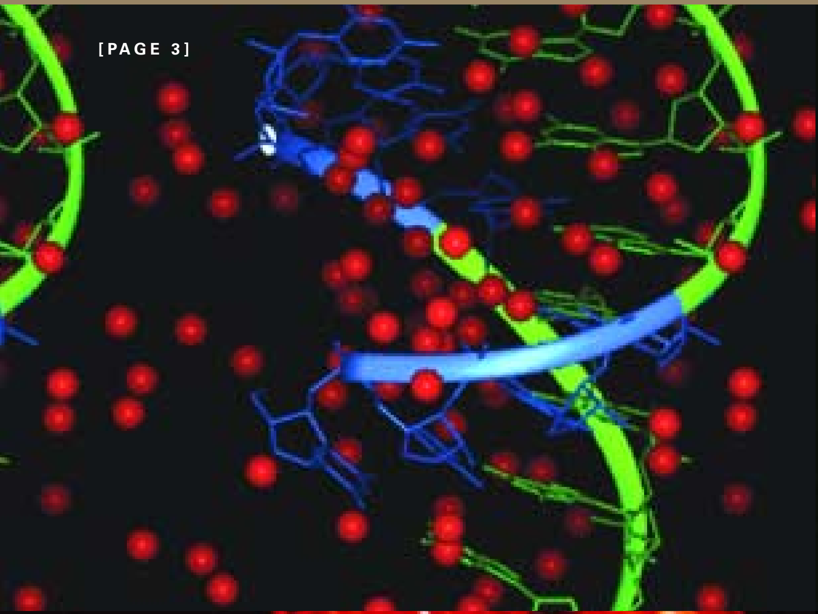
NOBEL PRIZE page 3

CarnegieScience

THE NEWSLETTER OF THE CARNEGIE INSTITUTION [FALL 2006]

[PAGE 3]

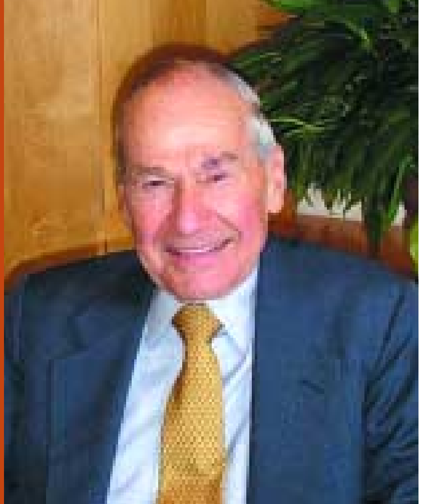


[PAGE 10]

[PAGE 11]

Inside

- DEPARTMENT OF EMBRYOLOGY
- GEOPHYSICAL LABORATORY
- DEPARTMENT OF GLOBAL ECOLOGY
- THE OBSERVATORIES
- DEPARTMENT OF PLANT BIOLOGY
- DEPARTMENT OF TERRESTRIAL MAGNETISM
- CASE/ FIRST LIGHT



Carnegie Institution of Washington

1530 P Street, NW
Washington, D.C.
20005-1910

202.387.6400
www.CarnegieInstitution.org

As an institution founded with a mandate to conduct basic scientific research, Carnegie can often appear removed from the problems that dominate our headlines. Indeed, stories of violent crime, scandal, and complicated political problems can sometimes seem like dispatches from another frontier.

The institution also seems distant from people who tackle issues of social gravity. One could easily conclude that Carnegie's explorations of the nature of life, the Earth, and the cosmos have little to do with issues that are germane to our daily lives.

Is this perceived gulf as wide as it seems? As a nonscientist, I am struck by how the passage of time can illuminate the value of basic research. Throughout the institution's history, many of our scientists' fundamental discoveries have laid the foundation for solutions to vexing real-world problems. This translation may take anywhere from months to decades, but Carnegie's work has undoubtedly affected the way we care for our ill, cultivate our food, and mitigate the hazards of Mother Nature. Some examples come to mind:

Andrew Fire, formerly at the Department of Embryology, and his colleague Craig Mello of the University of Massachusetts devised a technique to selectively block the expression of specific genes, called RNA interference, or RNAi. They just won the Nobel Prize for this work (see page 3). Today, this incredibly versatile tool is used in biomedical laboratories the world over to explore the most pressing research questions relating to human cancer and other diseases.

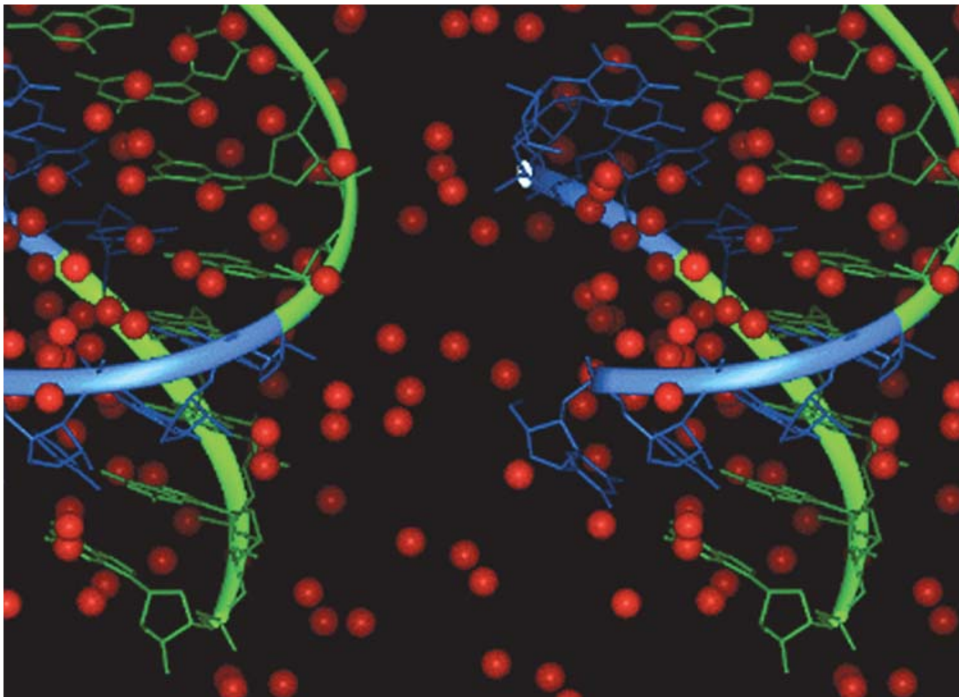
Chris Somerville, director of our Department of Plant Biology, was an early and outspoken champion of *Arabidopsis thaliana*, a relative of the mustard plant, as a model for studies of plant genetics and physiology. He also led the push to sequence this plant's genome. Today, this knowledge has enabled the engineering of plants with greater nutrient content, enhanced disease resistance, and increased yields—essential in the effort to create fuel from plants and to feed a growing world population. His work has earned him a share of this year's prestigious Balzan Prize in Plant Molecular Genetics.

Selwyn Sacks of the Department of Terrestrial Magnetism and his colleague Dale Evertson of the University of Texas coinvented the borehole strainmeter, a sensitive instrument that can measure subtle shifts in rock. These devices enabled the discovery of a phenomenon known as "slow" earthquakes. Today, Sacks and his close collaborators Alan Linde, instrument maker Nelson McWhorter, and others have installed strainmeter networks in many corners of the globe, helping to bring us closer than ever to understanding potentially dangerous earthquakes and the "plumbing" of volcanoes.

Given our scientists' track record, it is tempting to speculate about the future impact of basic research at Carnegie today. For example, it is easy to envision the benefits of the Carnegie Landsat Analysis System, developed by Greg Asner's group at Global Ecology, with its ability to reveal environmental destruction that other analysis tools had missed. Geophysical Laboratory staff members such as Viktor Struzhkin, Ronald Cohen, Alexander Goncharov, Chih-Shiue Yan, Russell Hemley, and Ho-kwang Mao are pushing the boundaries of materials science, including the rapid synthesis of diamonds that are harder and clearer than natural crystals; together, the fruits of their labor may one day revolutionize electronic and other devices we depend on every day. And as Observatories astronomers Wendy Freedman, Pat McCarthy, Matt Johns, Steve Shectman, and others lead the charge to build the Giant Magellan Telescope, we expect that we will one day be able to peer into the earliest reaches of time.

Like many of us, I am graying. Contrary to popular opinion, I find that age does not necessarily confer more patience. But I recognize that when it comes to Carnegie and its work, the perspective of time is important. Andrew Carnegie was wise to assert, over 100 years ago, that the seeds of basic research would yield a bumper crop of knowledge that can vastly improve our quality of life, even in the near term, while enriching the intellectual soil for future discoveries.

—Michael E. Gellert, *Chairman*



EMBRYOLOGY ALUMNUS ANDREW Z. FIRE SHARES

NOBEL PRIZE

(Above left, image courtesy IMB Jena Image Library of Biological Macromolecules.)
(Above right, image courtesy Linda A. Cicero/Stanford News Service.)
(Below right, registered trademark of the Nobel Foundation.)

Andrew Z. Fire, who discovered RNA interference (RNAi) while at Carnegie's Department of Embryology, along with Craig C. Mello of the University of Massachusetts Medical School, was awarded the 2006 Nobel Prize in Physiology or Medicine on October 2.

The Fire-Mello discovery that double-stranded RNA can quash the activity of specific genes is a major breakthrough in modern molecular biology. RNAi is now used as a research tool and for the development of products that could combat diseases such as cancer and HIV.

"Every one of us at Carnegie is thrilled for Andy, for the institution, and for the promise this discovery has for advancing our understanding of basic molecular processes and helping cure disease," said Carnegie president Richard A. Meserve. "Andy's work is a vivid example of how Carnegie's commitment to freedom of research can yield extraordinary results for humanity." Fire was employed by Carnegie for 17 years. He joined the faculty of Stanford University in November 2003 to be closer to his family.

THE DISCOVERY

In 1997 the Fire-Mello team found that by specially designing RNA with two strands they could silence targeted genes. The single-stranded RNA molecule of messenger RNA, also known as "sense" RNA, conveys information from a DNA template to the machinery that "turns on," or expresses, a specific gene. The Fire-Mello RNA molecule has two strands similar to the famous double-helix structure of the related molecule DNA. One strand of the double-stranded RNA molecule is sense RNA, with a structural sequence that is the same as the nucleotide sequence in the target gene. The other strand, known as "antisense" RNA, has a complementary sequence to that in the target gene. When the double-stranded molecule is

The Nobel Prize Medal for Physiology or Medicine.

A model of ribonucleic acid, RNA, appears upper left. There are several forms of RNA; all are involved in protein synthesis.

Andrew Z. Fire (top right) appears at a press conference about his shared Nobel Prize on October 2.

(Image courtesy Andrew Fire.)

Carnegie alumnus and Nobel Prize winner Andrew Fire stands with members of his Carnegie lab in 2001. Fire is in the center in the blue jacket.

Fire (center) is congratulated by students in his Stanford office.

(Image courtesy Linda A. Cicero / Stanford News Service.)

introduced into an organism, it interferes with the message-carrying process and shuts down the gene.

RNAi also exists naturally as a defensive mechanism in cells. Using RNAi, scientists now routinely "knock out" specific genes to prevent their expression, observe the disruptions to normal processes, and thereby help determine what the gene does. The method also opens up the possibility of treating various types of diseases by either shutting down the disease-causing gene or by directing researchers to appropriate pathways for developing new drugs. The Fire-Mello discovery is patented and has been widely licensed in the U.S., Europe, and elsewhere.

THE MAN BEHIND THE PRIZE

Fire, a California native, received an A.B. in mathematics from the University of California, Berkeley, in 1978. He went to the Massachusetts Institute of Technology (MIT) for graduate work, studying RNA polymerase type 2 transcription under Phillip Sharp, a Nobel laureate in gene research. Fire received his Ph.D. from MIT in 1983 and won a Helen Hay Whitney Fellowship to conduct research on the nematode *Caenorhabditis elegans* at the Medical Research Council Laboratory of Molecular Biology in Cambridge, England, under the guidance of Sydney Brenner.

In 1986 Fire was appointed a staff associate at Carnegie's Department of Embryology, ordinarily a nonrenewable junior faculty position. However, Fire's research progress was so significant that he was promoted to the position of staff member. Staff members at the department automatically receive an unpaid part-time position in the Department of Biology at The Johns Hopkins University. Fire joined the faculty of Stanford University in November 2003, but maintains strong ties with Carnegie as a Carnegie Investigator.

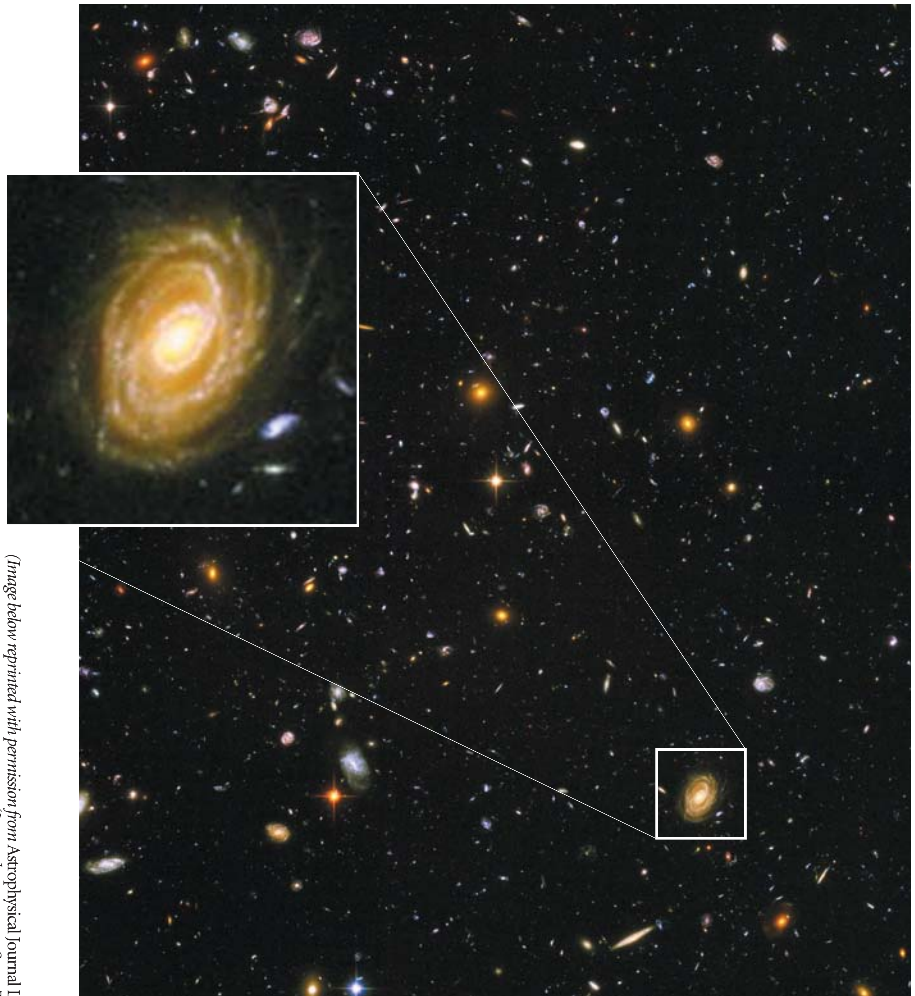
Tipping the Mass Scales at the Edge of the Visible Universe

Astronomers have taken an amazing pair of toddler snapshots—infrared pictures of two very young galaxies at the farthest reaches of the visible universe. Data from the images have revealed the mass, age, distance, and star formation rates of these celestial cherubs. The discovery has further expanded the frontiers of the known universe while providing important clues about the evolutionary origins of galaxies like our Milky Way.

Carnegie Fellow Ivo Labbé, along with colleagues at the University of California, Santa Cruz, and the Leiden Observatory in the Netherlands, examined galaxies in the Hubble Ultra Deep Field (UDF) using the powerful Infrared Array Camera (IRAC) aboard the Spitzer Space Telescope. The UDF, scanned by the Hubble Space Telescope in late 2003 and again by the Very Large Telescope and Magellan Baade Telescope in 2004, remains the deepest view ever taken in the visible and near-infrared light wavelengths. The combination of these data with Spitzer's new mid-infrared observations proved essential for Labbé's team to confirm the reality and physical properties of the distant galaxies.

"Spitzer is an amazing little machine," Labbé said. "Who would have predicted that a small 0.85-meter telescope could see sources 12.7 billion light-years away?" Though astronomers have observed faraway galaxies before, these are the most distant for which detailed physical characteristics have been calculated. "I am certain that we would never be able to confirm the existence of these galaxies, let alone calculate their stellar mass and age, without these data," Labbé added.

As seen by Spitzer, the two galaxies existed when the universe was just a baby—750 million years after the Big Bang. They were between 50 and 200 million years old—infants themselves,



(Image above courtesy Space Telescope Science Institute, S. Beckwith, NASA, ESA, and the UDF team.)

(Image below reprinted with permission from Astrophysical Journal Letters*, Vol. 649, p. L67. Copyright 2006 American Astronomical Society.)*

This image is a section of the Hubble Ultra Deep Field (HUDF), the deepest picture of the universe ever taken in visible and near-infrared light wavelengths. The image looks nearly 13 billion years back in time. A closer look (inset) shows that the image is filled with countless galaxies at the edge of the visible universe.

The series of images below shows two galaxies found in the HUDF, dubbed 964 and 1417, which existed 750 million years after the Big Bang. Data from the images allowed researchers to calculate their mass, age, distance, and star formation rates, making these the youngest and most distant galaxies for which this information exists.

From left, the first four columns were taken with cameras aboard the Hubble Space Telescope: i_{775} and z_{850} were taken in visible light wavelengths with the Advanced Camera for Surveys (ACS), while J_{110} and H_{160} were taken in near-infrared wavelengths with the Near Infrared Camera and Multi-Object Spectrograph (NICMOS). The final two columns, 3.6 μm and 4.5 μm, were taken in the mid-infrared with the Infrared Array Camera (IRAC) aboard the Spitzer Space Telescope.

by galactic standards. The galaxies are on the small side, which is not surprising given their youth; like human babies, galaxies tend to get bigger as they age. For example, our full-grown Milky Way is about 100 times more massive.

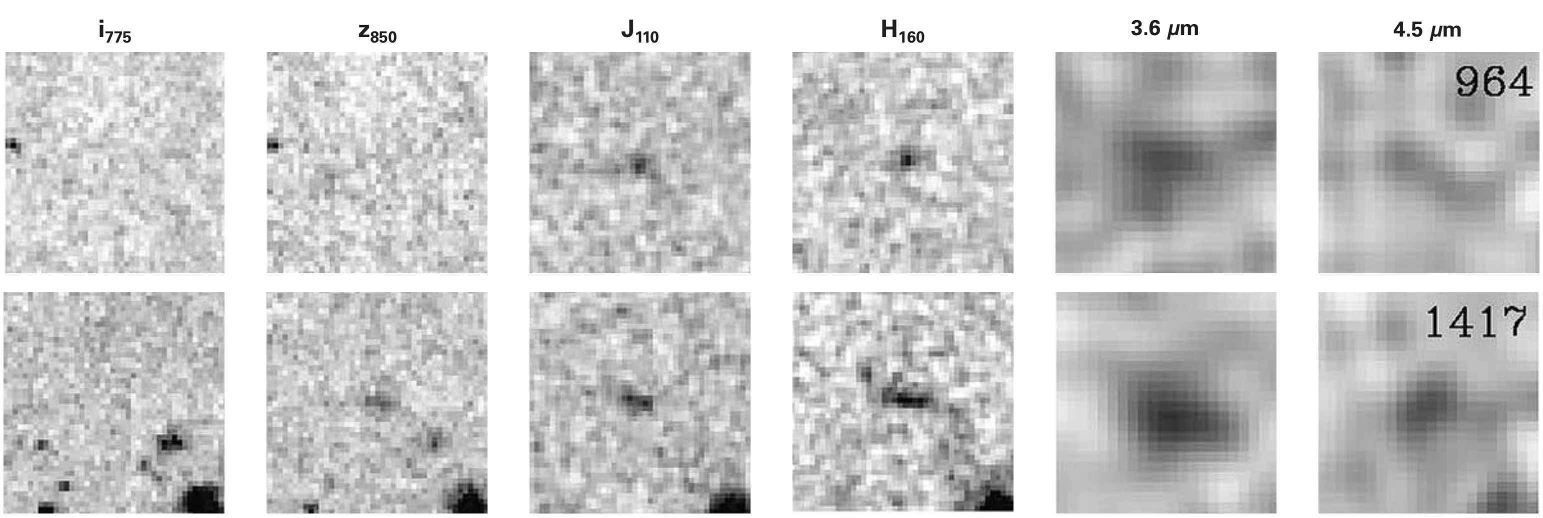
"The galaxies themselves don't have very surprising characteristics, from the looks of it," Labbé explained. "They are within the range of masses, ages, and densities that the latest simulations have predicted for this location within the universe. What makes them special is precisely that—their location. Nobody has directly observed anything this distant in such detail."

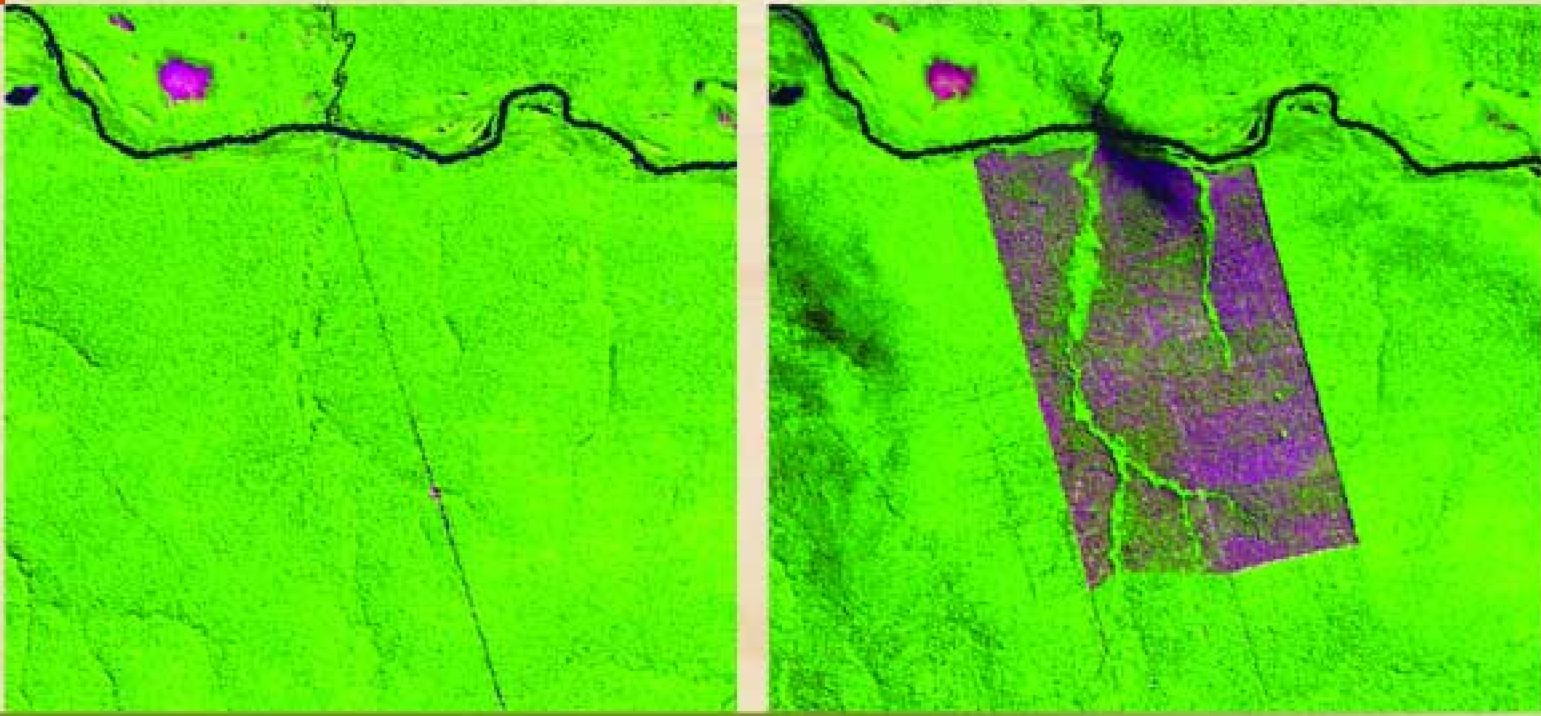
The galaxies probably formed during a period known to astrophysicists and cosmologists as the Dark Ages. During this time, estimated to have lasted about half a billion years after the Big Bang, the universe was filled with massive clouds of neutral hydrogen gas that obscured galaxies from our view like a dark, opaque haze. Newly formed stars in fledgling galaxies soon began to emit enough radiation to ionize the hydrogen clouds and burn through the cosmic fog, turning the universe transparent through a billowing froth of plasma.

Labbé and his team investigated whether galaxies like the two young sources in the study could have driven the ionization process. But their calculations suggested that the galaxies are too small and too few, and that large numbers of smaller galaxies, yet to be discovered, probably ionized the early universe.

"I suspect the UDF has many more secrets to divulge," Labbé said. "With help from the next generation of telescopes, such as the James Webb Space Telescope and the Giant Magellan Telescope, we should be able to pry many more discoveries from this relatively tiny sliver of the heavens." •

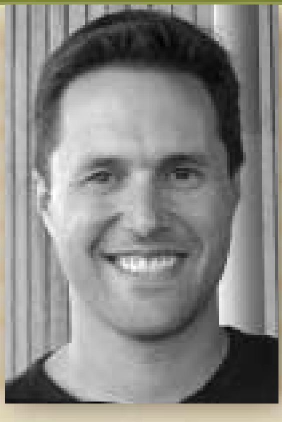
—Matthew Early Wright





Small-scale Logging Blazes the Trail

"The link between selective logging and clear-cutting is a one-two punch. Once a forest is selectively logged, it is likely on the path to destruction."



Global Ecology's Greg Asner

A team of scientists led by Greg Asner of Carnegie's Department of Global Ecology has discovered an important indicator of rain forest vulnerability to clear-cutting in Brazil. They surveyed an area about three times the size of the state of Texas from 1999 to 2004 and quantified, for the first time, the relationship between selective logging, in which loggers extract individual trees from the rain forest, and complete deforestation, or clear-cutting. They found that 16% of rain forests that had been selectively logged were completely clear-cut within one year and 32% of logged areas were completely cleared within four years. Virtually all of this double damage occurs within 15 miles (25 km) miles of major roads. Practically no selective logging takes place at distances greater than 15 miles from the roads. The work was widely reported in the media including the *New York Times*, *The Economist.com*, and *National Geographic News*.

Bolstered by Brazilians

The results, published online and in the August 22, 2006, print edition of *The Proceedings of the National Academy of Sciences*, come on the heels of recent Brazilian legislation to regulate logging for better sustainability and the announcement by the Brazilian National Space Research Institute (INPE) to develop a remote sensing system to monitor logging in collaboration with the Brazilian nongovernmental organization IMAZON. The ongoing work of the Carnegie-led team could bolster the long-term timber management goals and monitoring efforts of the government.

The scientists used their novel high-resolution, remote sensing techniques to measure logging and combined that information with the deforestation maps that Brazil makes publicly available through the INPE PRODES program. The research depended on the INPE state-of-the-art digital deforestation maps for comparing deforested areas to logged forest.

On the trail of clear-cutting

The researchers detected the selective logging and then quantified the gaps in harvested forests, which covered 17,760 square miles, (46,000 sq km) across four Brazilian states. They tracked those logged forests over time, and found that the probability that logged areas will be clear-cut is highly dependent on their distance from major roads. Most of the selective logging is concentrated within 3 miles (5 km) of major roads. While there was no cause and effect relationship between selective logging and clear-cutting for

(Image courtesy Greg Asner and NASA.)

These satellite images show how deforestation increases in areas close to roads in the Brazilian rain forest. Most selective logging takes place within 3 miles of major roads. The purple areas depict logged acreage. Some 16% of selectively logged rain forests are completely clear-cut within a year; 32% of logged areas are cleared within four years.

forests within 3 miles of roads, between 3 and 15.5 miles (5 to 25 km) from roads there was a clear relationship: selective logging blazes the trail for deforestation. Areas with selective logging at these distances are two to four times more likely to be cleared than intact forests.

"The link between selective logging and clear-cutting is a one-two punch. Once a forest is selectively logged, it is likely on the path to destruction," said Asner. The researchers were surprised by such a tight relationship between the two land-use activities because different groups are involved—loggers versus ranchers and farmers—and those actors are treated differently by government regulators.

The remote sensing system has a spatial resolution of 98 feet by 98 feet. Through advanced computational methods, the

for Deforestation

scientists can determine the level of canopy damage and how long it takes to grow back, information which they use to understand the severity and duration of ecological disruption. Foliage cover regulates such processes as the rate of photosynthesis, water balance, plant and animal population dynamics, and most critically, the probability of drought and fire.

Overall, the researchers found that selective-logging operations in the Brazilian Amazon were conducted using highly damaging techniques. Encouragingly, though, they also found that federally regulated preserves were much less disturbed than unprotected forests.

The logging picture becomes clearer

"Asner's group first showed that forest degradation by loggers affects as much forest as clear-cutting for cattle ranching and swidden agriculture," commented Daniel Nepstad, of the Woods Hole Research Center. "This latest article demonstrates that these two processes are intimately linked—that the thinning begets forest replacement by cattle pastures and swiddens."

Diane Wickland, manager of the Terrestrial Ecology Program at NASA headquarters, which funded the study, hailed this work as "a compelling demonstration of how satellite data can be used to provide quantitative information over large regions—regions too large to measure effectively in any other way."

Looking to the future Asner observed: "The new Brazilian timber concession laws for federally protected lands could bring more control over both the high levels of forest damage caused by current logging operations and the loss of selectively logged forest to full deforestation."

Sugar Metabolism Tracked in Living Plant Tissues in Real Time

Plant Biology's Wolf Frommer

Scientists at Carnegie's Department of Plant Biology have made the first real-time observations of sugars in the cells of intact and living plant tissues. With the help of groundbreaking imaging techniques, the group has determined that plants maintain extremely low levels of sugar in their roots—as much as 100,000 times lower than previous estimates. The technology will enable new studies of sugar metabolism in plants, which will inform the effort to engineer higher crop yields for food and biofuel production.

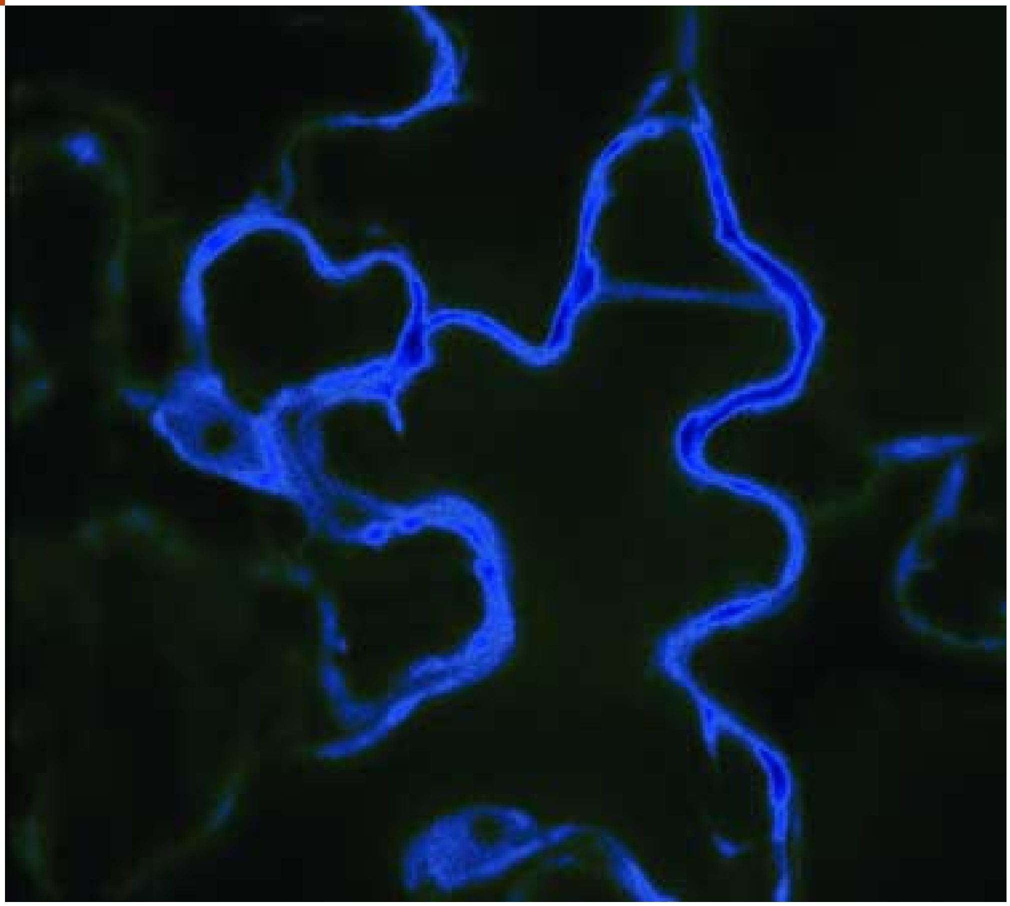
Led by Carnegie staff member Wolf Frommer, the researchers designed genetically encoded fluorescent tags to monitor glucose, an important sugar, in leaf and root tissues of the model plant *Arabidopsis thaliana*. The tags have allowed the researchers to track glucose over time and space at unprecedented detail in living and undisturbed plant tissues. The work appears in the September issue of the journal *Plant Cell*. The group has also developed a sensor for sucrose, a major transport sugar in plants; this research appears in the September *Journal of Biological Chemistry*.

"Until now, we have had few clues regarding how much sugar is in an individual cell in a multicellular plant," Frommer said. "We normally grind up a leaf or a root and average the information for all cells, but if sugar levels rise in one cell and drop in another, we would see no change in this average." Also, because the cell can distribute sugar among subcellular organelles, it is nearly impossible to know how much sugar is in any cell compartment at a given time.

"Time resolution is another problem," Frommer added. "We can sample tissue at intervals, but if the sugar changes in waves, we might miss the right time point. Our new technology addresses all of these problems by measuring sugar flux in real time in individual cells, with subcellular resolution."

Frommer and his colleagues have used similar imaging tags, called fluorescence resonance energy transfer (FRET) sensors, to track sugars and neurotransmitters in animal cells. Most recently, the group used FRET sensors

(Image courtesy Sylvie Lalonde and Wolf Frommer.)



This false-color image shows cells from the epidermis of an *Arabidopsis thaliana* plant that have been marked with fluorescent imaging sensors designed to detect the sugar glucose. In this image, only the densely packed interior of the cells, in which most metabolic functions occur—called the cytosol—is targeted by the glucose sensors. The dark area sits inside the vacuole—a large storage organelle that can occupy up to 90% of the cell's volume.

to study glutamate, an important mammalian neurotransmitter. (See summer 2005 *Carnegie Science.*) Frommer has tracked glucose in cultured mammalian cells, but until now plant tissues had proven problematic because of interference from the plants' virus defense mechanisms, as well as high background fluorescence in some plants. To surmount these issues, Frommer's team dramatically improved the sensors while inserting them in mutant *Arabidopsis* plants with disabled defense genes. The fluorescent tags worked well where they had failed before.

"It may not be ideal to use defense-mutant plants—the ideal would be for the sensors to work in any wild-type genetic background," Frommer explained. "But proving that the sensors can work in plants is an important first step. Now we can begin addressing important questions about the way plants manage sugar distribution while we continue to improve the sensors."

In preliminary experiments, Frommer's group compared fluctuations in glucose levels in root tissue and leaf epidermis—the topmost layer that absorbs sunlight—and found that the plant maintained glucose at higher levels in leaf tissue than in roots. In fact, the researchers found that root cells contain sugar at concentrations at least 100,000 times lower than previous estimates.

FRET sensors are encoded by genes that, in theory, can be engineered into any cell line or organism. They are made of two fluorescent proteins that produce different colors of light—one cyan and one yellow—connected by a third protein that resembles a hinged clamshell. The two fluorescent proteins are derived from jellyfish and the third from a bacterium; the shape of the clamshell protein determines which sugar or other molecule the sensor can detect. When a target molecule such as glucose or sucrose binds to the third protein, the hinge opens, changing the distance and orientation of the fluorescent proteins. This physical change affects the energy transfer between the cyan and yellow markers.

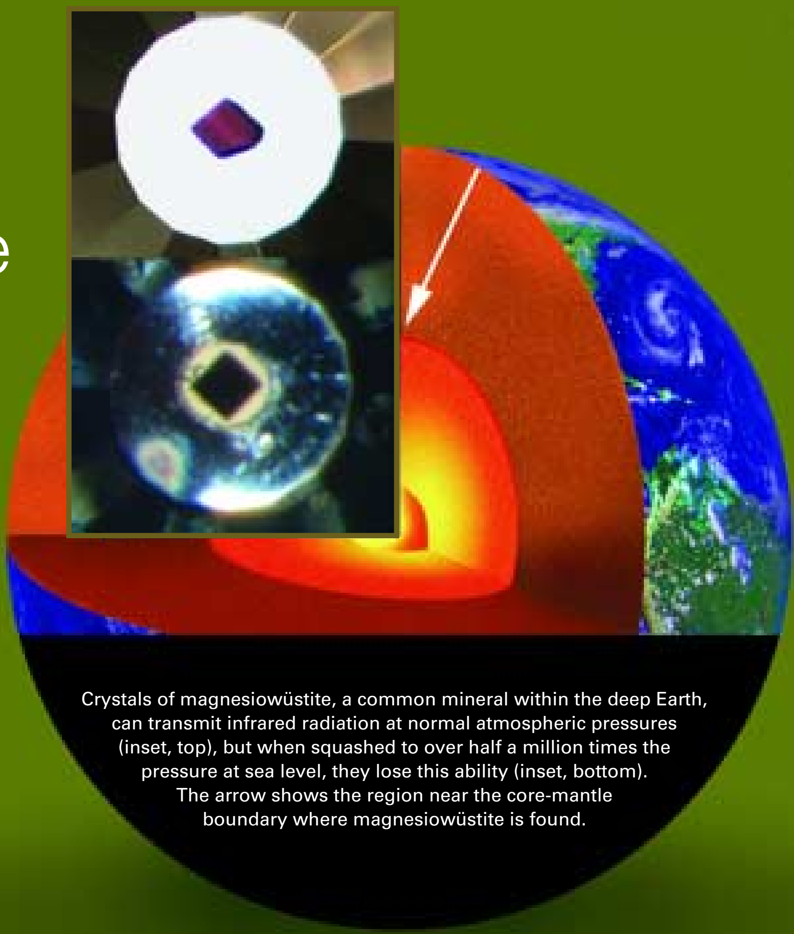
When the researchers hit the tags with light of a specific wavelength, the cyan tag starts to fluoresce. If the yellow tag is close enough, the cyan tag will transfer its energy to the yellow tag, causing it to resonate and fluoresce as well. This energy transfer affects how much cyan and yellow fluorescence can be seen, and by calculating this ratio, researchers can accurately track molecules such as glucose and sucrose in both time and space.

"The strength of this technology lies in its elegant simplicity; with the power of computational design, we can potentially design FRET tags to detect virtually any small molecule in living cells," Frommer said. "Imaging techniques like this are the next frontier in the study of metabolism and will help to answer some of the most pressing questions on plant biologists' minds, such as the role of individual genes in the distribution of sugars. This in turn can help us engineer plants to produce more biomass."

— Matthew Early Wright

The two projects were supported by grants from the U.S. Department of Energy, the National Institutes of Health, and the Körber European Science Award of the Körber Foundation, Hamburg.

Minerals Go "Dark" Near Earth's Core



Crystals of magnesiowüstite, a common mineral within the deep Earth, can transmit infrared radiation at normal atmospheric pressures (inset, top), but when squashed to over half a million times the pressure at sea level, they lose this ability (inset, bottom). The arrow shows the region near the core-mantle boundary where magnesiowüstite is found.

(Inset images used with permission of the American Association for the Advancement of Science, Science, May 26, 2006, issue. Background image courtesy NASA and the Johns Hopkins Applied Physics Laboratory.)

Minerals crunched by intense pressure near the Earth's core lose much of their ability to conduct infrared light, according to a new study from the Carnegie's Geophysical Laboratory. Since infrared light contributes to the flow of heat, the result challenges some long-held notions about heat transfer in the lower mantle, the layer of rock that surrounds the Earth's core. The work could aid the study of mantle plumes—large columns of hot upwelling magma believed to produce features such as the Hawaiian Islands and Iceland.

Crystals of magnesiowüstite, a common mineral within the deep Earth, can transmit infrared light at normal atmospheric pressures. But when squashed to over half a million times the pressure at sea level, these crystals instead absorb infrared light, which hinders the flow of heat. The research appeared in the May 26, 2006, issue of *Science*.

Carnegie staff members Alexander Goncharov and Viktor Struzhkin, with postdoctoral fellow Steven Jacobsen, pressed crystals of magnesiowüstite using a diamond anvil cell—a chamber bound by two superhard diamonds capable of generating incredible pressure. They then shone intense light through the crystals and measured the wavelengths of light that made it through. To their surprise, the compressed crystals absorbed much of the light in the infrared range, suggesting that magnesiowüstite is a poor conductor of heat at high pressures.

"The flow of heat in Earth's deep interior plays an important role in the dynamics, structure, and evolution of the planet," Goncharov said. There are three primary mechanisms by which heat is likely to circulate in the deep Earth: conduction, the transfer of heat from one material or area to another; radiation, the flow of energy via infrared light; and convection, the movement of hot material. "The relative amount of heat flow from these three mechanisms is currently under intense debate," Goncharov added.

Magnesiowüstite is the second most common mineral in the lower mantle. Since it does not transmit heat well at high pressures, the mineral could actually form insulating patches around much of the Earth's core. If that is the case, radiation might not contribute to overall heat flow in these areas, and conduction and convection might play a bigger role in venting heat from the core.

"It's still too early to tell exactly how this discovery will affect deep-Earth geophysics," Goncharov said. "But so much of what we assume about the deep Earth relies on our models of heat transfer, and this study calls a lot of that into question."

—Matthew Early Wright

The U.S. Department of Energy supported work at the Advanced Photon Source at Argonne National Laboratory. Work at Carnegie was supported by the National Science Foundation, the W. M. Keck Foundation, and the Carnegie Institution.

More A

TWO OTHER CARNEGIE

September was another landmark month fo
tional Balzan Foundation in Milan, Italy, an
in Plant Molecular Genetics to Christopher
ment of Plant Biology since 1994, with his
the California Institute of Technology. On
New York announced that Embryology's Jo
Lasker Award for Special Achievement in M

"Although their departments are 3,000 mile
isms, these two senior scientists were similar
in biology," remarked Carnegie president Ri
should be very proud of their achievements

BALZAN PRIZE

Department of Plant Biology director Christopher Somerville is co-recipient of the 2006 Balzan Prize in Plant Molecular Genetics.

The image above is a picture of the model organism *Arabidopsis thaliana*, a relative of the mustard plant, which Somerville advocated the use of as a model organism.

PLANT BIOLOGY'S CHRISTOPHER SOMERVILLE

The Balzan Prize committee recognized Somerville and Meyerowitz "for their joint efforts in establishing *Arabidopsis* as a model organism for plant molecular genetics." The citation also praised their work as having "far reaching implications for plant science at both the fundamental level and in potential applications."

Somerville and Meyerowitz were among the first to advocate the use of *Arabidopsis thaliana*, a relative of the mustard plant, as a model organism to study the genetics and physiology of plants. Somerville currently studies how plant cells use cellulose, the most abundant plant-made molecule on the planet, to construct cell walls. This work has significant implications for the use of plants as fuel sources.

The Balzan Prize is awarded to scientists, artists, and institutions for outstanding achievements in humanities, social sciences, physics, mathematics, natural sciences, and medicine. Each Balzan prize is worth 1 million Swiss Francs (about $810,000), half of which must be devoted to projects involving young researchers. It is the second year in a row that Carnegie scientists have recieved the award. Last year Russell Hemley and Ho-kwang (Dave) Mao of the Geophysical Laboratory were honored. Somerville's award will be presented on November 24, 2006, by Giorgio Napolitano, president of the Italian Republic, in Rome.

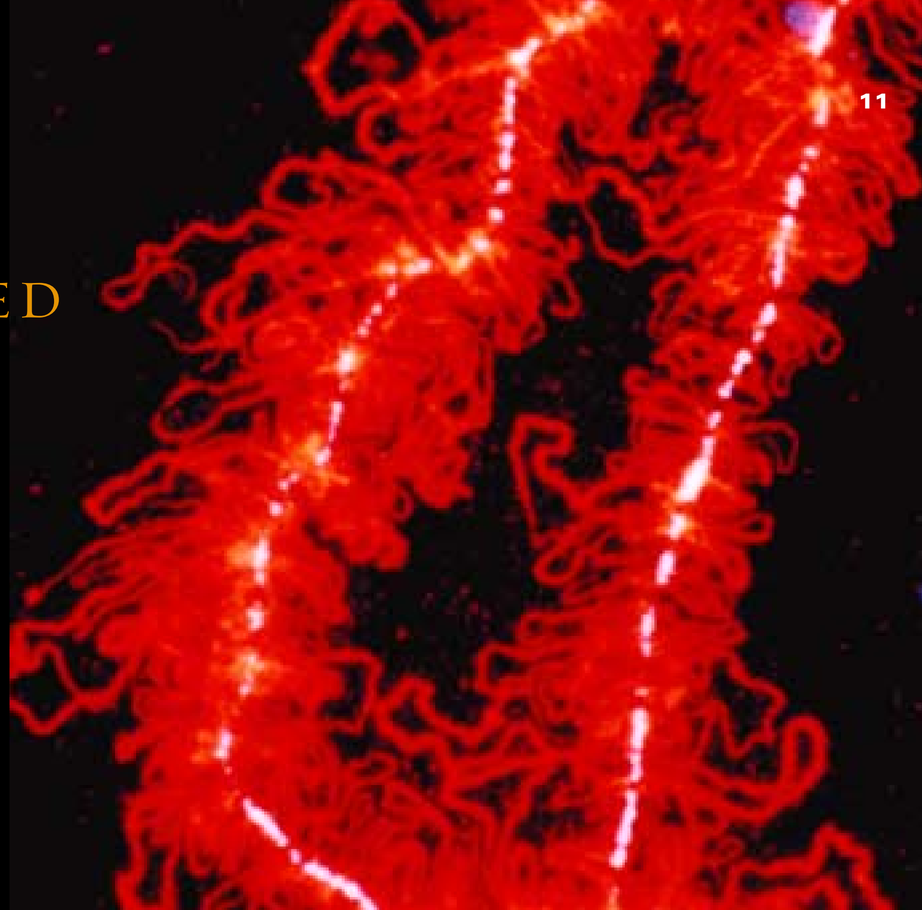
For more information on the Balzan Prize see http://www.balzan.it.
Additional information about the Lasker Awards can be found at http://www.laskerfoundation.org.

AWARDS

LUMINARIES HONORED

or Carnegie science. On the 4th, the Interna-
nounced the award of the 2006 Balzan Prize
r Somerville, director of Carnegie's Depart-
longtime collaborator, Elliot Meyerowitz of
September 17th, the Lasker Foundation in
oseph G. Gall had won the prestigious 2006
Medical Science.

s apart and they study very different organ-
rly recognized for their highly original work
chard Meserve. "Everyone in the institution
."



LASKER AWARD

Embryology staff scientist Joseph Gall is the 2006 winner of the Lasker Award for Special Achievement in Medical Science.

The image above is a picture of the lampbrush chromosome, from unlaid eggs of the frog *Xenopus*, used by Gall over the years for countless gene studies.

EMBRYOLOGY'S JOSEPH GALL

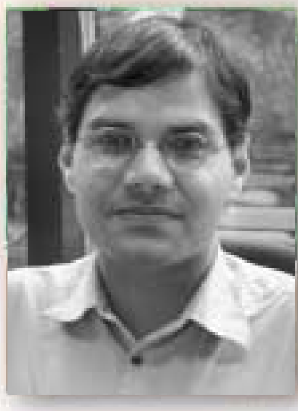
The Lasker Awards, considered to be the U.S. Nobel Prizes, recognize basic researchers and clinical scientists whose work has been seminal to understanding and treating disease. Gall was honored "for a distinguished 57-year career as a founder of modern cell biology and the field of chromosome structure and function; bold experimentalist; inventor of in situ hybridization; and early champion of women in science."

Gall has been a staff scientist at the Carnegie Institution's Department of Embryology and adjunct professor of The Johns Hopkins University since 1983, and a professor of developmental genetics of the American Cancer Society since 1984. His in situ hybridization technique, developed with graduate students Mary Lou Pardue and Susan Gerbi in 1969, is a powerful method that allows researchers to locate and map genes and specific sequences of DNA on a chromosome. It revolutionized molecular biology and is now used worldwide in gene studies.

Gall's career-long interest is in studying how the structure of the cell, particularly the nucleus, is related to the synthesis and processing of ribonucleic acid, RNA, during gene activity. Gall's development of in situ hybridization was a byproduct of his renowned research on so-called lampbrush chromosomes—the largest chromosomes in any animal, which are found in amphibian eggs. Gall has made many discoveries about genes in the lampbrush chromosome including gene amplification, in which extra copies of DNA are created at certain times in the egg.

The Lasker Awards, with a $100,000 honorarium, were presented at a luncheon at the Pierre Hotel in New York City, September 29.

Mice Aid the Study of **Human Eye Cancer**



Embryology's David MacPherson

Every year in the United States, a malignant eye cancer called retinoblastoma will affect about 300 children under the age of three. The disease causes debilitating tumors that grow on the retina and often requires removal of the affected eye. Compared with other childhood cancers, retinoblastoma is rare—leukemia, by contrast, affects 10 times as many children annually. But despite its rarity, retinoblastoma is one of the most heritable cancers known; in humans it has been traced to a defect in just one gene.

There are many unanswered questions regarding this gene, called *Rb*, and its function in normal cells. For years it was difficult to study because laboratory mice with a defective *Rb* gene don't develop tumors in the same way humans do. Staff associate David MacPherson of the Department of Embryology and colleagues have engineered strains of mice that frequently develop retinoblastomas, and they use these mice in detailed studies of *Rb* physiology and genetics.

"It is essential to learn more about why *Rb* loss causes retinoblastoma and how this gene normally functions," MacPherson says. "*Rb* was the first gene ever identified as a tumor suppressor—a gene that contributes to cancer when inactivated—and remains a classic model for these genes."

Every gene has two copies. Both copies of a tumor suppressor gene such as *Rb* must be damaged, or mutated, for cancer to result. In retinoblastoma, mutant gene copies can either be inherited or arise spontaneously, and the pattern of mutation determines how the disease presents itself.

The inherited form causes multiple tumors, sometimes in both eyes. These children inherit one mutant copy of the gene, and then the remaining healthy copy becomes mutated early in development. Whether tumors will grow in one or both eyes is most likely determined by when and where the second mutation happens.

In rare cases, two spontaneous mutations can knock out the function of both healthy gene copies. This leads to a single tumor in one eye. Both the inherited and the spontaneous form of the disease can be described by "Knudson's two-hit hypothesis," named both for its discoverer, Alfred Knudson, and the fact that two "hits" are required to knock out the gene's normal function and cause cancer.

"We understand very little about the specific cell that gives rise to retinoblastoma and why the developing retina is so sensitive to cancer upon *Rb* loss," MacPherson explains. "We also have evidence that other genes may be mutated as retinoblastomas progress, but these genes remain to be identified."

To answer questions like this, researchers need a model organism—a mouse, for example—to study in the lab during many phases of development. But mice with single *Rb* mutations do not develop tumors, making it difficult to model the condition. Early on, some research groups tried using chimeras—organisms that contain two or more genetically distinct cell types—with a double-mutant strain of cells included. But in these cases, the mutant cells did not survive long enough to form tumors.

For his graduate work with Tyler Jacks at the Massachusetts Institute of Technology, MacPherson focused on two other genes that had been previously linked to retinoblastoma in mice. Called p107 and p130, these "retinoblastoma-like" genes seem to pick up the slack for a defective *Rb* gene, protecting the mouse from tumor growth. But when either of these genes becomes mutated along with the *Rb* gene, tumors that closely resemble human retinoblastoma form.

Researchers in MacPherson's lab use mice engineered with combined defects in both the *Rb* and the *Rb*-like genes to pinpoint where and when retinoblastoma appears during development, and to understand how mutations in p107 and p130 influence this process. They are also using these models to identify other mutations that occur as retinoblastomas progress.

"Predictable mouse models allow careful examination of early events in tumor formation," MacPherson says. "We can now trace tumor development to very early lesions that can help us understand the cell of origin. This is shedding light on the nature of the specific cell type that gives rise to retinoblastoma."

The new mouse models should also help the study of *Rb*'s role in normal development, where it acts as a check against excessive cell division, among other important roles. In many human cancers, such as those of the brain, lung, and bone, *Rb* is frequently mutated, and the pathway controlled by *Rb* is somehow disrupted in virtually all cancers.

The mouse models might help researchers to better understand the cells that give rise to retinoblastoma, and how these normal cells convert into tumors. Such work could aid the design of therapies to save the sight of children with retinoblastoma or to combat the many other malignancies in which the *Rb* pathway is inactivated.

—Matthew Early Wright

A normal mouse eye (left) is shown in side view next to one with a malignant eye cancer called retinoblastoma.

(Image courtesy David MacPherson.)

Above, former director of Carnegie's Department of Terrestrial Magnetism (DTM) George Wetherill poses with then-President Bill Clinton after receiving the National Medal of Science in 1997.

Below, Wetherill wrote this poem in La Serena, Chile, on the occasion of the return of Halley's comet in 1986.

La Serena
April 1986

Among the eucalyptus trees,
Green leaves dancing in the autumn wind,
The cold pale watcher of mankind
Treads his ancient trail again.

Pass swiftly by the angry bull,
The starry fish and water jar,
Defy the Sun's consuming flame,
The archer's bow,
The scorpion's sting,
The centaur's wrath,
The deadly coil of the hydra —
But then be gone.
Ask not for Harold of Hastings,
You know he is not here;
Nor Attila, vanquished at Chalons,
Edmund, master of Isaac's rules,
Nor Giotto, and the Zealots of Jerusalem.

You must have seen
The ships that rose to greet you.
Next time there will be more.
They'll even mount your haggard head
And ride you into Neptune's night!
Yes, we still are bold.
Though once more we now learn
The message that you bear,
Resonate to your grim tattoo,
The gravest rhythm of our race,
Yet wait with hope your sure return.

Carnegie's
George West Wetherill
Father of Earth-Formation Models, Dies at 80

Former director of the Department of Terrestrial Magnetism (DTM), planetary-formation theorist, and 1997 National Medal of Science recipient George Wetherill died of heart failure on July 19, 2006, at his Washington, D.C., home. Wetherill revolutionized our understanding of how our planets and solar system formed through his theoretical models.

Born in Philadelphia on August 12, 1925, Wetherill served in the U.S. Navy during World War II, teaching radar at the Naval Research Laboratory in the District. He graduated from the University of Chicago in 1953 after earning a succession of degrees in physics: Ph.B., S.B., S.M., and Ph.D. After receiving his doctorate, he joined DTM as a member of the scientific staff. In 1960 he left Carnegie to become professor and department chairman at the University of California, Los Angeles. He came back to Carnegie in 1975 as director of the department, a position he held until 1991. After he stepped down, he continued his research as director emeritus.

Wetherill acknowledged Russian scientist Victor Safronov as a major influence on his own work. Safronov showed that groups of tiny planetesimals could grow into large bodies, such as the terrestrial planets. Wetherill was among the first to develop calculations of the orbital evolution and dynamics of accretion and growth. He predicted the size and orbits of the inner planets and how collisions in the asteroid belt could result in asteroid impacts on Earth, such as the one that extinguished the dinosaurs.

In the 1950s, Wetherill was among a group of scientists who developed geochemical methods involving natural radioactive decay to date the Earth's rocks. Later, his interests in age-dating techniques expanded to include extraterrestrial materials, including meteorites and rock samples from the Moon. In the 1970s, he began theoretical explorations into the origins of meteorites and the terrestrial planets and developed a technique to calculate the orbital evolution and accumulation of swarms of small bodies as they coalesce into planets.

Wetherill's computations have also revealed how important Jupiter's enormous gravitational field may be in protecting the Earth and other inner planets from bombardment. He showed that the field provides a shield from orbiting asteroids and comets by scattering most of them out of the solar system. The discoveries of planets orbiting other stars provided him with further theoretical challenges in his final years of research.

Wetherill was elected to the American Academy of Arts and Sciences in 1971 and to the National Academy of Sciences in 1974. He received the 1981 F. C. Leonard Medal of the Meteoritical Society, the 1984 G. K. Gilbert Award of the Geological Society of America, the 1986 G. P. Kuiper Prize of the Division of Planetary Sciences of the American Astronomical Society, and the 1991 Harry H. Hess Medal of the American Geophysical Union. In 2003 Wetherill was awarded the Henry Norris Russell Lectureship, the highest honor bestowed by the American Astronomical Society. In 1997 George Wetherill received the highest scientific award in the nation—the National Medal of Science.

Wetherill's funeral was held at St. Alban's Episcopal Church in Washington, D.C., on July 24, 2006. Survivors include his wife, Mary Bailey, of the District, and his daughters, Rachel Wetherill, of Round Hill, Virginia, and Sarah Wetherill Okumura, of Morgan Hill, California.

At the family's request, contributions in his memory can be made to the Wetherill Fund; please contact Linda Feinberg at (202) 939-1141 or lfeinberg@ciw.edu for more information.

Why Waves Go Wacky at Earth's Center

Funny things happen in the Earth's deep interior. A particularly intriguing region is near the planet's core, about 1,800 miles down, called the core-mantle boundary. Through novel experiments mimicking the high pressures and temperatures there, the Geophysical Laboratory's Ho-kwang (Dave) Mao, Yingwei Fei, and Russell Hemley, with colleagues at Los Alamos National Laboratory (LANL), may have solved a long-standing mystery about why certain seismic waves called shear waves move so sluggishly through clumpy patches there called ultralow velocity zones. The team found that when lots of iron is added to the most prevalent mineral in that region, (post-perovskite) shear waves put on the brakes and move in slow motion. Their discovery offers an alternative to the prevailing idea that these regions are partially melted, and it has important implications for understanding how volcanoes, located in places such as Hawaii and Iceland, may originate. The research was published in the April 28, 2006, *Science*, and made "Science News of the Week" in the April 29, 2006, *Science News*.

Seismologists learn about the deep Earth in part by observing different seismic waves from earthquakes as they travel through the planet. Shear waves wiggle at right angles to the direction of their movement, but they don't move through liquid at all and are thus useful for understanding certain aspects of the Earth's composition. The team used a novel technique to measure the velocity of shear waves in the lab as they moved through the most abundant mineral in that region, post-perovskite.

"The major mineral in Earth's mantle is iron-magnesium silicate perovskite," explained Dave Mao. "Post-perovskite, discovered a couple years ago, is a different phase of the mineral at the core-mantle boundary, and scientists have been fascinated by its properties. Understanding the mineral and the intrigue of the ultralow velocity zones led us to these experiments," he continued.

Ultralow velocity zones exist as patches between the solid mantle and the liquid core, and are very different from the mantle above and the material on the sides. Since shear waves can't propagate through a liquid, a prevailing thought has been that the zone contains some liquid, or melts, which would slow the waves down. Scientists have noticed that the ultralow velocity patches could also give rise to mantle plumes, eventually sparking so-called hot-spot volcanoes in places like Hawaii and Iceland.

The researchers subjected post-perovskite containing 40% iron to pressures as high as 1.6 million times the pressure at sea level (170 gigapascals) and temperatures of 3100°F (2000 K). Although the researchers can add as much as 80% iron in the post-perovskite, only 40% is needed to match the ultralow velocity zones.

In addition to offering an alternative explanation to partial melting of the ultralow velocity zones, the dense material would sink instead of rising with the convection at hot spots. This behavior would explain why these zones are clumped and not uniformly distributed and why the clumps are associated with the hot spots and contribute to the volcanic activity at the surface.

This work was supported by Earth Sciences Research and the National Science Foundation. The HPCAT facility is supported by the Department of Energy, the W. M. Keck Foundation, and the Carnegie Institution.

Three New "Trojan" Asteroids Found Sharing Neptune's Orbit

Terrestrial Magnetism's Scott Sheppard

Three new objects locked into roughly the same orbit as Neptune—called Trojan asteroids—have been found by researchers from Carnegie's Department of Terrestrial Magnetism (DTM) and the Gemini Observatory. The discovery suggests that Neptune, much like its big cousin Jupiter, hosts thick clouds of Trojans in its orbit, and that these asteroids probably share a common source. It also brings the total of known Neptune Trojans to four.

Trojan asteroids cluster around one of two points that lead or trail the planet by about 60 degrees in its orbit, known as Lagrangian points. In these areas, the gravitational pull of the planet and the Sun lock the asteroids into stable orbits synchronized with the planet. German astronomer Max Wolf identified the first Jupiter Trojan in 1906, and since then more than 1,800 such asteroids have been identified marching along that planet's orbit. Because Trojan asteroids share a planet's orbit, they can help astronomers understand how planets form and how the solar system evolved.

"It is exciting to have quadrupled the known population of Neptune Trojans," said Carnegie Hubble Fellow Scott Sheppard, lead author of the study, which appeared in the June 15 online issue of *Science Express*. "In the process, we have learned a lot both about how these asteroids become locked into their stable orbits, and what they might be made of, which makes the discovery especially rewarding."

The recently discovered Neptune Trojans are only the fourth stable group of asteroids observed around the Sun. The others are the Kuiper Belt, just beyond Neptune, the Jupiter Trojans, and the main asteroid belt between Mars and Jupiter. Evidence suggests that the Neptune Trojans are more numerous than either the asteroids in the main belt or the Jupiter Trojans, but they are hard to observe because they are so far away from the Sun. Astronomers therefore require the largest telescopes in the world to detect them. They used Carnegie's 6.5-meter Baade telescope at Las Campanas Observatory, Chile, and the 8-meter Gemini North telescope on Mauna Kea in Hawaii.

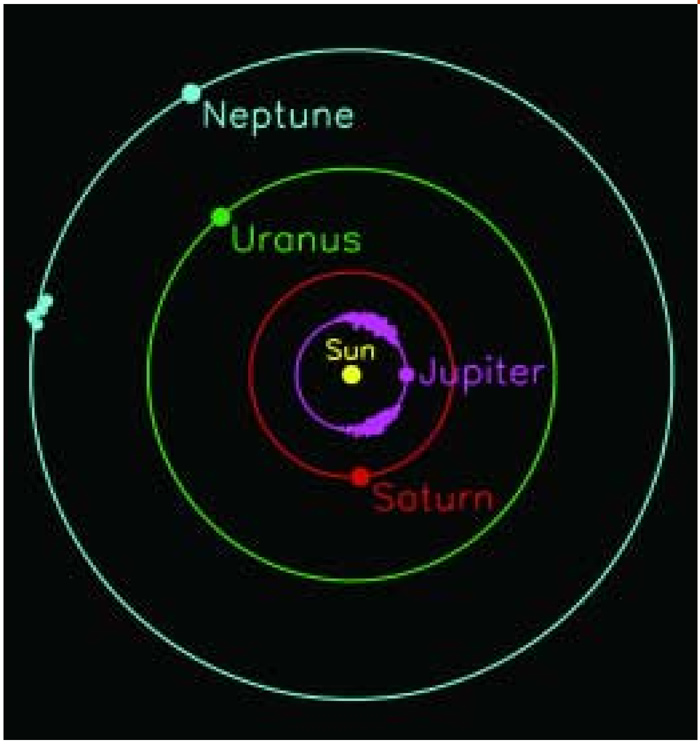
Researchers theorized that Trojans might also flank other planets, but evidence for this has surfaced only recently. In 2001, the first Neptune Trojan was spotted in the planet's leading Lagrangian point. In 2004, Sheppard and Chadwick Trujillo of the Gemini Observatory, who is also an author on the current study, found the second Neptune Trojan using the Baade telescope. They found two more in 2005, bringing the total to four, and observed them again using the Gemini North telescope to accurately determine their orbits. All four of the known Neptune Trojans reside in the planet's leading Lagrangian point.

One of the new Trojans has an orbit that is more steeply tilted to the plane of the solar system than the other three. "We were really surprised to find a Neptune Trojan with such a large orbital inclination," Trujillo said. "The discovery of the one tilted Neptune Trojan implies that there may be many more far from the solar-system plane than near the plane, and that the Trojans are really a 'cloud' or 'swarm' of objects co-orbiting with Neptune."

A large population of high-inclination Neptune Trojans would rule out the possibility that they are left over from early in the solar system's history, since unaltered primordial asteroid groups should be closely aligned with the plane of the solar system. These clouds probably formed much like Jupiter's Trojan clouds did: once the giant planets settled into their paths around the Sun, any asteroid that happened to be in the Trojan region "froze" into its orbit.

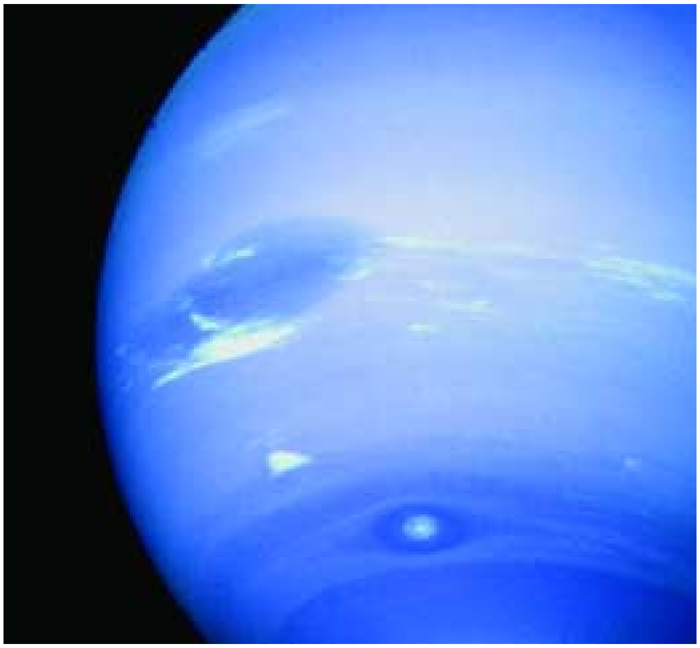
Sheppard and Trujillo also compared, for the first time, the colors of all four known Neptune Trojans. They are all about the same shade of pale red, suggesting that they share a similar origin and history. Although it is hard to tell for sure, the researchers believe that the Neptune Trojans might share a common origin with the Jupiter Trojans and outer irregular satellites of the giant planets. These objects might be the last remnants of the countless small bodies that formed in the giant planet region, most of which eventually became part of the planets or were tossed out of the solar system.

— MATTHEW EARLY WRIGHT



(Image courtesy Scott Sheppard.)

In this schematic (above) of the outer solar system, Trojan asteroids can be seen sharing the orbits of Jupiter and Neptune. At either of two points 60 degrees away from each planet, the gravitational forces of the planet and the Sun combine to lock the asteroids into a stable, synchronized orbit. Three new Trojans have been found in the region ahead of Neptune, bringing the total to four; the discovery suggests that Neptune hosts clouds of Trojans that are more dense and populous than those in Jupiter's orbit.



(Image courtesy NASA-Jet Propulsion Laboratory.)

This photo (above) from the Voyager 2 mission, shows Neptune up close.

Funding for the work was provided by NASA and the Gemini partnership, which includes the National Science Foundation (United States), the Particle Physics and Astronomy Research Council (United Kingdom), the National Research Council (Canada), CONICYT (Chile), the Australian Research Council (Australia), CNPq (Brazil), and CONICET (Argentina).

IN Brief

❶ Secretary of the Carnegie board Deborah Rose

Embryology employees enjoy wine, cheese, and pastries at Pat Englar's retirement party. Pat's husband, Gerry (center, in red shirt), chats with Joe Gall, Allan Spradling, and Doug Koshland.

Trustees and Administration

President Emerita **Maxine Singer's** portrait by Jon R. Friedman is on display at the National Portrait Gallery in the exhibit Americans Now. The work is a study of the painting that hangs in the administration building.

—

❶ Secretary of the board **Deborah Rose** received the Yale Medal, the highest award of the Association of Yale Alumni, in recognition of her outstanding service to the university.

—

Carnegie president **Richard Meserve** gave the keynote address in a session at the International Atomic Energy Agency's 50th General Conference in Vienna, Austria, on Sept. 18 on nuclear safety issues. He also attended the Western Regional Meeting of the National Academies' Committee on a New Government-University Partnership for Science and Security at Stanford U. Sept. 27-28. He was invited to comment on nuclear waste policy for the journal *Issues in Science and Technology* and on energy policy for the journal *Innovations: Technology | Governance | Globalization*.

—

The National Science Foundation (NSF) has awarded the **Carnegie Academy for Science Education** (CASE) a three-year $820,000 grant to assist Washington, D.C., high school students to pursue careers in biotechnology.

—

Executive assistant to the president **Rhoda Mathias** retired from the administration in July. She was replaced by **Lisa Klow,** who had previously served as executive secretary to the president of a small nursing college Springfield, MO.

Embryology

Director **Allan Spradling** spoke separately to faculty and to graduate students as the Stubenbord Visiting Professor at the Cornell U. Medical Center in June. He also presented the keynote address at the American Society for Cell Biology (ASCB) summer meeting on "Stem Cell Niches" in Boston July 15-18.

—

Yixian Zheng spoke at the Biochemical Society meeting in Glasgow July 23-27. She also lectured at the Marine Biological Laboratory in Woods Hole, MA, in July.

—

Doug Koshland delivered the keynote lecture at the FASEB Summer Research Conference on Yeast Chromosome Structure, Replication, and Segregation in Palm Springs, CA, June 24-29.

—

Mary Goll joined the Halpern and Spradling labs as the first Carnegie Collaborative Postdoctoral Fellow in June following completion of her Ph.D. at Columbia U. The program identifies one or two exceptionally creative graduate students each year and allows them to tailor a postdoctoral experience that exceeds the boundaries of any single laboratory.

—

Embryology's Pat Englar, administrative assistant to the director, examines a scrapbook that Susan Kern and Connie Jewell filled with mementos, photos, and letters from well-wishers at her retirement party.

Former postdoctoral researcher **Rachel Brewster**, now at U. Maryland, Baltimore County, received the NSF's Presidential Early Career Award for Scientists and Engineers (PECASE), the highest national honor for NSF-funded beginning researchers.

—

Postdoctoral fellow **Hong-Guo Yu** left for an assistant professor position at Florida State U.

—

The department welcomed new postdoctoral fellows **Sandeep Mukhi** from Texas Tech U. in July and **Safia Malki** from the Institut de Génétique Humaine CNRS in Montpellier, France, in Aug.

—

Graduate students **Jill Heidinger** and **Courtney Akitake** received Johns Hopkins U. Dupont Teaching Awards for Cell Biology and Developmental Biology.

—

Graduate student **Lori Orosco** received the Johns Hopkins Diversity Recognition Award from JHU president William R. Brody and the Diversity Leadership Council for her work on the Mentoring to Inspire Diversity in Science project.

—

Graduate students **Zehra Nizami** and **Julio Castañeda** joined the department in June.

—

Senior technician **Jaya Kuchibhotla** began work in the Gall lab in Aug.

—

Summer student **Atil Saydere** returned to Bilkent U. in Turkey.

Geophysical Laboratory

Marilyn Fogel received a grant from the Fulbright Senior Specialists Program for her work with the Physics of Geological Processes at U. Oslo, Norway. In Aug. Fogel traveled to Oslo to discuss AMASE and other projects, and gave two seminars. Fogel also joined postdoctoral researcher **Seth Newsome** and colleagues Gifford Miller (U. Colo., Boulder), John Magee (Australian Nat'l. U.), and Steve Webb (Bond U., Queensland) for fieldwork in the Outback east of Lake Frome.

—

Yingwei Fei attended the Western Pacific Geophysics Meeting in Beijing July 23-27, where he organized an AGU Union Session on "Composition, Structure, and Dynamics of the Mantle." He also visited several Chinese universities including Peking U., Zhejiang U., and Southwest Jiaotong U.

—

Rus Hemley spoke at the DeBeers Diamond Conference in Cambridge, UK, July 10-12, and at the American Chemical Society National Meeting in San Francisco Sept. 10-14.

—

Ho-kwang (Dave) Mao spoke at the Future Frontiers in High-Pressure Science with ERL X-Ray Beams Workshop at Cornell U. June 5-6; at the Academia Sinica's Biannual Meeting in Taipei, Taiwan, July 1-5; at the Taipei International Meeting Center July 7; and at the International Mineralogical Association (IMA) meeting in Kobe, Japan, July 23-28. He also presented at the Fifth International Conference on Synchrotron Radiation in Materials Science (SRMS-5) in Chicago July 31; at the 11th International Experimental Mineralogy, Petrology, and Geochemistry Conference (EMPG XI) in Bristol, UK, Sept. 11-13; and at the Diamond SR User Meeting in Chilton, UK, Sept. 12-13.

—

Doug Rumble served as a visiting professor for the summer term in the Dept. of Earth Sciences at Dartmouth College.

—

Robert Hazen spoke at the Brookings Institution about the emergence of life on June 14 and cochaired a Gordon Research Conference on the Origin of Life at Bates College in Lewiston, ME, July 23-28. He also spoke about life origins at the National Institutes of Health, and about complexity theory at Harvard U. Hazen conducted field studies on the Middle Cambrian Meagher formation in Montana and on hydrothermal systems at Lassen Peak, CA. Hazen also taped segments on the origin of life for NOVA (WGBH, Boston) and Spanish national television.

—

George Cody spoke at the Santa Fe Institute in May and presented a lecture at the Nobel Symposium on the Origins of Life at the Swedish Academy of Sciences in Stockholm in June. He also spoke at the IMA meeting in Kobe, Japan, July 23-28.

—

In Aug. **Ronald Cohen** and **Burkhard Militzer** hosted a workshop on Quantum Monte Carlo Calculations of Deep Earth Materials at GL. The workshop was part of a four-year NSF-sponsored program. Cohen also spoke at the IMA meeting in Kobe, Japan, July 23-28.

—

Bjørn Mysen gave a keynote lecture titled "Structure and Properties of Hydrous Silicate Melts" at the IMA meeting in Kobe, Japan, July 23-28.

—

The AMASE team, including **Andrew Steele**, **Marilyn Fogel**, **Jen Eigenbrode**, **Marc Fries**, **Jake Maule**, and **Verena Starke**, performed fieldwork in Svalbard, Norway early Aug., working with collaborators to test instruments for the Mars Science Laboratory in 2009.

—

Staff associate **James Henry Scott** is now an assistant professor of geobiology at Dartmouth College in Hanover, NH. Scott became one of the lab's first geomicrobiologists as a postdoctoral researcher in 1999 and was awarded GL's first staff associate position in 2002.

—

While still a research scientist at GL (before moving to U. Edinburgh earlier this year), **Olga Degtyareva** organized a session on Non-Ambient Crystallography at the American Crystallographic Association meeting July 22-27 in Honolulu, HI.

—

Yann Le Gac returned to École Normale Supérieure in Aug.

—

Razvan Caracas has accepted a position at Bayerisches Geoinstitut Universität in Bayreuth, Germany.

—

Mathieu Roskosz has accepted a permanent position at U. de Lille in Lille, France.

—

Sue Schmidt retired after nearly 20 years as GL's coordinating secretary. A barbecue was held in her honor June 9.

—

Stephen Hodge joined GL as an instrument maker in Apr.

Global Ecology

Chris Field spoke to the California State Board on Food and Agriculture. He attended the Lead Author's Meeting for the IPCC's Fourth Assessment Report in Cape Town, South Africa, Sept. 11-14.

—

Ken Caldeira spoke at the Society for Conservation Biology's annual meeting June 24-28. He gave a presentation on ocean acidification to six members of Congress—covered by a front-page story in the July 5 *Washington Post*—and taught a class at the Urbino Summer School in Paleoclimatology in Urbino, Italy, July 19-Aug. 2. Caldeira discussed climate change on KNX 1070, CBS radio's Los Angeles affiliate, and spoke about ocean acidification on San Francisco NPR affiliate KQED's *Forum* with Michael Krasny. He was also featured in the fifth installment of a series called Altered Oceans in the *Los Angeles Times* on Aug. 3, and was

GL postdoctoral fellow **Penny Morrill** and undergraduate intern **Jennifer Cotton** from Brandeis U. traveled to The Cedars, a site in Sonoma County, CA, where rock is chemically changing in a process known as serpentinization. The process is believed to occur on Mars and Titan, where it could provide the gases and energy necessary to support chemolithotrophs—organisms that get their energy from simple chemical compounds. Cotton studied dissolved gases in the spring water while Morrill focused on the gases that bubbled to the surface to decipher their origins. The research was funded by the NSF REU program and the Lewis and Clark Fund for Exploration and Field Research.

Penny Morrill and collaborator Orion Johnson from U. California compare GPS coordinates.

❷ The Carnegie Supernovae Project team met in Pasadena in August. From left to right are Mark Phillips, Eric Hsiao, Nick Suntzeff, Pamela Wyatt, Eric Persson, Wendy Freedman, Nidia Morrell, Sergio Gonzalez, Miguel Roth, Christopher Burns, Gaston Folatelli, Carlos Contreras, Barry Madore, and Mario Hamuy.

quoted in an article on high-altitude wind power in the Sept. issue of *Scientific American*.

—

Postdoctoral researcher **Ulrike Seibt** spoke at the International Workshop on the Isotope Effects in Evaporation in Pisa, Italy, May 3-6. In July she left to complete her Marie Curie Fellowship at Cambridge U.

—

Roland Pieruschka was awarded a Marie Curie Fellowship to study photosynthetic efficiency at the canopy scale using chlorophyll fluorescence measurements.

—

Postdoctoral researcher **Damon Matthews** joined the Caldeira lab from U. Calgary.

—

Postdoctoral researcher **Natalie Boelman** left for the Lamont-Doherty Geological Observatory of Columbia U.

—

Masahiro Negishi, an engineer from ImageONE of Japan, joined the Asner lab in Sept. to work on hyperspectral remote sensing.

—

Doctoral student **Adam Wolf** participated in NCAR's Community Climate System Modeling Workshop in Breckenridge, CO, June 20-22, and attended the Summer Graduate Workshop on Data Assimilation for the Carbon Cycle at the Mathematical Sciences Research Institute in Berkeley, CA, July 16-29.

—

Jasper Ridge Project lab technician **Alison Appling** left for a Ph.D. program at Duke U.

—

Eben Broadbent began a Ph.D. program in Stanford's Dept. of Biological Sciences.

—

Kim Carlson left the Asner lab to pursue a Ph.D. at Yale U.

—

Interns **Michael Alyono**, **Chris Carlson**, **Brandon Cortez**, **Melissa Kunz**, and **Rebecca Sorenson** joined the department this summer.

—

David Kroodsma's bike ride for climate has taken him more than 9,000 miles. As of early Sept. he was in northern Peru. Check his progress at www.rideforclimate.com.

Observatories

Staff astronomer **Luis Ho** gave an invited talk at Yunnan Observatory in China on the operation and science goals of small telescopes. He also gave colloquia at Wuhan University in Wuhan, China; at the Chinese Academy of Sciences' Institute of High Energy Physics in Beijing; and at UC-Berkeley.

—

❷ The Carnegie Supernovae Project team met in Pasadena Aug. 7-8. The group is observing type Ia supernovae with the goal of measuring the amount of dark energy in the universe.

Plant Biology

Department director **Chris Somerville** spoke at the Gordon Research Conference on Plant Cell Walls at U. New England in Biddeford, ME, July 30-Aug. 4, and at the American Society of Plant Biologists annual meeting in Boston Aug. 5-9. He also gave the keynote address at the UC-Berkeley Dept. of Plant and Microbial Biology's retreat at Asilomar, CA, on Sept. 8. Somerville presented a keynote address at a special meeting in Kyoto on Sept. 13 and spoke at a workshop titled "Plant Biotechnology for Production of Industrial Materials" in Osaka on Sept. 14. He also gave the Beach Lecture at Purdue U. on Sept. 18 and presented seminars at the Joint Genome Institute in Walnut Creek, CA, on Oct. 10, and at the dedication of UC-Riverside's new Genome Center on Oct. 18.

—

Director Emeritus **Winslow Briggs** spoke at the International Plant Photobiology Meeting in Paris in Apr., and at the Gordon Research Conference on Photosensory Receptors and Signal Transduction in Barga, Italy, Apr. 30-May 5. In Apr. Briggs gave several talks in China: at the Advances in Plant Biology symposium in Beijing, at the Frontiers of Plant Biology 2006 symposium in Changsha, and at the National Institute for Plant Physiology in Shanghai. Briggs received a Centennial Award at the Botanical Society of America's annual meeting at California State U., Chico, July 28-Aug 2.

—

Shauna Somerville spoke at the Gordon Research Conference on Plant Cell Walls at U. New England in Biddeford, ME, July 30-Aug. 4.

—

Zhiyong Wang spoke at the 11^{th} International Symposium of the Society of Chinese Bioscientists in America on July 19-23 in San Francisco, and at the 11^{th} International Congress of Plant Tissue Culture and Biotechnology on Aug. 13-18 in Beijing.

—

Devaki Bhaya taught at the Microbiology Summer Course at Stanford U.'s Hopkins Marine Station in July, and spoke at the 3^{rd} annual Frontiers in Integrative Biological Research workshop July 31-Aug. 2 at Montana State U. in Bozeman.

—

Postdoctoral research associate **Friederike Hoermann** arrived from U. Munich in June, and **Sabine Mueller** arrived from UC-San Diego in July.

—

Postdoctoral fellow **Karen Deuschle** left for U. Ulm, Germany, in Apr., and **Sonja Vorwerk** returned to Germany in May. Postdoctoral research associate **John Emery** left for the Stanford Medical School in May, **Pablo Jenik** went to Oberlin College in Ohio in July, and **Serry Koh** accepted a position at Sogang U. in Seoul in Aug. Predoctoral fellow **Ida Lager** returned to Germany in June.

—

Researcher and greenhouse manager **Dana Parmenter** left to teach at the College of New Caledonia in Prince George, BC, in July.

—

Graduate student **Alex Paredez** defended his Ph.D. thesis at Stanford U. and will begin his postdoctoral research at UC-Berkeley. **Rebecca McCabe** also received her Ph.D. and left for a position in Southern California.

—

Stanford U. student **Ryan Gutierrez** has joined Dave Ehrhardt's lab.

—

The following visiting investigators arrived this summer: **Nicolas Blouin** from U. Maine, **William Eisinger** from U. Santa Clara, **Inseob Han** from U. Ulsan, South Korea, **Carlos Melo** from U. Coimbra in Portugal, former graduate student **Margaret Olney,** now at St. Martin's University in Lacey, WA, and **Stephan Wenkel** from the Max Planck Institute in Cologne. **Christian Voigt** and **Steffan Bauer** arrived from Germany in July and Aug., respectively.

—

❸ Sara Seager is one of *Popular Science*'s 2006 "Brilliant 10."

❹ Visiting investigator Derek Richardson

Visiting student **Clara Sanchez Rodriguez** arrived from U. Politécnica de Madrid in Spain in July, and visiting student **Georgios Perrakis** returned to Greece in Aug.

—

The intern program welcomed **Stephane Bagneris** from San Jose State U.; **Candice Cherk** from Swarthmore College; **Ericka Fernquist** from Gavilan College; **Adam Herman** from Northern Michigan U.; **Chi Hsu**, a recent high school graduate; **Young Hsu**, a current high school student; **John McGee** from Stanford U.; and **Anh Nguyen** from Lafayette College.

—

The TAIR group welcomed **Robert Muller** as technical lead curator in May, **Thomas Meyer** as software engineer in June, and **Donghui Li** and **G. Shanker Singh** as curators in July. **Leonore Reiser** is now director of outreach at the Molecular Science Institute in Berkeley, CA. Technical lead curator **Douglas Becker** left in Apr., and **Danny Yoo** left for graduate school in May. **Suparna Mundodi** left for a job in industry. Other departures were **Aleksey Kleytman**, **Daniel Maclean**, **Thomas Yan**, and **Brandon Zoeckler.**

—

Lab assistants **Doug Simmons** and **Nadejda Kleimenova** began work this summer.

—

Lab technician **Gabi Fiene** returned to U. Cologne in Germany in Aug.

—

Dahlia Wist, formerly of the Stanford U. Grounds Department, joined the facilities group as horticulturist/greenhouse manager in July.

—

The Briggs lab is hosting two high school teachers from Korea, **Hakhyun Kim** and **Moon Sung Tae.** The teachers are sponsored by a Korean Science Foundation program to provide science training.

—

Accounts payable specialist/receptionist **Lisa Simons** began work in Mar.

—

Financial officer **Deborah Tausch** left for a nonprofit organization in San Francisco in Aug.

Terrestrial Magnetism

❸ **Sara Seager** has been named one of this year's "Brilliant 10" by *Popular Science* magazine.

—

Alan Boss gave a plenary talk at the XXVI General Assembly of the International Astronomical Union (IAU) in Prague, Czech Republic, in Aug. He also provided commentary about Pluto's planetary status for several news outlets in Aug., including the *New York Times*, the *Washington Post*, and PBS's *NewsHour with Jim Lehrer*. Boss also presented a paper at the Meteoritical Society Meeting in Zurich in Aug., spoke at the NASA Goddard Space Flight Center in Sept., and gave an invited talk at the Pale Blue Dot III Workshop at the Adler Planetarium in Chicago in Sept.

—

Rick Carlson spoke at the Geochemical Society's Goldschmidt Meeting in Melbourne, Australia, in Aug. He was appointed chair of the international program committee for the 2008 Goldschmidt Meeting in Vancouver, BC.

—

Rick Carlson, **David James**, and field seismologist **Steven Golden**, with colleagues at Arizona State U. including former postdoctoral fellow **Matt Fouch**, installed 12 more broadband seismic stations in Oregon as part of the High Lava Plains (HLP) seismic experiment in June. James and Carlson gave talks at the second HLP workshop in Bend, OR, in July. The team then serviced all 16 HLP stations.

—

John Chambers gave an invited talk about habitable planets at the Pale Blue Dot III Workshop at the Adler Planetarium in Chicago in Sept.

—

Conel Alexander, **Larry Nittler**, and postdoctoral fellow **Henner Busemann** presented at the Meteoritical Society Meeting in Zurich in Aug. Nittler also spoke at U. Utrecht in the Netherlands in Aug.

—

Postdoctoral fellow **Alceste Bonanos** gave two invited talks at the XXVI General Assembly of the International Astronomical Union (IAU) in Prague, Czech Republic, in Aug.

—

Henner Busemann served as a member of the NASA Cosmochemistry Program Review Panel in Baltimore in Aug. In Sept. he spoke at the Lawrence Berkeley National Laboratory's Advanced Light Source.

—

Postdoctoral associate **John Debes** spoke at the Naval Research Laboratory in July. In Aug he presented a talk at the 15th European Workshop on White Dwarfs (EuroWD) in Leicester, UK.

—

MESSENGER associate **Catherine Hier-Majumder** attended NASA's Mission Lifecycle Process Summer School at JPL in July.

—

Hubble Fellow **Scott Sheppard** spoke at the Naval Research Laboratory in June. In July he assisted the History Channel for a show on the hazards of asteroids. In Sept. he spoke at a meeting for the New Horizons mission to Pluto in Boulder, CO.

—

Postdoctoral associate **Margaret Turnbull** spoke at the Gordon Research Conference on the Origin of Life at Bates College in Lewiston, ME, in July, and attended the Gordon Research Conference on Science and Technology Policy in Big Sky, MT, in Aug.

—

Ion microprobe research specialist **Jianhua Wang** gave an invited talk at the Western Pacific Geophysics Meeting in Beijing in July.

—

Postdoctoral fellow **Brian Savage** accepted a faculty position at U. Rhode Island and left DTM in Aug.

—

Former research scientist **James Cho**, now at the College of Queen Mary of U. London, returned to work with members of the astronomy group over the summer.

—

Visiting investigator **Jianghui Ji** of the Purple Mountain Observatory of the Chinese Academy of Sciences arrived in June to work with Paul Butler.

—

❹ Visiting investigator **Derek Richardson** of the astronomy dept. at U. Maryland arrived in Aug. for a sabbatical visit.

—

Several visiting investigators returned to DTM over the summer: **Sonja Aulbach**, **Mark Behn**, **Maud Boyet**, **Fenglin Niu**, **Mark Schmitz**, and **Maria Schönbachler.**

—

DTM welcomed summer research interns **Meredith Langstaff**, U. Chicago; **Elizabeth Monahan**, U. Mass.; **Sonali Shukla**, NYU; **Erica Staehling**, Bucknell U.; and **Max Zinner**, a high school student from the Mary Institute and St. Louis Country Day School.

GL/DTM

Librarian **Shaun Hardy** spoke about the Carnegie Legacy Project at the Special Libraries Association annual conference in Baltimore June 11-14.

—

Fabian Moscoso joined the BBR Campus as a building engineer apprentice on Aug. 21.

David Greenewalt Building Dedicated at Broad Branch Road

Under a brilliant September 7 sky, Carnegie dedicated the reengineered Experiment Building on the Broad Branch Road Campus in northwest Washington, D.C., in honor of former trustee and secretary of the board David Greenewalt. Greenewalt, who died in 2003, had been a board member since 1992. As a geophysicist and oceanographer, he had a particular affinity for the science conducted at the Geophysical Laboratory (GL) and the Department of Terrestrial Magnetism (DTM), co-located on the campus.

The event began with a social hour on the patio. Directors Wesley Huntress (GL) and Sean Solomon (DTM) then summoned guests and members of the Greenewalt family for an unveiling of the bronze plaque that bears the building's new name. The gathering then convened in the auditorium for the dedication ceremony, where President Richard Meserve welcomed the attendees.

Meserve recognized Greenewalt for his longtime dedication to, and support of, the institution, his love for science, and his enthusiasm for the Earth sciences in particular. In addition to Carnegie staff, Greenewalt's wife, Charlotte, their children, and other family members and friends attended.

Sean Solomon followed with a historical tour of the old Experiment Building, beginning with vintage photographs from 1919 and concluding with a chronicle of the renovation project. After the presentation, the Greenewalt family assembled at the front of the auditorium for the presentation of a series of photographs of the late trustee, which will hang in the building. The festivities ended with coffee and dessert in the Merle Tuve Room.

(Image courtesy Shaun Hardy.)

The David Greenewalt Building dedication began with refreshments on the patio, above.

Members of the Greenewalt family gather in the front of the auditorium for the unveiling of the framed photos of David Greenewalt, below.

Carnegie Institution of Washington
1530 P Street, NW
Washington, D.C. 20005-1910

Nonprofit Org.
U.S. POSTAGE
PAID
Washington, DC
PERMIT NO.1657