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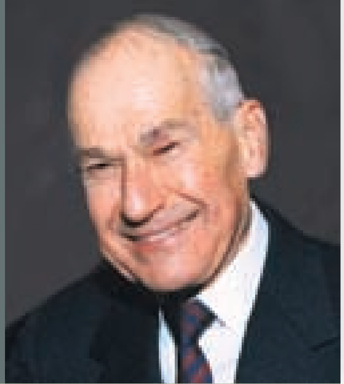

(Photo courtesy Richard Holden Photography.)

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This past October, over 400 members of the global philanthropic community met at the Scottish Parliament to discuss how philanthropy can contribute to solving the many problems that confront humanity. The sessions were part of the celebrations for the third biennial Carnegie Medal of Philanthropy award ceremony, held this time in Edinburgh, near Andrew Carnegie's birthplace. Carnegie Institution president Dick Meserve and I attended the events and found the sessions and celebrations particularly rewarding. The future of philanthropy appears to be a strong one.

The past 20 to 25 years has seen an explosion of nonprofit organizations established to solve global problems and nourish cultural vitality. Many different institutions and foundations focus on combating poverty and enhancing health, spreading democracy and cultivating civil society, encouraging the arts, advocating international peace, preserving the environment, and much more.

In hindsight it's clear how forward-looking our founder Andrew Carnegie was. He was foremost in his time to act on the belief that it is one's obligation to use private wealth to benefit the common good. A century ago he established 23 organizations, with very different missions, that continue to pursue his vision. They are all vibrant—supporting the arts, education, international affairs, and scientific research.

As in the past, the winners of this year's Medals of Philanthropy embodied Carnegie's concept of pointed, sustained generosity. I was particularly pleased that two of the six 2005 medal recipients are longtime supporters of our scientific initiatives.

Eleanor Hewlett Gimon accepted the Carnegie Medal on behalf of the Hewlett family. Her father, Bill Hewlett, was the legendary electronics inventor and cofounder of Hewlett-Packard Company. He was also a Carnegie board member beginning in 1971, serving as chairman from 1980 until 1986. Hewlett set a new standard for Carnegie giving during his tenure. His unprecedented generosity to the institution continued until his death in 2001, and his gifts were particularly vital to the completion of the Magellan telescopes at our Las Campanas Observatory.

Another important supporter of Carnegie science is the David and Lucile Packard Foundation. Susan Packard Orr accepted another Carnegie Medal on behalf of the Packard family. The Packard Foundation began giving to Carnegie science in 1995; they have awarded grants to the Geophysical Laboratory for instrumentation and have become ardent advocates of the Department of Global Ecology, making a particularly generous gift for the department's new, environment-friendly building.

Although these medal recipients were formally acknowledged for their philanthropy, there are many other deserving institutions, foundations, and individuals who have invested in Carnegie science over the years. Our supporters are exceptional people. Like our founder, they understand that basic scientific research is essential to advancement and understanding, and that human progress relies on improving scientific knowledge. Carnegie supporters also grasp the importance of championing the Carnegie mission of cultivating exceptional scientists and allowing them to pursue their often high-risk research.

The bold new Maxine F. Singer Building, formally dedicated on December 1, is the most recent manifestation of the creative and successful Carnegie science legacy. Its design should serve to enhance collaborations and to inspire grand ideas. I was very pleased that the dedication provided us with an opportunity to share with our supporters, firsthand, the unique atmosphere in which Carnegie science is conducted. Everyone who attended was clearly enthusiastic about the design and proud to be a part of the celebration. The building would not have been possible without many generous gifts. I thank everyone who donated to the Maxine F. Singer Building, the Carnegie trustees for their continuing support, and the hundreds of others who are making Andrew Carnegie's original dream an enduring reality.

—Michael E. Gellert, *Chairman*

Maxine F. Singer Building Dedicated

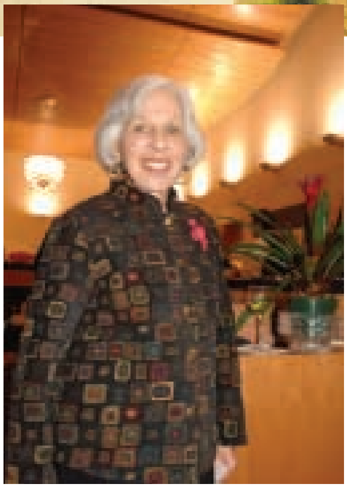
(Images courtesy Zimmer Gunsul Frasca Partnership.)

(Image courtesy Bob Stockfield.)

The sleek entranceway (left) belies the large rooms, some with two-story windows that are a feature of the new building.

Maxine F. Singer (far left), for whom the new Embryology building is named, is shown standing under "artichoke" lights in a common meeting area the night of the building's dedication.

Secretary of the board of trustees Deborah Rose (above) stands in the auditorium that bears her name.



(Image courtesy Bob Stockfield.)

The dazzling copper and glass indoor-outdoor laboratory that is now home to the Department of Embryology bulged with an enthusiastic crowd on December 1, the day of its formal dedication. The festivities, which coincided with the Carnegie board of trustees meeting, were in honor of former Carnegie president Maxine F. Singer, for whom the new building is named; of board secretary Deborah Rose, who is the namesake for the building's state-of-the-art auditorium; and of the many trustees and other donors who made the building possible. The crowd enjoyed talks, tours, a reception, and dinner in the new facility.

As the featured after-dinner speaker, Singer described how the Carnegie style of research has thrived since the department's inception 100 years ago on The Johns Hopkins University campus in Baltimore. Commenting on the approach to science at Carnegie, she stated that "there is no question but that living this way in science is living on the edge. Carnegie history tells us that it is the edge that consistently yields impacts way out of proportion to the institution's small size . . . The true reason for this building is not to honor me, but to assure that the bold Carnegie approach . . . is sustained within these wonderful spaces through research and the training of generations of new scientists . . ."

Singer emphasized that a small research group using the Carnegie approach to science would be particularly likely to flourish in such a setting. "There are huge benefits to being small, including flexibility, minimal bureaucracy, and, most important, the engagement of each scientist in the work of the others."

Like the other Carnegie departments, the Department of Embryology is unusual in its field in encouraging the pursuit of high-risk research. The building's design stimulates frequent interaction between the researchers, which fosters collaborations and surprising advances. The 80,000-square-foot building has 13 modern and well-equipped laboratories as well as shared spaces, such as a library, meeting rooms, genomics facilities, specialized instrument rooms, and supply rooms. It also features the state-of-the-art Rose Auditorium. The building was designed by the Zimmer Gunsul Frasca Partnership and would not have been possible without the support of more than 180 individuals, foundations, and corporations, including the Kresge Foundation, which awarded the institution a $1.5 million challenge grant.

Singer, a biochemist, served as the Carnegie Institution's eighth president from 1988 to 2002. She came to Carnegie from the National Institutes of Health, where she retained her association with the institute as scientist emerita during her decade and a half at Carnegie. In recognition of her contributions, she was awarded the nation's highest honor in science in 1992, the National Medal of Science. She currently serves on Carnegie's board of trustees.

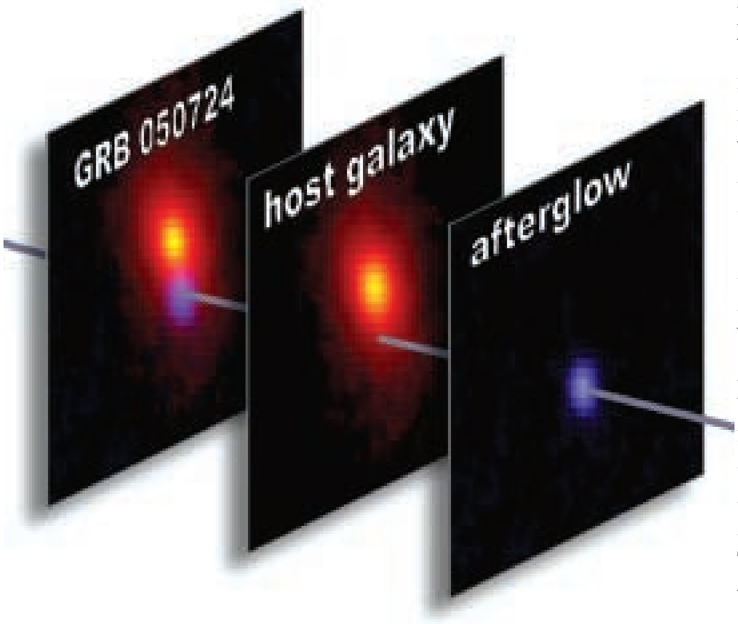
Trustee News

Trustees Meet and Get the Grand Tour

The highlights of the Carnegie board of trustees meetings December 1 and 2 were the tours and dedication of the Department of Embryology's new Maxine F. Singer Building and its Deborah Rose Auditorium. Prior to the dedication on December 1, the Finance, Development, and Research committees met. The trustees then toured the labs and participated in science demonstrations.

Committee reports and the report from the president followed the Nominating Committee meeting on December 2. Once board business was completed, Department of Terrestrial Magnetism staff scientist John Chambers described his work in his talk, "How to Build a Planetary System." Each of the six department directors then gave brief talks about significant research conducted by their staffs.

A Swift Picture of Short Gamma-Ray Bursts



Three different views of a short gamma-ray burst (named GRB 050724) seen by the Baade Magellan telescope on July 24, 2005, are shown here. On the left, the burst's bright afterglow is embedded in the red light of the galaxy's old stars. The middle panel shows the galaxy once the afterglow has faded away. On the right, the afterglow is shown by itself, an image achieved by subtracting the light of the galaxy. The axis connecting the three images shows the position of the burst.

The calm of a senescing galaxy is shaken by a cataclysmic explosion. In a split second, the energy of a billion billion Suns breaks free, sending a barrage of electromagnetic radiation in all directions. This short gamma-ray burst leaves an afterglow that will last a few hours at most, and then fade away. Three and a half billion years later, the most energetic radiation from the blast reaches our solar system and the eye of Swift, a tiny satellite telescope in orbit just above Earth. The satellite sends a message home, beckoning ground-based telescope crews to work.

Historically, it has been hard to get a good look at short gamma-ray bursts; by the time one appeared, it was too late to focus on it. Unlike long gamma-ray bursts—understood to result from the death of a massive star and the subsequent birth of a black hole—the cause of short bursts remains veiled in uncertainty. Researchers such as Carnegie-Princeton and Hubble Fellow Edo Berger are using Swift's unprecedented gamma-ray sensitivity and quick reaction time to coordinate follow-up observations from a battery of ground-based telescopes. In just over a year since launch, Swift has caught a number of short bursts in the act, bringing Berger and his colleagues closer than ever to understanding these enigmatic blasts. "We had no idea if they explode in nearby galaxies or the farthest reaches of the universe, or even what kind of object was producing them," Berger explained. "Now, after eluding us for years, we have finally found out where these explosions come from, and the first clue as to what they are."

Within minutes of receiving Swift's message, astronomers at Carnegie's Las Campanas Observatory in Chile, the Hale telescope in California, the twin Keck telescopes in Hawaii, and the Very Large Array (VLA) in New Mexico scramble to catch a glimpse of the burst's afterglow. Observers working on a scope typically drop what they're doing to focus on a burst; in return for sacrificing valuable telescope time, they become coauthors on any resulting publication. Some stations will succeed and some will not, but with luck, the network as a whole will capture a picture of the burst in optical, infrared, and radio wavelengths. The first such full-spectrum image was snapped on July 24, 2005, when Las Campanas and the VLA zeroed in on a burst from an old elliptical galaxy 3.5 billion light-years away. "When the images came in from the telescope in the middle of the night I was astonished," Berger said. "We finally had a precise position for a short burst, and it happened in the most unlikely of places, an old dead galaxy."

Berger was not alone in his surprise. Astronomers had no idea if short bursts would be found in young galaxies, much like their long-lived counterparts, or in different environments. But finding this burst in a sleepy old galaxy meant that its source, or sources, must have been at least several billion years old. Pinpointing the burst's location also meant that the distance, and therefore the energy, could be accurately measured. Exhaustive radio and infrared data revealed that the burst gave off two or three orders of magnitude less energy than a typical long burst. Suddenly an idea favored by theorists found empirical support: the burst seems to have resulted from the devastating collision of two old neutron stars, or a neutron star and a black hole, drawn together in a steadily shrinking orbit by gravitational waves.

Even as they work to solve the riddle of short bursts, Berger and his colleagues are busy taking advantage of their longer-lived cousins. They are using the intense light from burst afterglows as cosmic "flashlights" to illuminate the first galaxies and the composition of the gas that permeated the early universe. Berger compares the process to shining a flashlight into a dark room. However, he says, "Because the flashlight is on for only a few hours, we have to act quickly."

—BY MATTHEW EARLY WRIGHT

Rain Forest Ravage Is Double Previous Estimate

The red areas show where the Asner-led team found selective logging disturbance in Brazil.

(Image courtesy the Carnegie Institution and Google Earth.)

Using the X-ray-like vision of a superhero, Greg Asner's team at Carnegie's Department of Global Ecology is the first to penetrate the rain forest canopy and catalog just how much "selective logging" is going on in Brazil. "We discovered that annually an area about the size of Connecticut is disturbed this way," Asner said. Selective logging is a stealth harvesting method whereby loggers pluck valuable trees from the forest one by one under cover of the jungle canopy. The scientists found that, when selective logging is accounted for, the total amount of forest degradation in the Brazilian Amazon has been underestimated by half.

The new large-scale study was conducted using high-resolution satellite data and advanced computational methods developed in Asner's lab. The research, published in the October 21, 2005, issue of *Science*, has far-reaching ecological impacts for the region and beyond. "Selective logging negatively impacts many plants and animals and increases erosion and fires," Asner added. "Additionally, up to 25% more carbon dioxide is released to the atmosphere each year above that from methods such as clear-cutting.

Brazil's National Institute for Space Research has used remote sensing to accurately measure deforestation, such as that caused by clear-cutting, for over two decades. Surprisingly, though, little has been known about the extent of selective logging in the region because the satellite techniques could not penetrate the shielding upper layers of forest leaves. The Carnegie scientists developed the Carnegie Landsat Analysis System (CLAS), which penetrates this layer. They corroborated the CLAS results with selected on-ground field studies. "With the new Carnegie system, we can now see what's happening from the top of the forest all the way to the soil; we have a whole new picture of the Amazon region and selective logging," said coauthor Natalino Silva of the Brazilian Agricultural Research Corporation.

From 1999 through 2002 the scientists used remote sensing, with a spatial resolution of 98 ft. x 98 ft., over millions of square miles. For their analysis they also used data from selected on-ground surveys over the five states in which 90% of all deforestation in the Brazilian Amazon occurs. The annual extent of selective logging was found to be between 4,685 square miles (12,135 km^2) and 7,973 square miles (20,651 km^2). As a result of the harvest, up to 80 million metric tons of carbon are released each year.

The researchers are hopeful that their new techniques can be expanded to monitor logging in other tropical forest countries. "Our ultimate goal is to provide these satellite results to government officials in Brazil since much of the logging is illegal but difficult to control because it is usually clandestine," Asner said. "This will require support from the international community, but the payoffs could be enormous for all of the stakeholders affected by legal and illegal logging and other forest disturbances."

The research gained international attention, being widely reported on from Australia and Europe to India and China as well as in such prominent U.S. media outlets as the ***New York Times,*** **National Public Radio,** and **USATODAY.com.**

The new satellite processing system was funded by the Carnegie Institution. Application of this new system to Brazil was supported by the National Aeronautics and Space Administration.

A Tribute to the Golden Touch

The Carnegie Institution is privileged to have had the support and guidance of senior trustee William T. Golden for the past 35 years. An icon of American science policy for more than half a century, Golden began his remarkable career influencing the direction of the nation's scientific progress during the Cold War. In 1950, after the outbreak of the Korean War, President Harry Truman asked Golden to determine how the executive branch could best coordinate and invigorate its science advice and military efforts. Golden recommended the creation and appointment of a science advisor to the president, a position of singular importance in ensuring that sound scientific and technological input is considered in presidential decisions. He also recommended the creation of a President's Science Advisory Committee (PSAC), which is now known as the President's Council of Advisors on Science and Technology Policy (PCAST). Later he was heavily involved in establishing the policies and initial programs of the National Science Foundation, and he has been pivotal to the leadership of the American Association for the Advancement of Science. Over the decades, Golden's name has become synonymous with national science policy.

Golden knew early on that he wanted to "do interesting and useful things." After attending Harvard Business School for a year, he went to Wall Street for 10 years, from 1931 to 1941, where he was highly successful. He left Wall Street to become an officer on active duty in the U.S. Navy throughout World War II. With the time and the capacity to pursue "interesting things," he has since touched many lives.

Golden began his affiliation with Carnegie in the late 1960s, when then-Carnegie president Caryl Haskins called him and invited him to consider joining the board. "I accepted, and I have been very pleased with events ever since," he reflected. "I am very interested in what is done in the Carnegie labs. I have great respect and admiration for the scientific staff and the administration."

Golden served as secretary of the Carnegie board of trustees from 1971 to 1999. He was a member of the Finance and Executive committees and was chairman of the Nominating Committee and the Embryology and Observatories visiting committees. He was particularly instrumental in counseling the institution as it planned and built the Las Campanas Observatory high in the Chilean Andes. It is now home to some of the largest and most scientifically productive telescopes in the Southern Hemisphere. The Observatories auditorium in Pasadena now bears the Golden name in appreciation of his efforts.

Senior trustee Bill Golden has been a Carnegie board member since the late 1960s.

(Image courtesy the American Philosophical Society.)

Former Carnegie president Maxine Singer, commenting on Golden in the *New York Times* in 2001, remarked that he is "the kind of trustee who gets involved in things." Golden has been extensively involved in nearly 100 different groups, many of them scientific organizations, and has received numerous awards, including honorary degrees and the 1996 Public Welfare Medal of the National Academy of Sciences (its highest honor). "I am only an amateur of science," Golden insists, "but I do have the ability to understand in a general way the work that is going on, especially in astronomy and biology." Golden, who earned his ham radio license (call letters 2AEN) at age 13, may not be a scientist, but he decided to go back to school and, at age 70, earned a master's degree in biology at Columbia University. He wanted to understand new developments in the field. In recent years, he acquired the 4,000-acre Black Rock Forest from Harvard and established the Black Rock Forest Consortium of scientific and educational institutions to operate it for research and education.

Golden, who turned 96 this year, still goes to his midtown Manhattan office daily when he is not attending board or committee meetings. He devotes almost all his time to not-for-profit activities. "It's so rewarding to see what becomes of the projects I become involved in," he says.

"Carnegie is a stronger institution because of Bill's longtime guidance and generosity," noted Carnegie president Richard Meserve, who has known and respected Golden for decades. "Bill embodies the Carnegie principle that exceptional people can produce extraordinary results when given the freedom to pursue their passions. We are truly fortunate that this legendary man chose to join the Carnegie family." •

Genetic Defenders Protect Crops from Fungal Disease

These mustardlike *Arabidopsis* plants are inoculated with *Erysiphe pisi* fungal spores. From left to right, plants with no mutations (WT), a disabled *PEN2* gene, disabled *PAD4* and *SAG101* genes, and all three disabled genes together are increasingly vulnerable to the fungus. This last variant is the most susceptible to infection; it allowed *E. pisi* to proliferate as well as it does on pea plants, its normal host.

(Images reprinted from Science, vol. 310, issue 5751, November 18, 2005, by permission of the American Association for the Advancement of Science.)

Like waves of soldiers guarding a castle gate, multiple genetic defenders cooperate to protect plant cells against powdery mildew disease. Powdery mildew is a common fungal infection in plants that attacks more than 9,000 species, including many crops such as barley and wheat, and horticultural plants such as roses and cucumbers. The researchers, including Shauna Somerville and Mónica Stein of Carnegie's Department of Plant Biology, are the first to document how these defense genes team up in plants. The discovery could help combat fungal parasites that devastate crops and cost growers billions of dollars every year.

The study, published in the November 18, 2005, issue of *Science*, describes powdery mildew infection in the mustard relative *Arabidopsis thaliana*. Each species of mildew can infect some plant species, but not others. By disabling protective genes in *Arabidopsis*, the researchers were able to infect those plants with species of powdery mildew that normally attack peas or barley. The research revealed much about how plants use genes to fight infection. "Most plants are resistant to the majority of pathogens they encounter, but the basis for this resistance was unknown," Somerville said. "Identifying these genes has provided us with the first insight into how plants defend against multiple pathogens."

Once a powdery mildew infection takes hold, it covers the plant with fuzzy splotches, while sapping precious nutrients. At the cellular level, the fungal spores invade healthy plant cells and form root-like feeding structures called haustoria. The plant cell wall is the primary barrier to this invasion, and one of the defense genes described in the current study, called *PEN2*, prevents the fungus from penetrating cell walls in the first place.

If this first line of defense breaks down, as it does in about 5% to 25% of normal *Arabidopsis* plants (depending on the mildew species), a second set of genes jumps into the fray. These genes, called *EDS1*, *PAD4*, and *SAG101*, work together in a complex inside the cell, and can signal infected cells to die. By sacrificing these fallen cells, the defense genes can spare healthy ones from infection.

Somerville, Stein, and colleagues at the Max Planck Institute for Plant Breeding in Cologne disabled the protective genes in *Arabidopsis* by introducing mutations, one at a time and in various combinations. They infected these mutants with one of two species of powdery mildew: *Blumeria graminis hordei*, a species that attacks barley, and *Erysiphe pisi*, one that thrives on the leaves and pods of pea plants. "Disabling just three genes allowed the pea powdery mildew to reproduce as well on *Arabidopsis* as it does on its normal host," Somerville remarked. "Thus, the resistance barriers limiting the growth of inappropriate pathogens are much less complex than expected, relying on just a limited number of genes."

The *EDS1*, *PAD4*, and *SAG101* gene complex's ability to signal cell death is relatively well known to scientists. However, very little is known about how *PEN2* behaves in the cell. The current study demonstrates that the PEN2 protein is a catabolic enzyme—a protein that breaks down other molecules—though its specific target remains unknown.

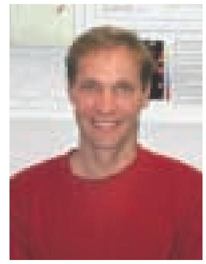
The study expands on the researchers' previous work with a gene called *PEN1*. As its name suggests, *PEN1* and *PEN2* seem to share a common purpose. However, they seem to act via different mechanisms, and *PEN2* protects against a wider range of fungal pathogens. For example, *Arabidopsis* plants with a disabled *PEN2* gene are also more susceptible to *Phytopthora infestans*, the fungus responsible for the notorious Irish Potato Famine of the mid-19th century.

"The resistance mechanisms operating at the cell wall seem to be surprisingly simple," Somerville said. "This suggests it might be possible to reverse engineer crops like wheat with *Arabidopsis PEN* genes to help control powdery mildew and other destructive diseases, thus minimizing the need for pesticides."

—BY MATTHEW EARLY WRIGHT

This work was supported by grants from the National Science Foundation and by a Stanford Graduate Fellowship to Mónica Stein.

Messengers from the Dark Reaches of Time

George Cody of Carnegie's Geophysical Laboratory (left) and Conel Alexander of the Department of Terrestrial Magnetism (right).

Some 40,000 tons of cosmic debris bombard Earth annually; some of it holds the secrets to our origins. We see these cosmic messengers as spectacular displays of shooting stars or meteor showers. The bits that avoid incineration and make it to the surface, meteorites, carry chemical clues about how the solar system formed. George Cody of Carnegie's Geophysical Laboratory and Conel Alexander of the Department of Terrestrial Magnetism investigate a particular class of the most ancient meteorites to decipher how the dusty, gaseous interstellar medium coalesced to form the solar system billions of years ago. The duo recently became the first scientists to be able to decipher and compare the chemistry of four meteorites from different groups to begin to understand their processing histories.

Most meteorites are pieces of asteroids—the small bodies that originate between Mars and Jupiter in the asteroid belt. They are cousins to the material that accreted to form the rocky planets, and they have remained mostly unchanged over the dark reaches of time. Their composition is believed to be similar to that which made up the solar nebula and eventually formed the Sun and planets.

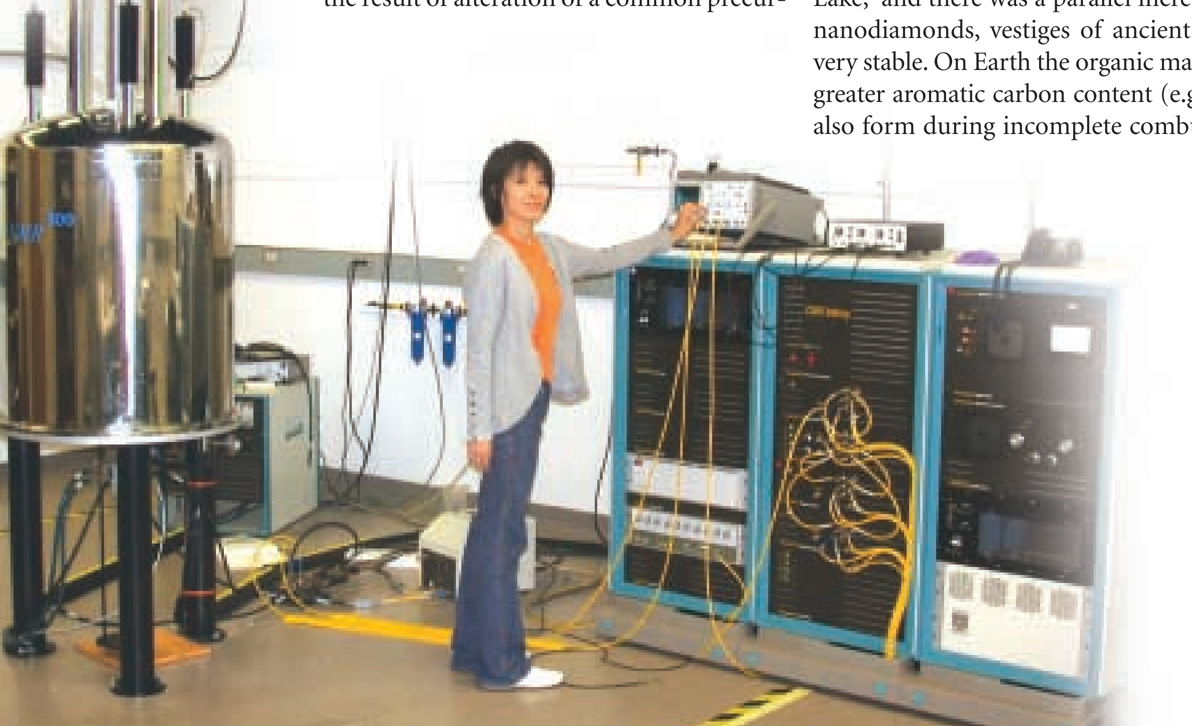
Cody and Alexander study carbonaceous chondrite meteorites. "These meteorites are the oldest type," explained Alexander. "They are also particularly rare, and hold the most history. They have large amounts of organic carbon. Not only can we use the carbon to investigate the steps that led to life, we can go back even further in time and determine the temperatures, pressures, and other chemical processing that went on as the interstellar medium formed into the solar system."

The organic matter in these meteorites has a diverse range of compositions. Until now, it has been unclear whether this range was the result of alteration of a common precursor on the meteorite parent bodies or whether it reflects a range of sources. Cody and Alexander's landmark work suggests that the organic matter in the different meteorites has been modified to varying degrees by the same basic reaction pathway, pointing to a common origin for the organics.

More than 70% of the organic matter in carbonaceous chondrites is insoluble organic matter (IOM). Truly hard nuts to crack, IOMs are difficult to break down and analyze by standard molecular methods. Cody and Alexander have overcome this hurdle by using solid-state nuclear magnetic resonance (NMR) spectroscopy. NMR reveals molecular information when certain atomic nuclei, aligned by an enormous magnetic field and irradiated with radio-frequency pulses, resonate with characteristic frequencies.

The researchers developed a painstaking analysis of meteorites from four groups whose parent bodies came from different parts of the solar nebula—EET92042 (CR group), Orgueil (CI group), Murchison (CM group), and Tagish Lake (a unique group). With a custom-designed procedure developed by Terrestrial Magnetism's Fouad Tera, they extracted the material and used a protocol with eight different ^{1}H and ^{13}C NMR experiments to verify the hydrogen and carbon molecular environments. "It took about one month to completely analyze each sample," Cody said.

The scientists found remarkable variation in the chemical composition of IOM across the meteorite groups. The proportion of aromatic carbon increased enormously from CR to Tagish Lake, and there was a parallel increase in the abundances of tiny nanodiamonds, vestiges of ancient stars. Aromatic carbons are very stable. On Earth the organic matter in sedimentary basins has greater aromatic carbon content (e.g., coals). Aromatic molecules also form during incomplete combustion of fossil fuels and as a



Hikaru Yabuta, a Geophysical Laboratory postdoctoral fellow, works with George Cody and Conel Alexander. Here she is making adjustments before starting solid-state nuclear magnetic resonance (NMR) analysis of meteoritic organics. The silver cylinder at left contains the enormous magnet necessary for sample analysis.

by-product of thermal processing during fossil-fuel refining.

The multiple NMR experiments revealed the surprising result that the increase in aromatic carbon was not due to thermal processes, as might be expected, but rather to a loss of other carbon through an unexpected low-temperature, chemical-oxidation reaction mechanism in the meteorite parent bodies. They suspect that the oxidant is hydrogen peroxide, a likely component of the interstellar ices that ferried water into the solar system.

The recognition of this reaction mechanism allowed Cody and Alexander to identify the evolutionary trajectory of extraterrestrial IOM, leading to the conclusion that the CR meteorite represents the most primitive organic matter of the group. This IOM is chemically very complex (rich in hydrogen, oxygen, and nitrogen), and it probably formed from smaller molecules that were synthesized in the interstellar medium—further evidence that extraterrestrial organic matter is older than the solar system.

These studies represent the proverbial tip of the iceberg. Cody and Alexander are broadening their investigation to include a very wide range of IOM obtained from many different meteorites. They are also applying state-of-the-art X-ray microspectroscopy at the Advanced Light Source to further refine their understanding of this complex chemistry.

On January 15, 2006, the intrepid STARDUST mission returned to Earth carrying samples obtained from the comet Wild 2. Synchrotron-based X-ray microspectroscopy provides the best means of analyzing the carbon chemistry of these micron-sized particles. Cody and Alexander are members of the STARDUST experimental science team and look forward to applying their knowledge of extraterrestrial organic chemistry and their expertise in X-ray microspectroscopy to the analysis of these remarkable samples.

The carbonaceous chondrite meteorite Allende (right) came to Earth in 1969 by landing in Mexico. It exhibits the dark fusion crust formed during atmospheric heating. The mottled white and light gray interior is pristine meteorite, with various mineral phases and very little extraterrestrial organic carbon. The vial contains about 400 milligrams of extracted, pure insoluble organic matter from a carbonaceous chondrite. It records history from before the formation of the solar system.

Trustee Emeritus John Diebold, 79, Passes Away

John Diebold, visionary architect of the information age and Carnegie Institution trustee emeritus, died of esophageal cancer on December 26, at his home in Bedford Hills, New York. He was 79 years old.

Decades before the dawn of the personal computer, Diebold prophesied that technology would transform the flow of information in business and in government. In 1952, he outlined his ideas in his influential book *Automation*.

Diebold was born on June 8, 1926, in Weehawken, N.J. He earned his bachelor's degree in economics from Swarthmore College, and an M.B.A. from Harvard Business School. In 1954, he founded the Diebold Group, an international consulting firm that advised major corporations, including AT&T, Boeing, Xerox, and IBM, on emerging technologies. Diebold anticipated such advances as digital recordkeeping, electronic communication networks, and automated assembly lines years before their implementation. In 1968 he founded the Diebold Institute for Public Policy Studies to further his commitment to technology-based reform.

Diebold served on the Carnegie board of trustees for 27 years, from 1975 to 2002. He was a member of several standing committees and was chairman of the Audit Committee from 1997 to 2002. He was dedicated to the Carnegie mission of basic scientific research, which he demonstrated through his tireless service and through many generous gifts to the institution.

Diebold is survived by his wife, Vanessa; his daughter Joan, of Quincy, Massachusetts; his daughter Emma and his son John, both of Bedford Hills.

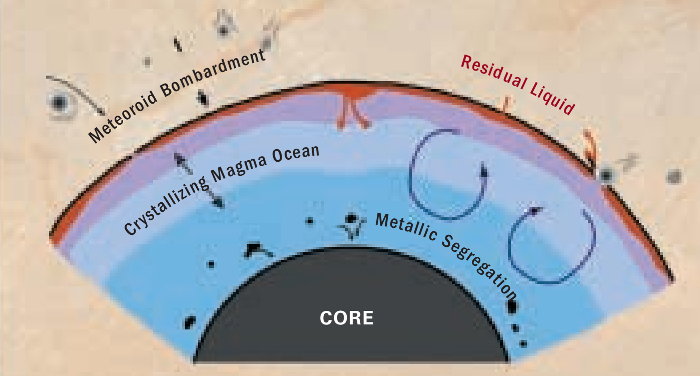
Revising Earth's Early History: A 2005 Science Breakthrough

Earth's future was determined at birth. Using refined techniques to study rocks, researchers at Carnegie's Department of Terrestrial Magnetism (DTM) found that Earth's mantle—the layer between the core and the crust—separated into chemically distinct layers faster and earlier than was previously believed. The layering happened within 30 million years of the solar system's formation, instead of occurring gradually over more than 4 billion years, as the standard model suggests. The new work was recognized by *Science* magazine, in its December 23 issue, as a runner-up science breakthrough for 2005.

Carnegie scientists Maud Boyet and Richard Carlson analyzed isotopes—atoms of an element with the same number of protons, but a different number of neutrons—of elements in rock samples for their work. As Carlson explains, "Isotopes exist naturally in different proportions and are used to determine conditions under which rock forms. Radioactive isotopes are particularly handy because they decay at a predictable rate and can reveal a sample's age and when its chemical composition was established."

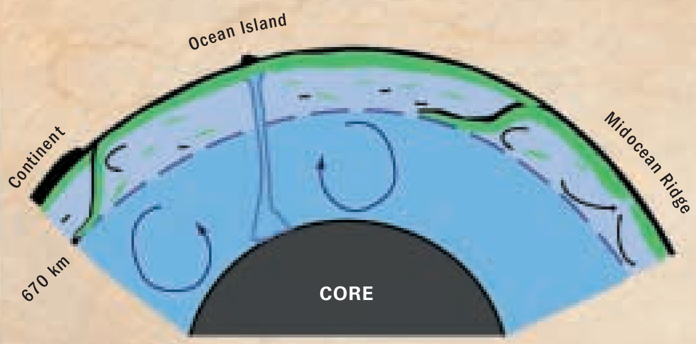
In the standard model of the geochemical evolution of the Earth, the Earth's mantle has been evolving gradually over Earth's 4.567-billion-year history primarily through the formation of the chemically distinct continental crust. Shortly after solid material began condensing from the hot gas of the cooling early solar system, the object that would become Earth grew by the collision and accretion of smaller rocky bodies. The chemical composition of these building blocks is preserved today in primitive meteorites called chondrites.

In the 1980s, scientists analyzed the ratio of isotopes of the rare Earth element neodymium in chondrites and various terrestrial rocks collected at or near the Earth's surface and found that the samples shared a common composition. Researchers believed that this ratio remained constant from the beginning of Earth formation. Using new-generation equipment, Boyet and Carlson found, surprisingly, that the terrestrial samples did not have the same ratio as the meteorites. Compared with chondrites, all terrestrial rocks measured have an excess of the mass 142 isotope of neodymium (^{142}Nd), which is the decay product of a now-extinct radioactive isotope of samarium of mass 146 (^{146}Sm) that was present at the birth of the solar system but decayed away shortly thereafter. The excess in ^{142}Nd allowed the researchers to determine when the composition of the part of the Earth that has contributed melts to the surface



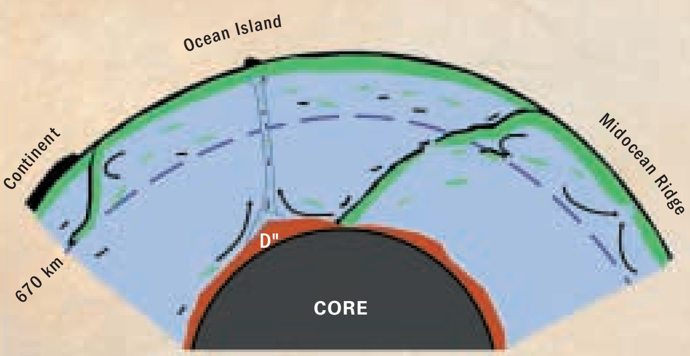
EARTH BEFORE 30 MILLION YEARS

During Earth formation, decay of short-lived radioactive isotopes and surface bombardment from large bodies heated Earth's mantle and created a deep magma ocean. Crystallization of the magma ocean created compositionally distinct layers (blues), while leftover liquid (red) remained just under the primordial crust.



EARTH TODAY
CONVENTIONAL MODEL: TWO-LAYER CONVECTION

In the conventional model of Earth history, the mixing caused by mantle convection erased this early chemical differentiation. The only chemical variation in the mantle is that caused by the formation of the continental crust, leaving the upper mantle (light blue) deficient in those elements concentrated in the crust (black), while most of the mantle is still similar in composition to the chondritic meteorites from which Earth accumulated.



EARTH TODAY
NEW MODEL

The Boyet and Carlson result requires the Earth to have differentiated early, within 30 million years, leaving most of Earth's mantle (light blue) depleted in those elements that prefer melts over crystallizing solids. The chemical complement to the depleted mantle could be small and quite enriched in radioactive elements, such as uranium and thorium; this complementary material may coincide with the seismically observed D" layer, located between the core and the mantle some 2700 km deep.

(Image courtesy Maud Boyet.)

over time diverged from that of the meteorites' parent bodies. The divergence occured within the first 30 million years after solar system formation, which is less than 1% of the age of our planet.

To explain the excess of ^{142}Nd found in the terrestrial samples, the Carnegie scientists believe that the Earth was largely molten during its formation and that rapid crystallization of Earth's early magma ocean caused the mantle to separate into chemically distinct layers, one containing a high ratio of Sm to Nd similar to that observed today in the mantle source of the volcanism along ocean ridges. The complementary reservoir, with low ^{142}Nd abundance, has never been sampled at the surface and hence could now be deeply buried in the so-called D" layer at the very base of the mantle, above the core. This "missing" layer should be rich in the elements uranium, thorium, and potassium, whose long-lived radioactive decay heats Earth's interior and causes our planet to remain geologically active. This hot layer above the core could help to keep the outer core molten so that circulation of liquid iron can produce Earth's magnetic field, and it could instigate the hot plumes of upwelling mantle material that give rise to volcanically active islands, such as Hawaii.

Measurements by Boyet and Carlson also show that lunar rocks have the same abundance of ^{142}Nd as the terrestrial samples, a finding that adds to the evidence that the Moon formed from the Earth. Since Mars also experienced early melting, as indicated by the chemical and isotopic composition of Martian meteorites, the new results now link the early evolution of Earth, the Moon, and Mars, and highlight the importance of early events in determining the chemical characteristics of the terrestrial planets.

"The work of Boyet and Carlson, when added to what has already been determined for the Moon and Mars, shows that the earliest days of the inner planets were violent times in solar system history," adds DTM director Sean Solomon. "Theoretical work by Carnegie scientist George Wetherill had pointed to this result, but now we have a clear chemical signature of this episode of Earth history."

Life in a Frozen Volcano: The Key to Finding Life on Mars?

(Photos courtesy Kjell Ove Storvik/AMASE.)

GL's Andrew Steele examines an ice-coring tool penetrating blue ice.

Trapped mineral fragments associated with microbial communities appear inside blue ice.

A shaft of solid blue ice inside a volcanic vent might sound like a nasty place to eke out a living. Yet diverse microbial communities thrive in this environment, according to new research from the Arctic Mars Analogue Svalbard Expedition (AMASE). "Ice-filled volcanic vents such as these are likely to occur on Mars and may be a potential habitat for life there," said Andrew Steele of Carnegie's Geophysical Laboratory, science leader for AMASE.

The discovery, notable for further expanding the definition of what life can tolerate, also demonstrated that AMASE-designed instruments can contribute to the search for life on Mars. "The instruments detected both living and fossilized organisms, which is the kind of evidence we'd be searching for on the Red Planet," remarked Hans E. F. Amundsen of Physics of Geological Processes (PGP) at the University of Oslo, Norway, leader of the international AMASE team.

The team has studied the Svalbard Islands of Norway as an earthbound surrogate for the frozen, desolate Martian environment for the past three years because they share certain geological features. For example, the carbonate rocks found inside one volcano, called Sverrefjell, are similar to carbonate rosettes found in Martian meteorite ALH84001. The researchers believe both might have been formed by the action of microbe-laden blue ice.

To avoid contaminating blue ice samples with outside bacteria, GL's AMASE team members worked out a reliable protocol for sterile sampling. This involved keeping the ice-coring tool free of foreign microbes while formulating a strategy to avoid cross-contamination of samples.

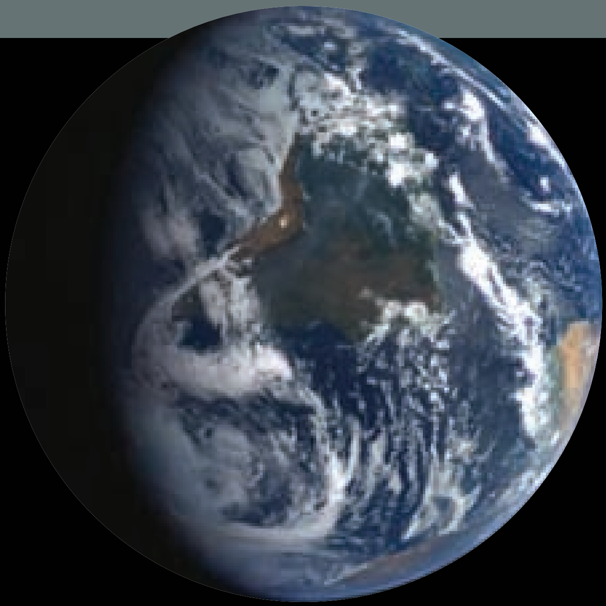
In addition to finding life in blue ice vents, AMASE described communities in glacial ice. The team also found 780-million-year-old sedimentary rocks that contain well-preserved microbial remains. "These rocks hold potential chemical markers of fossilized life," said GL's Marilyn Fogel. "If there is similar evidence in ancient rocks on Mars, our equipment will be able to find it."

Confronting the Changing Climate

The kind of devastation seen on the Gulf Coast from Hurricane Katrina may be a small taste of what is to come if emissions of the greenhouse gas carbon dioxide (CO_2) are not diminished soon, warned Ken Caldeira, newest staff member of Carnegie's Department of Global Ecology, in his opening remarks at the Seventh International Carbon Dioxide Conference in Boulder, Colorado, September 26, 2005.

Some 5 trillion tons of carbon could be spewed into the atmosphere over the next three centuries from human fossil-fuel burning if current trends continue, Caldeira explained. It would have serious consequences by warming the planet on average between 7 and 20 degrees Fahrenheit and turning the oceans acidic. Caldeira cautioned that "the global changes would happen so fast they would overwhelm most natural processes and have devastating effects on plant and animal life on land and in the oceans. What we do this decade and the rest of this century will dramatically affect what happens to our planet for thousands of years to come."

Caldeira's talk followed the opening address given by the Bush administration's James Mahoney, director of the U.S. Climate Change Science Program. Caldeira set the stage for the long-term consequences of continued CO_2 emissions with details on the physics and chemistry of ecological systems, an analysis of Earth's history, and sophisticated climate modeling. He called on international governments, policy makers, and industry "to act now to meet our responsibility to reduce emissions so we can avoid scenarios of devastation and be proud of how our civilization responded to this global challenge."



(Images courtesy NASA/The John Hopkins University, Applied Physics Laboratory.)

Where Is MESSENGER Now?

Fifteen months after blastoff, the compact Mercury-bound MESSENGER spacecraft had about 30 million miles on its odometer and was en route to a rendezvous with Venus in October 2006. A year after leaving Earth orbit, MESSENGER reconnected with its home planet in August 2005, in the first of a series of flybys designed to change the craft's trajectory and to slow it down enough to enter Mercury orbit in March 2011.

MESSENGER will use the gravitational attraction of Earth, Venus, and Mercury to accomplish the braking necessary for orbit insertion. It will then begin a year of data collection to learn about Mercury's atmosphere, polar ices, crustal composition, internal structure, density, and magnetic field. It will also map the half of the planet that no one has ever seen before.

MESSENGER will fly by Venus twice and Mercury three times. The Earth flyby allowed the spacecraft team to test several science instruments. Sean Solomon, principal investigator of the mission and director of Carnegie's Department of Terrestrial Magnetism, said, "The opportunity to view the Earth and Moon from close range provided critical calibration information for our instruments, and the mission operations team learned how to optimize scientific observations before, during, and after closest approach. We're all looking forward to the Venus flybys in 2006 and 2007 and to our first Mercury flyby about two years from now."

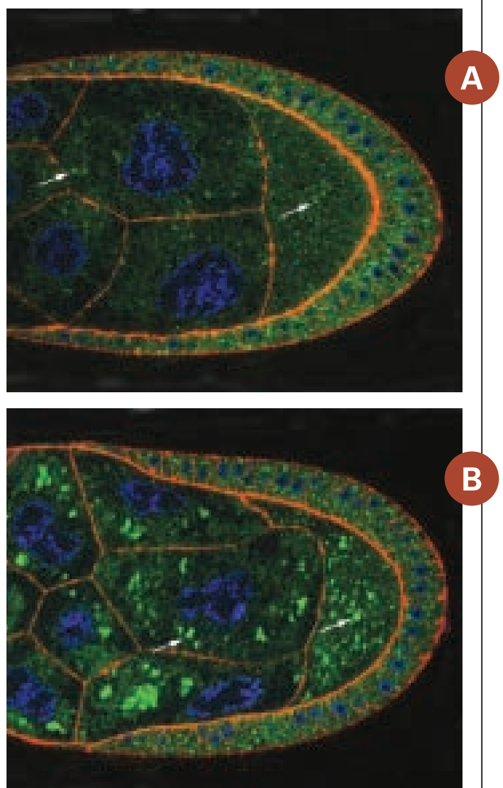
On December 12, the tiny craft successfully fired its bipropellant thruster for the first time since it was launched. The thruster is critical for maneuvers to help reach the innermost planet's orbit.

MESSENGER flew by Earth August 2, 2005, to adjust the spacecraft's path to Mercury using a gravity assist. The spacecraft team also used the flyby to test instruments and to observe the home planet. These twin images show Earth as it appears "normally" and in the infrared (right). To keep up with MESSENGER's progress go to http://messenger.jhuapl.edu/whereis/index.php.

Hitching an RNA Trailer to Protein Traffic at Embryology

A cell, like a miniature city, is made of unique neighborhoods that give it character and shape. Scientists long believed that the cell's biomolecular citizens, proteins and RNA, used separate transit systems to get around. But James Wilhelm and colleagues at Carnegie's Department of Embryology have found otherwise.

They discovered a single gene, which they named *trailer hitch* (*tral*), that links RNA and protein transport in the eggs of the fruit fly *Drosophila melanogaster*. The discovery opens up a new area of basic research, and might also have implications for developmental and nervous disorders such as fragile X syndrome, a common inherited form of mental deficiency with symptoms that can range from barely noticeable to debilitating. "We did this work in egg cells, but we believe *tral* is expressed more broadly," Wilhelm said. "We want to know what it's doing in other tissues. Hopefully this is just the tip of the iceberg."



Inside the cell, proteins shuttle through a convoluted network of membranes and channels, including the endoplasmic reticulum (ER) and the Golgi apparatus. But in *tral* mutants, the sites where traffic leaves the ER for the Golgi become muddled by large lumps of mismanaged proteins. These ER exit sites, stained green and marked by arrows, are abnormally large in mutant egg chambers (B) as compared with wild type (A).

Wilhelm studied fly eggs with a mutant *tral* gene and found several defects in protein trafficking. A healthy cell depends on a convoluted network of membranes and channels including the endoplasmic reticulum (ER) and the Golgi apparatus; proteins shuttle between these two structures and the cell surface in small membrane sacs. But in *tral* mutants, this process doesn't quite work as it should: the ER exit sites—where traffic leaves for the Golgi—become muddled by large lumps of mismanaged proteins.

The story became more interesting when Wilhelm's team sequenced the *tral* gene and found a striking resemblance to RNA-processing genes. Surprised, the researchers explored the possibility of a functional link between *tral* and RNA. They found that *tral*'s protein forms part of an RNA/protein complex that helps process and shuttle messenger RNAs throughout the cell.

The *tral* mutation causes problems as the egg develops into an embryo; for example, a protein that normally helps distinguish the top side from the bottom becomes tied up in the protein lumps at the ER exit sites. As a result, a proper top-to-bottom pattern is never established, and the embryo dies early.

"There are hints that *tral* is doing a lot of other things," Wilhelm said. A large variety of organisms have some form of the gene, but it is not yet clear if these genes serve the same functions, he added. For example, in the worm *Caenorhabditis elegans*, a mutant form of a *tral*-like gene interferes with the final stage of cell division. Normally, the cell membrane pinches in half to form two daughter cells, but in the mutants this process "goes almost all the way to completion and then snaps back," Wilhelm said. "It's possible the gene and protein complexes are the same across species, but their activity isn't. We're interested in finding new mutant phenotypes."

The gene could prove especially important in nerve cells, which depend heavily on the traffic of both RNA and protein. RNA localization helps to determine a neuron's orientation, which is vital for the development of nerve fibers. Protein trafficking is necessary for the release of neurotransmitters at the synapse. If a link is found between *tral* mutations and nerve defects, the gene could help in the search for therapies.

One such disease, called fragile X syndrome, results from a defect in RNA shuttling and has also been tied to faulty neurotransmitter release. Even though the condition is relatively common, researchers still have much to learn about its exact cause. In light of his group's results, Wilhelm has started to wonder about a connection between *tral*-like genes and fragile X.

The possibility of such a link is "an intriguing idea, and we may be able to uncover some connections," Wilhelm said. But he noted that researchers are just starting to characterize *tral*-like genes and their defects, so it may be a while before any connection to fragile X comes to light. "It's all very forward-looking at this point."

—BY MATTHEW EARLY WRIGHT

IN Brief

(Image courtesy Arnold Pryor.)

❶ John Lively (right) stands with Carnegie president Richard Meserve at the administration holiday party.

❷ Allan Spradling

Trustees and Administration

Trustee and Finance Committee chairman **David Swensen** was featured in the Oct. 10 *Time* magazine as "the best money manager in higher education."

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On July 19-20 and Sept. 20-21 Carnegie president **Richard Meserve** participated in the Consumer Energy Council of America's Fuels & Technology Forum. On Sept. 28-29 he was moderator and speaker at a session entitled "The Global Safety Regime–Setting the Stage," part of the General Conference of the International Atomic Energy Agency (IAEA) in Vienna. On Oct. 3-4 he attended the award ceremonies for the Carnegie Medals of Philanthropy in Scotland with trustees Gellert, Turner, Stone, and Crawford. On Oct. 19 he served on a visiting committee to MIT's Nuclear Engineering Department. On Nov. 1 he was moderator for the Opening Plenary Session of the Norwegian Embassy Climate Seminar held at the Carnegie administration building. On Nov. 2 he delivered a talk on the Carnegie Mellon U. Speaker Series on "The Nuclear Renaissance in the United States," and on Nov. 7-9 he chaired a meeting of the International Nuclear Safety Group in Vienna. In a reprise of his previous federal position, on Dec. 10 Meserve played the role of chairman of the Nuclear Regulatory Commission in a simulated meeting of the National Security Council as part of an exercise concerning terrorist attacks on two nuclear plants. It was held at Andrews Air Force Base and was conducted by the Center for International and Strategic Studies.

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❶ **John Lively**, Carnegie's director of administration and finance for the last 15 years, has retired. A luncheon was held in his honor at the Cosmos Club in Washington, D.C., Dec. 16.

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Matthew E. Wright joined the Carnegie publications office as science writer and publications coordinator. He comes from the UC-Santa Cruz Science Communication program and holds an M.S. in biology from Arizona State U.

Hemley and Mao **Awarded Balzan Prize**

(Image courtesy the International Balzan Foundation.)

The International Balzan Foundation awarded GL's **Russell Hemley** and **Ho-kwang (Dave) Mao** the 2005 Balzan Prize for mineral physics on Nov. 11. Hemley and Mao's high-pressure physics team subjects matter to intense pressure and temperature. Their work has led to the discovery of previously unknown properties and structures of matter as well as to the creation of entirely new substances, and continues to shed light on the constitution of planetary interiors and the study of materials science.

The Balzan Prize is awarded to scientists, artists, and institutions for outstanding achievements in humanities, social sciences, physics, mathematics, natural sciences, and medicine. Hemley and Mao received 1,000,000 Swiss francs (about $800,000), half of which will be devoted to projects involving young researchers.

Ho-kwang (Dave) Mao (above left) and Russell Hemley pose at their hotel on Nov. 11, the day they received the Balzan Prize at the Swiss Houses of Parliament.

Embryology

❷ **Allan Spradling** was elected president of the Genetics Society of America for 2006. He gave keynote addresses at the NIDDK Cellular Niches Workshop in Bethesda on May 16-17, and at the Juan March Foundation Workshop on Plant Stem Cells in Madrid, May 23-25. He also spoke at an NCI Workshop on epithelial and cancer stem cells in Colorado.

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Joseph Gall gave an invited talk and chaired a session at the first EMBO/FEBS Conference on Nuclear Structure and Dynamics in La Grande Motte, France, Sept. 24-28.

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Biswajit Das is now at the National Institute of Child Health and Human Development at NIH.

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Johns Hopkins U. graduate student **Zehra Nizami** is doing a rotation in the Gall lab.

Geophysical Laboratory

Wes Huntress was appointed to NASA's Advisory Committee by NASA administrator Michael Griffin. The committee is a panel of outside scientists and engineers that convenes several times annually to advise the agency. He was also invited to join the Executive Forum of NASA's Ames Research Center in Moffett Field, CA.

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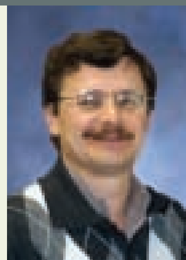
Ho-kwang (Dave) Mao received the prestigious Roebling Medal, the Mineralogical Society of America's highest award, at the GSA/MSA Meeting in Salt



Alexander Goncharov

Geophysical Lab **Alumnus Returns**

High-pressure researcher **Alexander Goncharov,** a GL alumnus from 1993 to 2002, returned to the department as a staff member this summer. Goncharov came to Carnegie initially as a fellow; he then became a senior research associate and later a research scientist. This July he left his post as a staff scientist at Lawrence Livermore National Laboratory to rejoin Carnegie.

Goncharov received his B.S. and M.S. from the Moscow Institute of Physics and Technology, and in 1983 received his Ph.D. in physics and mathematics from the Institute of Spectroscopy, Russian Academy of Sciences. He began his career at the Institute of Crystallography, Russian Academy of Sciences, and rose to become a world-recognized expert in optical spectroscopy under high pressure. In 1991 his work won the annual European High Pressure Research Group Award for young scientists. Also in 1991 he was awarded a prestigious Humboldt Fellowship in Germany (MPI Stuttgart). At the Geophysical Laboratory today he continues to lead the field of optical spectroscopy under extreme conditions of high pressure and temperature.

❸ Chris Field (left) at Jasper Ridge Biological Preserve.

Lake City, Oct. 16-19. He also gave an invited talk at Hydrogen Workshop 2005 in Bad Honnef, Germany, Oct. 24-28.

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Russell Hemley gave an invited talk at the Stewardship Science Academic Alliances Program Symposium in Las Vegas, Aug. 23-24. He also spoke at the First International Industrial Diamond Conference in Barcelona, Oct. 20-21, and at the GSA Annual Meeting in Salt Lake City, Oct. 16-19.

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Robert Hazen delivered the Mineralogical Society of America's presidential address at the GSA meeting in Salt Lake City, Oct. 16-19. He gave radio interviews for KDKA in Pittsburgh, for WBAI in NY, and for NPR's *Earth and Sky* program. Hazen was also appointed by the NAS to revise their *Science and Creationism* pamphlet.

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Nabil Boctor presented at the Meteoritical Society Meeting in Gatlinburg, TN, Sept. 12-16.

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Former postdoc **Olga Degtyareva** is now a CDAC research scientist. She gave an invited talk and presented a poster at the XX Congress of the International Union of Crystallography in Florence, Italy, Aug. 23-31.

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Muhetaer Aihaiti gave a talk at the 14th International Conference on Internal Friction and Mechanical Spectroscopy in Kyoto, Sept. 3-10.

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Postdoctoral fellow **Steven Jacobsen** taught a short course in experimental geophysics at the Bayerisches Geoinstitut in Bayreuth, Germany, in Oct.

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Razvan Caracas gave an invited talk at the VLAB workshop in Minneapolis, MN, July 19-24, and spoke at the 2005 AGU Spring Meeting in New Orleans, May 23-27. He also spoke at the GSA Annual Meeting in Salt Lake City, Oct. 16-19.

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Former postdoctoral research associate **Lars Ehm** is now a visiting investigator.

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New arrivals at GL include **Jennifer Ciezak,** a postdoctoral associate from Syracuse U.; **Patrick Griffin**, an NAI predoctoral associate from George Mason U.; **Jennifer Jackson,** a postdoctoral fellow from U. Illinois; **Elizabeth Cottrell Stevenson**, a postdoctoral fellow from Lamont-Doherty Earth Observatory; **Yu Wang,** a predoctoral fellow; and **Wenge Yang,** a beamline scientist at HPCAT.

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Valentina Degtyareva is a visiting investigator from Russia.

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Visiting investigator **Gudmundur Gudfinnsson** has returned to Kopavogur, Iceland.

Global Ecology

❸ **Chris Field** is the new faculty director of Stanford U.'s Jasper Ridge Biological Preserve.

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Greg Asner spoke at the Gordon Research Conference on CO_2 Assimilation in Plants in Aussois, France, on Sept. 11-16, and gave a radio interview for NPR's *All Things Considered* program.

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Ken Caldeira spoke at the Seventh International CO_2 Conference in Boulder, CO, Sept. 25-30, and gave a radio interview for NPR's *Earth and Sky* program.

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Todd Tobeck is now a laboratory coordinator in the Field lab.

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Lisa Moore completed her thesis and left the Field lab to begin a one-year Lokey Fellowship at Environmental Defense in New York City.

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David Kroodsma began a bicycle tour from Palo Alto, CA, to southern Argentina to raise awareness about climate change. His progress can be monitored at www.rideforclimate.com.

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Halton Peters was granted a research fellowship by UNIDO's Northeast Asia Office.

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Rebecca Raybin and **Tim Varga** joined the Asner lab as lab assistants.

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Stanford Ph.D. student **Angelica Almeyda** joined her husband, **Eben Broadbent,** in the Asner lab.

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Winston Wheeler completed his M.S. work in the Asner lab.

Observatories

Director **Wendy Freedman** was the recipient of AAPT's 2005 Klopsteg Memorial Award, presenting her lecture, "The Accelerating Universe," on Aug. 8 at the AAPT Summer Meeting at U. Utah in Salt Lake City. On Aug. 24 she delivered a talk about Carnegie Observatories and its exciting new project, the GMT, to the

❹ Chris Somerville

Pasadena Rotary Club. More than 200 people were in attendance. Sept. 28 found her at Gustavus Adolphus College, St. Peter, MN, to address the 41st Nobel Conference, "The Legacy of Einstein," speaking on "The Legacy of Albert Einstein for Cosmology." She was the invited speaker at the XVII International Conference on Particles and Nuclei, Santa Fe, Oct. 24-28. Her talk, "Frontiers of Cosmology: Recent Successes and Future Challenges," was delivered on Oct. 25.

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In Nov. **Steve Shectman** attended the review for the ESO Overwhelmingly Large Telescope in Garching, Germany.

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In July **François Schweizer** attended a conference at UC-Santa Cruz celebrating the 60th birthdays of George Blumenthal, Carnegie trustee Sandra Faber, and Joel Primack. He read a tribute from Vera Rubin to Sandra Faber, reminiscing about the early days at DTM.

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Luis Ho gave an invited talk at the meeting "Extreme Starbursts" in Lijiang, China; a colloquium at U. Wisconsin-Madison, and a colloquium at Seoul National U. He also gave an invited talk at the Yukawa Institute of Theoretical Physics, Kyoto, and at the "AGNs and Galaxy Formation" meeting at Castel Gandolfo, the Vatican.

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Adaptive optics systems engineer **Alex Athey** received the Ralph B. Baldwin Prize in Astrophysics and Space Sciences at U. Michigan-Ann Arbor for his thesis, "The Origin and Evolution of the Interstellar Medium in Early-Type Galaxies." He also gave an invited lecture on his thesis work.

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The fall Carnegie colloquium, "New Insights into the Nature of r-Process-Rich Stars," was given by Carnegie-Princeton Fellow **Inese Ivans**. She participated in the Annual Keck Science Meeting at Caltech on Sept. 23, and in the 2005 HST Calibrations Workshop at STScI, Oct. 26-28. She also participated in the NOAO Time Allocation Committee as a panel member of the Galactic TAC, Nov. 2-5.

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George Wallerstein of U. Washington visited Oct. 16-19 to collaborate on a globular cluster project. He spoke on "The Unusual Globular Clusters NGC 6388 and 6441" on Oct. 19.

Chesapeake Bay Impact **Crater Drilling Project**

On Oct. 19 GL's **Andrew Steele, Verena Starke, Penny Morrill, Jen Eigenbrode,** and **Jake Maule** visited the USGS Chesapeake Bay Impact Crater drill site on the Delmarva Peninsula. The USGS and the International Continental Scientific Drilling Program (ICDP) are drilling 2.2 kilometers below the surface of the crater, thought to have formed from a giant impact approximately 35 million years ago. The GL team tested for microbial lipids in core material from 3,000 feet below the surface.

GL's Jake Maule and Verena Starke swab a 3,000-foot core sample while USGS scientists Mary Voytek and Julie Kirshtein look on.

Plant Biology

Kathy Barton was elected to the Genetics Society of America's board of directors.

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❹ **Chris Somerville** presented the Woolhouse Lecture at the John Innes Institute on July 15. His talk, "Genetic Dissection of Cell Wall Synthesis," was also presented at the Plant Gene Expression Center, Albany, CA, on Sept. 13, and at Michigan State U. on Oct. 10.

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On Aug. 14 **Zhiyong Wang** gave a seminar at the Summer Workshop on Plant Molecular Biology at Beijing U. On Oct. 21 he visited the Bioscience and Biotechnology Center, Nagoya U., Japan, and gave the seminar "Brassinosteroid Signal Transduction and Transcriptional Regulation." He gave a similar seminar on Oct. 25 at the Institute of Biotechnology, Chinese Academy of Agricultural Sciences, Beijing. On Oct. 27-29 he attended the International Conference on the Frontiers of Plant Molecular Biology in Shanghai and gave a talk. He also spoke at the Symposium on Frontiers of Plant Biology, in Hainan Dao, China, Nov. 2.

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Yinglang Wan joined the Winslow Briggs lab as a predoctoral student. Wan arrived Sept. 21 from the Institute of Cellular and Molecular Botany at U. Bonn, Germany.

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Shauna Somerville's lab welcomed postdoc **Rieko Nishimura** from UC-Berkeley on Sept. 1.

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New lab assistant **Asif Haque** joined the Wang lab on Sept. 1.

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Thijs Kaper was awarded a three-year research fellowship from Wageningen U., Netherlands, to continue his research in the Frommer lab. **Totte Niittyla,** also in the Frommer lab, was awarded a Human Frontier Science Program Fellowship for three years to continue his research. **Keren Bracha-Drori** (Ph.D., U. Tel Aviv) joined the lab as a postdoc on Sept. 16. **Agnes Harms,** a visiting predoctoral student in the Frommer lab, returned to Germany on Aug. 30.

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David Swarbreck (Sanger Institute, Hinxton, UK) is a new curator in the Rhee TAIR group.

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The Bhaya lab welcomed postdoc **Oliver Kilian** from Melbourne, Australia, on July 20. Graduate student **Kenlee Nakasugi** from Brett Neilan's lab at U. New South Wales arrived on Oct. 24 for a visit to the Bhaya lab.

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Heather Youngs, a postdoc in Chris Somerville's lab, left on Aug. 31 for a position as assistant professor at Michigan Technical U.

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Marc Nishimura from Shauna Somerville's lab has taken a postdoctoral fellow position in Jeff Dangl's lab at U. North Carolina-Chapel Hill. **Mónica Stein** returned to Guatemala to do educational outreach.

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Lab assistant for the Somerville labs **Radhika Garlapati** left for a job in the business sector on Sept. 30.

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The Barton lab had two postdoc departures. **Nicholas Kaplinsky** left on Aug. 31 to become an assistant professor in the biology department at Swarthmore College, and **Mamatha Hanumappa** departed on Sept. 15 to take a postdoc position at U. Missouri.

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The Rhee TAIR group said good-bye to postdoc **Shijun Li,** who left for the Dept. of Urology, Stanford U., on Oct. 14, and curator **Nick Moseyko,** who left for a programmer/analyst position at UC-Berkeley on Oct. 15.

Terrestrial Magnetism

In Sept. **Sean Solomon** chaired the external Advisory Council to the Southern California Earthquake Center and served on a visiting committee to the Berkeley Geochronology Center. In Oct. he chaired visiting committees to U. Chicago and Rice U. He also delivered a paper on the MESSENGER Mission to Mercury at the Annual Meeting of the Geological Society of America in Salt Lake City, and a seminar on the same topic to the U.S. Naval Observatory in Nov.

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Senior Fellow **Vera Rubin** participated in a roundtable discussion on "Science of the Future" in July to celebrate the 125th anniversary of *Science* magazine. Also in July, Rubin and **Alycia Weinberger** traveled to Tucson to celebrate the first mirror casting of the Giant Magellan Telescope. Rubin and **Sara Seager** spoke at a memorial tribute to astrophysicist John Bahcall at the Institute for Advanced Study in Princeton in Oct. Rubin was featured in the Oct. 24 issue of *Newsweek*, which highlighted women's leadership roles in the 21st century.

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Alan Boss appeared on NBC *Nightly News* in July regarding the claimed discovery of the 10th planet in our solar system. In Sept. Boss spoke about NASA's Kepler Mission at George Mason U., and on giant planet formation at U. Texas-Austin. Boss gave a talk at the NASA Astrobiology Institute workshop on "Disk Chemistry," in Waikoloa, HI, in Oct. Also attending were **Alycia Weinberger** and postdoctoral fellows **Hannah Jang-Condell** and **Isamu Matsuyama.** Also in Waikoloa in Oct., Boss reviewed work on gravitational instabilities in protoplanetary disks at the Protostars and Planets V Conference, and spoke about extrasolar planets in a public lecture associated with that meeting. In Nov. Boss described recent progress in discovering and understanding extrasolar planetary systems at the Kepler Mission Science Team meeting at the NASA Ames Research Center in California.

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Several DTM scientists presented papers at the Meteoritical Society meeting in Gatlinburg, TN, in Sept. **Maud Boyet** and **Rick Carlson** spoke on "New ^{146}Sm-^{142}Nd Constraints on Moon Formation and Early Silicate Planetary Differentiation," and postdoctoral fellow **Henner Busemann** spoke on "Extreme H Isotopic Anomalies in Chondritic Organic Matter." **Larry Nittler** presented papers at both the Meteoritical Society and the Workshop on Oxygen in the Earliest Solar System Materials, also in Gatlinburg.

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In Sept. and Oct. **Henner Busemann** visited the Swiss Federal Institute of Technology, Zurich, and the Max Planck Institute for Chemistry to analyze interplanetary dust particles and meteoritic organic matter.

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Rick Carlson and **David James** led the first workshop on the Central Eastern Oregon Project in association with the annual meeting of the Geological Society of America in Salt Lake City in Oct. This project is a multi-institutional investigation into the causes of extensive volcanism in the Pacific Northwest. A field trip through a portion of eastern Oregon, led by former DTM postdoctoral fellow **Bill Hart,** followed the workshop.

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This summer **Steve Shirey** and **Rick Carlson** worked with former postdoctoral fellow **Mark Schmitz** on diamonds and xenoliths from the Kaapvaal Craton. Ph.D student Craig McClung of U. Johannesburg also worked with Shirey on the Re-Os systematics of South African massive sulfide ores. In Sept. Shirey gave the first department colloquium of the academic year at the Dept. of Geology at U. Maryland-College Park.

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John Chambers presented a paper on planetary accretion at the annual meeting of the Division for Planetary Sciences of the AAS in Cambridge, England, in Aug. He gave invited talks in Oct. at the U.S. Naval Observatory on the midstages of planet formation. In Nov. he spoke on the formation and early impact history of the inner planets at the MESSENGER Science Team meeting at the Applied Physics Laboratory.

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In Sept. postdoctoral fellow **Catherine Hier-Majumder** presented a poster at the 9th International Workshop on Numerical Modeling of Mantle Convection and Lithospheric Dynamics, in Erice, Italy. In Nov. she gave a talk at U. Maryland-College Park, "Interiors of Planetary Bodies: Formation of Iron Cores in Terrestrial Planets and Methods

Desert RATS in Arizona

Arizona's high desert might not be as tough an environment as Mars, but few other places on Earth have the right elements—including windblown grit and dust, rough terrain, and dramatic temperature swings—to simulate conditions on the Red Planet. Desert Research and Technology Studies (RATS) is a NASA-led expedition to Meteor Crater, Arizona, to test equipment intended for use on Mars. With the help of GL's Jake Maule, crew members tested GL's "lab-on-a-chip" microbial detection instruments while wearing pressurized, fully functional space suits. The team also developed an effective protocol to monitor and control microbial levels on the space suit.

Jake Maule tests for microorganisms with GL's lab-on-a-chip instrument at Meteor Crater, Arizona (above). An astronaut swabs his glove (right).

❺ Legacy Project members from left to right, John Strom, Ann Mulfort, Shaun Hardy, and Jennifer Snyder.

The annual Broad Branch Road picnic for members of the campus and their families and the staff from P Street was held in Oct. After a buffet-style barbecue prepared by BBR, the two departments took part in the second annual DTM/GL Olympic games.

for Characterizing Interiors of Extrasolar Planets."

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In Nov. postdoctoral fellow **Mercedes López-Morales** and collaborators presented their research on low-mass eclipsing binaries and galactic halo globular clusters at three invited talks at the 7th Rim Conference in Astrophysics, in Seoul.

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Postdoctoral fellow **Ivan Savov** conducted detailed mapping of several hundred dikes and related circular volcanic conduits in Utah with colleagues from U. South Florida for clues on how magma propagates hours before eruption and the effect on host rock assimilation into the viscosity, volatile contents, and overall eruption dynamics.

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In Aug. postdoctoral fellow **Alison Shaw** explored volcanoes along the Izu island arc in Japan for volcanic gas and rock samples. She also gave talks at U. Tokyo and at the Geological Survey of Japan.

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Postdoctoral fellow **Margaret Turnbull** presented an invited seminar at the astronomy department of U. Maryland-College Park.

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Postdoctoral fellow **Kaspar von Braun** gave a talk at the NASA Astrobiology Institute in Aug.

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In Sept. **Alycia Weinberger** participated in the Congressional Visits Day sponsored by the Coalition for National Science Funding; served on the NASA Keck Time Allocation Committee in Columbus, OH; participated as a member of the Magellan Science Advisory Committee in Ann Arbor, MI; and gave the Capital Science Evening lecture "Our Solar System and Others Not So Like It."

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Steven Beckwith, former director of the Space Telescope Science Institute and now a member of the institute staff and a professor at The Johns Hopkins U., visited DTM in Sept. and Oct. as the Merle A. Tuve Senior Fellow. On Oct. 19 he delivered a lecture, "The Hubble Ultra Deep Field: The Assembly of Young Galaxies."

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Several new postdoctoral fellows arrived in the fall: **Alceste Bonanos**, **Catherine Cooper, John Debes, Isamu Matsuyama, Ivan Savov,** and **Lara Wagner**.

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Alicia Case, a May graduate of U. Puget Sound in Tacoma, joined DTM as an administrative assistant in Aug. She majored in English and wrote and edited for several years at her school's Office of Communications.

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Web and publications coordinator **Alexis Clements** departed DTM in Sept. to pursue an M.Sc. degree in philosophy of science at the London School of Economics and Political Science.

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Visiting investigator **Jay Frogel** left at the end of July for a part-time position at U. Maryland-College Park as codirector of an undergraduate honors seminar. Frogel will also consult for the Association of Universities for Research in Astronomy (AURA).

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Kaspar von Braun and **Maud Boyet** departed DTM in Oct. Boyet returned to France and von Braun accepted a postdoctoral fellowship at the California Institute of Technology.

GL/DTM

The CIW NASA Astrobiology Institute interteam meeting was held at DTM in Oct. Presenters included DTM's **Alan Boss** and **Conel Alexander;** David Johnston, U. Maryland; David Deamer, U. California-Santa Cruz; and Jay Brandes, U. Texas-Austin. Afternoon discussion sessions were chaired by DTM's **Larry Nittler** and **John Chambers** and by GL's **Robert Hazen** and **Andrew Steele.** Approximately 40 of the CIW team members participated in the day's events.

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Librarian **Shaun Hardy** presented a talk on the Carnegie Legacy Project at the Geological Society of America meeting held in Salk Lake City in Oct.

Jerry Davis joined the BBR staff in Sept. as an apprentice building engineer.

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❺ Legacy Project archivists **Ann Mulfort** and **Jennifer Snyder** concluded their archival work for DTM and GL. The departments' archives now have field and laboratory notebooks, equipment designs, plans, unpublished correspondence, and thousands of expedition photographs documented and organized.

DTM and NASA celebrated 50 years of radio astronomy in Sept. A Maryland state historical marker was unveiled near the site of the radio antenna array with which DTM staff members **Bernard Burke** and **Kenneth Franklin** discovered radio emissions from Jupiter in 1955. A symposium held on campus featured talks by Burke, the William A. M. Buren Professor of Astrophysics at MIT; Joseph Alexander, National Academies Space Studies Board; and Joseph Laxio, Naval Research Laboratory. A luncheon and reception followed. Librarian **Shaun Hardy** displayed DTM's work in radio astronomy.

Bernard Burke, codiscoverer of the "voice of Jupiter," stands next to the new historical marker commemorating the event near Seneca, MD, 50 years ago.

More Construction . . .

A stunning new facility is rising from the remnants of the old Experiment Building on the Broad Branch Road Campus, home of the Geophysical Laboratory and the Department of Terrestrial Magnetism in Washington, D.C. The David Greenewalt Building, named for the longtime Carnegie friend and former secretary of the Carnegie board, is expected to be completed in March. The facility will be the social and intellectual hub of the two-department campus. It will feature a 1,800-square-foot auditorium for scientific and public lectures and other gatherings; conference rooms and galleries; and a kitchen and eating area where the decades-old lunch club will continue its culinary tradition.

(Image courtesy Gary Bors.)

The architectural rendering (below) shows the finished David Greenewalt building on the Broad Branch Road campus. Greenewalt's daughter and son (from left), Charlotte and Frederick , stand with Terrestrial Magnetism director Sean Solomon, director of the Geophysical Laboratory Wes Huntress, and Susanne Garvey of external affairs at the front of the building in January.

Carnegie Earns Highest Award for Fiscal Management

Charity Navigator, the largest charity evaluator in the U.S., has awarded Carnegie its highest, four-star rating for sound financial management for the fifth year in a row. Charity Navigator uses data-driven analysis to make their evaluations. Less than 12% of the charities they rate "have received at least two consecutive four-star evaluations, indicating that the Carnegie Institution of Washington outperforms most charities in America in its efforts to operate in the most fiscally responsible way possible."

Further information may be found at www.charitynavigator.org

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