary for their formation and orbital stability.

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Thomas Yan, a 2003 summer intern in the Rhee lab, has graduated from San Jose State U., receiving the Computer Science Student of the Year award. Thomas continues his work in the Rhee lab and will be entering graduate school in the fall.

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Peter H. Quail, a former research associate in the Briggs lab, was elected to the National Academy of Sciences.

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January saw the addition of three new lab members: **Staffan Persson** (North Carolina State) to the Chris Somerville lab; new postdoc **Clare Simpson** (Cornell U.) to the Bhaya lab; and new curator **Katica Ilic-Grubor** to the Rhee TAIR lab.

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Ida Lager, graduate student from U. Tübingen, Germany, arrived in Mar. to work in the Frommer lab.

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Hae-Young Cho, a graduate student of In-Seob Han at U. Ulsan, Korea, arrived Mar. 19 as a visitor in the Briggs lab.

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Behzad Mahini left the Rhee TAIR lab in Jan.

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Trevor Swartz, a postdoc in the Briggs lab, has left to return to UC-Santa Cruz. He will be a frequent visitor to the department while he continues his research with the Briggs lab.

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Renata Csihonyne Doczi, a lab assistant in the Frommer lab, left in Apr. to await the birth of her first child.

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Hector Pulido, of the facilities staff, left the department in Mar.

Terrestrial Magnetism

Sean Solomon delivered presentations on the MESSENGER mission to the NASA Explorer Schools Student Symposium in Cocoa Beach, FL, in May and in July to the COSPAR 35th Scientific Assembly in Paris. In May he also spoke at a symposium at MIT for the 70th birthday of Prof. M. N. Toksöz, who was Solomon's thesis advisor. In June Solomon served on the External Review Committee for the MIT-WHOI Joint Program in Oceanography and Applied Ocean Science and Engineering, as well as on the visiting committee for the Harvard-Smithsonian Center for Astrophysics.

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Ohio Wesleyan U. (OWU) presented **Vera Rubin** with an honorary D.Sc. degree in May. When Rubin and former DTM researcher **W. Kent Ford**, Jr., began observing at Lowell Observatory in 1965, the largest (69-inch) telescope there was owned by OWU. Also in May, Rubin spoke on "Reflections on Cosmology in the 21st Century" at the Friday night Sabbath service at Temple Emanuel in suburban Washington, D.C.

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Emeritus staff member **John Graham** began his term as secretary of the American Astronomical Society (AAS) after being formally appointed during the May 30-June 3 AAS annual business meeting. Graham was elected to the position in 2003. In early June, administrative assistant **Brenda Eades** joined Graham's office on the BBR campus. Eades comes to the campus after working for a number of organizations including the Federal Communications Commission, the World Bank, and the United Mine Workers of America.

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David James was made a fellow of the American Geophysical Union at the May AGU spring meeting in Montreal. Also attending were postdoctoral fellows **Lucy Flesch** and **Linda Warren**, predoctoral fellow **Saad Haq**, and staff member **Paul Silver**, who gave an invited talk. In late Apr. James gave a public lecture at the National Museum of Natural History, "Revealing the Mysteries of the Earth's Deep Interior: Plates, Plumes, and the Birth of Modern Seismology." James gave this talk as the IRIS/Seismological Society of America Distinguished Lecturer for 2003-2004 and has since repeated it at the IRIS annual meeting in Tucson in June, and again at the Pacific Science Center in Seattle in July. During the summer James and former postdoctoral fellow **Matt Fouch** traveled to Johannesburg, where they met with faculty at U. Witwatersrand to plan a new broadband seismic experiment in the Bushveld Province of South Africa. While there, James presented two lectures.

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Rick Carlson participated in June in the Ph.D. thesis defense of **Nina Simon**, a student at the Free U. of Amsterdam who did her thesis research at DTM. Also in June, Carlson attended the EarthScope Great Basin Workshop and a meeting of the EarthScope Science and Education Committee, both held in Lake Tahoe, CA. In July Carlson gave an invited keynote lecture at the SEDI (Study of Earth's Deep Interior) meeting held in Garmisch-Partenkirchen, Germany.

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Alan Boss was this year's speaker at the Carnegie Evening. Boss also gave a keynote address on the formation of giant planets at the conference "Planetary Timescales: From Stardust to Continents" held in Feb. at the Australian Academy of Science, Canberra. In Mar. he gave a seminar about solar system formation to the Dept. of Astronomy at Case-Western Reserve U., Cleveland. He also gave a public lecture on the search for new solar systems for the Frontiers of Astronomy Series at the Cleveland Museum of Natural History. In Apr. Boss spoke on the formation of sub-brown dwarf stars to the astronomy dept. at U. Illinois, Champaign-Urbana. In July he served as the chair for and spoke at the conference "Bioastronomy 2004: Habitable Worlds" held in Reykjavik. Other presenters included **John Chambers**, **Sara Seager**, and postdoctoral fellows **Nader Haghighipour** and **Kaspar von Braun**.

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In mid-May **Paul Butler** gave a colloquium on extrasolar planets at Dartmouth College.

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Larry Nittler gave a talk at the Annual Workshop on Secondary Ion Mass Spectrometry held in Denver in May. In June he spent a week at the Max Planck Institute for Chemistry in Mainz, and in Aug. he gave a talk at the 67th Annual Meteoritical Society Meeting in Rio de Janeiro. Others attending that conference were **Conel Alexander** and former NASA Astrobiology Institute research associate **Michael Smoliar**.

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On Apr. 14 **Alycia Weinberger** spoke to the physics dept. colloquium at U. Maryland-Baltimore County, and in May she spent time observing at the W. M. Keck Observatory and at the Las Campanas Observatory, where Carnegie fellow **Aki Roberge** joined her. In July she spoke at the second TPF/Darwin International Conference, "Dust Disks and the Formation, Evolution, and Detection of Habitable Planets," held in San Diego. Others in attendance were **Alan Boss**, **John Chambers**, **Nader Haghighipour**, **Aki Roberge**, and **Eugenio Rivera**.

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In Apr. **Sara Seager** gave an astrophysics seminar at Fermilab and an astronomy colloquium at Ohio State U. She also participated in the Terrestrial Planet Finder (TPF) Ancillary Science Workshop at Princeton U. In May she gave an invited talk at the Third Harvard-Smithsonian Conference on Theoretical Astrophysics: Astrophysics of Planetary Systems.

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The **DTM geochemistry group** celebrated the arrival and successful installation of a new thermal ionization mass spectrometer from Thermo Finnigan in Apr. Early results show isotope ratio precisions of better than 5 ppm, a factor of 3-5 improvement over that achieved with other isotope ratio instruments at DTM. This instrument replaces a similar instrument purchased 20 years ago, which was donated to U. College, Dublin, where it will continue measurements for geoscience research.

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At the Goldschmidt Conference held in Copenhagen in June, presenters included **Maud Boyet**, **Mary Horan**, **Katie Kelly**, **Ambre Luguet**, **Alison Shaw**, and predoctoral associate **Ben Garden**.

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Research scientist **James Cho** returned in Apr. from Santa Barbara, where he was invited to participate in the Kavli Institute of Theoretical Physics planet formation program. Also in Apr., Cho gave an invited talk at the Dept. of Astronomy and Planetary Science at U. Colorado-Boulder, and another at the "Exoplanets and Planet Formation" session of the 1st meeting of the European Geosciences Union in Nice.

In May Cho gave an invited talk at the Astrophysics of Planetary Systems meeting at Harvard U.

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Postdoctoral associate **Nader Haghighipour** gave a talk at the 35th Annual Meeting of the Division on Dynamical Astronomy of the American Astronomical Society in Apr. and an invited talk at the American Physical Society Mid-Atlantic Senior Physicists Group meeting, held at U. Maryland-College Park in June.

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On Mar. 27 Carnegie fellow **K. E. Saavik Ford** wed Barry McKernan, a research associate in U. Maryland's astronomy dept., in a ceremony in upstate New York attended by friends and family. In Apr. Ford spoke at the NASA Goddard Space Flight Center in the Planetary Science and Astrobiology Seminar Series. In May she gave a presentation at the ALMA Science Workshop. In addition Ford, along with DTM staff member **Alycia Weinberger**, participated in the Sally Ride Science Festival, held every year to encourage an interest in science in middle school girls. Ford continued her outreach efforts in July, participating in an astronomy-related Girl Scout program at The Johns Hopkins U., and in Aug. she spoke to a group of amateur astronomers about comets and some upcoming spacecraft missions.

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In June **Taka'aki Taira** joined DTM as a Starr fellow. Taira has a Ph.D. in seismology from Hokkaido U. in Sapporo, Japan. Taira works with the seismology group to help develop improved metrics for monitoring faults and volcanoes.

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Henner Busemann, a newly appointed Carnegie fellow, arrived in July. He earned his doctorate in natural sciences from the Institute for Isotope Geology and Mineral Resources at ETH in Switzerland, remained there for one year as a postdoctoral fellow, and then moved to the Institute of Physics at U. Bern. He will work with **Larry Nittler** and **Conel Alexander** on microscale isotopic and chemical distributions within interplanetary dust particles to understand processes in the very early solar system.

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Lindsey S. Bruesch joined DTM in mid-Apr. as a predoctoral fellow. A Ph.D. candidate in planetary science at the Dept. of Earth Sciences at U. California-Santa Cruz, Bruesch has studied the nature of impact crater formation on medium-size icy bodies, comparing the predictions of her models against impact features on the satellites of Saturn.

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Terry Blackburn, an undergraduate at U. Kansas, arrived in June to work with **Rick Carlson** on the study of mantle xenoliths in the kimberlites of central Kansas, one of the few kimberlite localities in the U.S.

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Ex-DTM postdocs **Mark Schmitz** and **Charlie Kehm** returned to DTM from May through July to conduct analytical work. Schmitz and Kehm are assistant professors at Boise State U. and Washington College, respectively.

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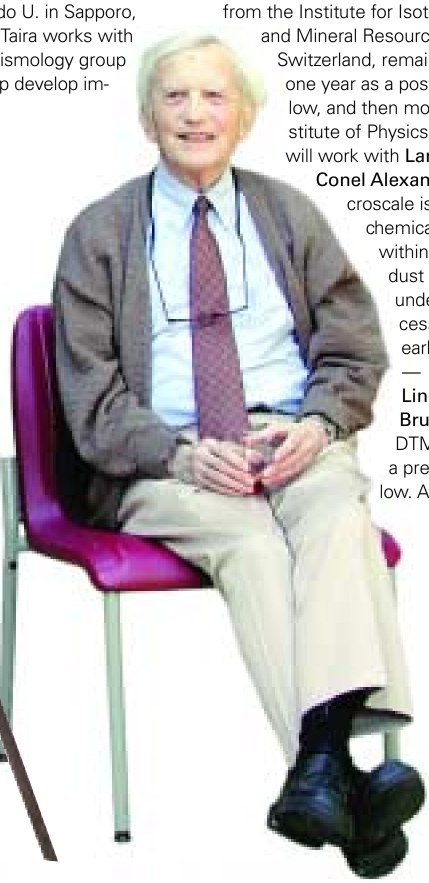
❷ Director Emeritus **George Wetherill** donated a portrait of himself to the DTM/GL library in a ceremony on May 4. The ceremony was held on the BBR campus and was attended by **Richard Meserve**, president of Carnegie; President Emerita **Maxine Singer**; Wetherill's wife, Mary Bailey; and Rachel Wetherill, Wetherill's daughter and a close friend of the artist, Maggie Siner.

Erik Hauri and Alison Shaw participated in an expedition to the Mariana Islands to study the fluxes of water, carbon, and other volatiles along the Mariana arc. They are studying volatiles trapped in olivine-hosted melt inclusions using DTM's ion microprobe and comparing them with magmatic production and volcanic degassing estimates to build a complete budget for volatile-element cycling in the Mariana subduction zone. The study is in collaboration with scientists at the Scripps Institution of Oceanography, U. New Mexico, and Boston U.

Erik Hauri in the Mariana Islands.



❷ George Wetherill, DTM director emeritus, poses with portrait.

DTM/GL

DTM/GL visiting investigator **Kevin Burke** returned to the campus in early May after spending the spring semester at U. Houston.

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DTM/GL archivist **Jennifer Snyder** attended the Society of American Archivists annual meeting in Boston in Aug.

Down Under Digging Unearths Carnegie History

By Shaun Hardy

(DTM Archives.)

DTM observer Edward Kidson used a camel in 1912 for his geomagnetic surveys in Australia.

A recent e-mail from Jane Tietzel-Hardley of Queensland Transport (QT), the highway commission in Brisbane, Australia, led to a historical surprise at the Department of Terrestrial Magnetism (DTM). Highway construction had unearthed a long-forgotten DTM relic—a sandstone marker placed 91 years ago by a magnetic survey party. The department, which is celebrating its centennial this fall, was initially conceived to map the geomagnetic field of the entire Earth. Tietzel-Hardley contacted Carnegie for background on the curious block, which was discovered six feet underground. Records in the DTM archives revealed that observer Edward Kidson laid the 6 x 6 x 15 inch marker in Brisbane's Victoria Park on July 17, 1913, as part of the General Magnetic Survey of Australia. Undertaken from 1911 to 1914, the survey took geomagnetic readings at 100-mile intervals across the entire continent. According to Gillian Anderson, a cultural heritage consultant for QT, the stone was found nearly 60 feet from its original location—not surprising, given the multiple uses of the site over the years, including relief housing during the Great Depression and army quarters during World War II. The marker is currently housed in the Museum of Mapping and Surveying of the Queensland Department of Natural Resources.

Carnegie Institution's **Capital Science Evenings** 2004-2005

All Capital Science Evenings are on Thursdays. They are free and open to the public and begin at 6:45 p.m. at the Carnegie Institution's administration building, 1530 P St., NW, Washington, D.C. For more information, call 202-328-6988, send an e-mail to ecarpenter@pst.ciw.edu, or visit our Web site at www.CarnegieInstitution.org.

September 30, 2004	**Robert Langer**	Massachusetts Institute of Technology/*Biomaterials and How They Will Change Our Lives*
November 4, 2004	**Maria Zuber**	Massachusetts Institute of Technology/*Climate Change on Mars*
January 20, 2005	**Leroy Hood**	Institute for Systems Biology/*Systems Biology: Changing Biology, Medicine, and Society*
February 17, 2005	**Greg Asner**	Carnegie Institution, Department of Global Ecology/
		Eyes in the Sky: Air and Space Observations of Our National and Global Ecology
March 10, 2005	**Laura-Ann Petitto**	Dartmouth College/*How the Brain Discovers Language*
April 7, 2005	**Margaret Geller**	Smithsonian Astrophysical Observatory/*How to Make a Milky Way*
May 12, 2005	**Sean Carroll**	University of Wisconsin/*Butterflies, Zebras, and Embryos: Genetics and the Making of Animal Diversity*

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