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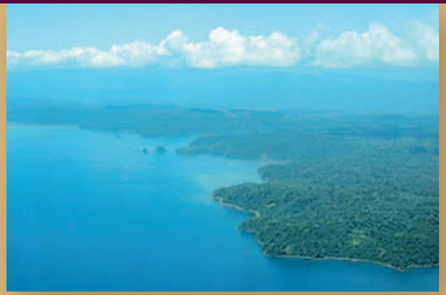


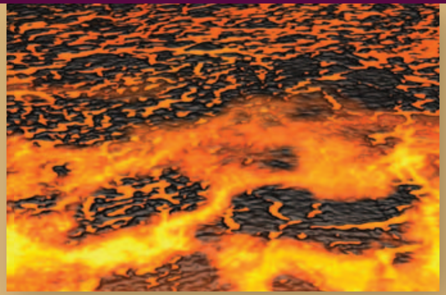


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2009-2010 YEAR BOOK

The President's Report

July 1, 2009 - June 30, 2010

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About Carnegie

". . . to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind . . ."

The Carnegie Institution was incorporated with these words in 1902 by its founder, Andrew Carnegie. Since then, the institution has remained true to its mission. At six research departments across the country, the scientific staff and a constantly changing roster of students, postdoctoral fellows, and visiting investigators tackle fundamental questions on the frontiers of biology, earth sciences, and astronomy.

Carnegie Institution

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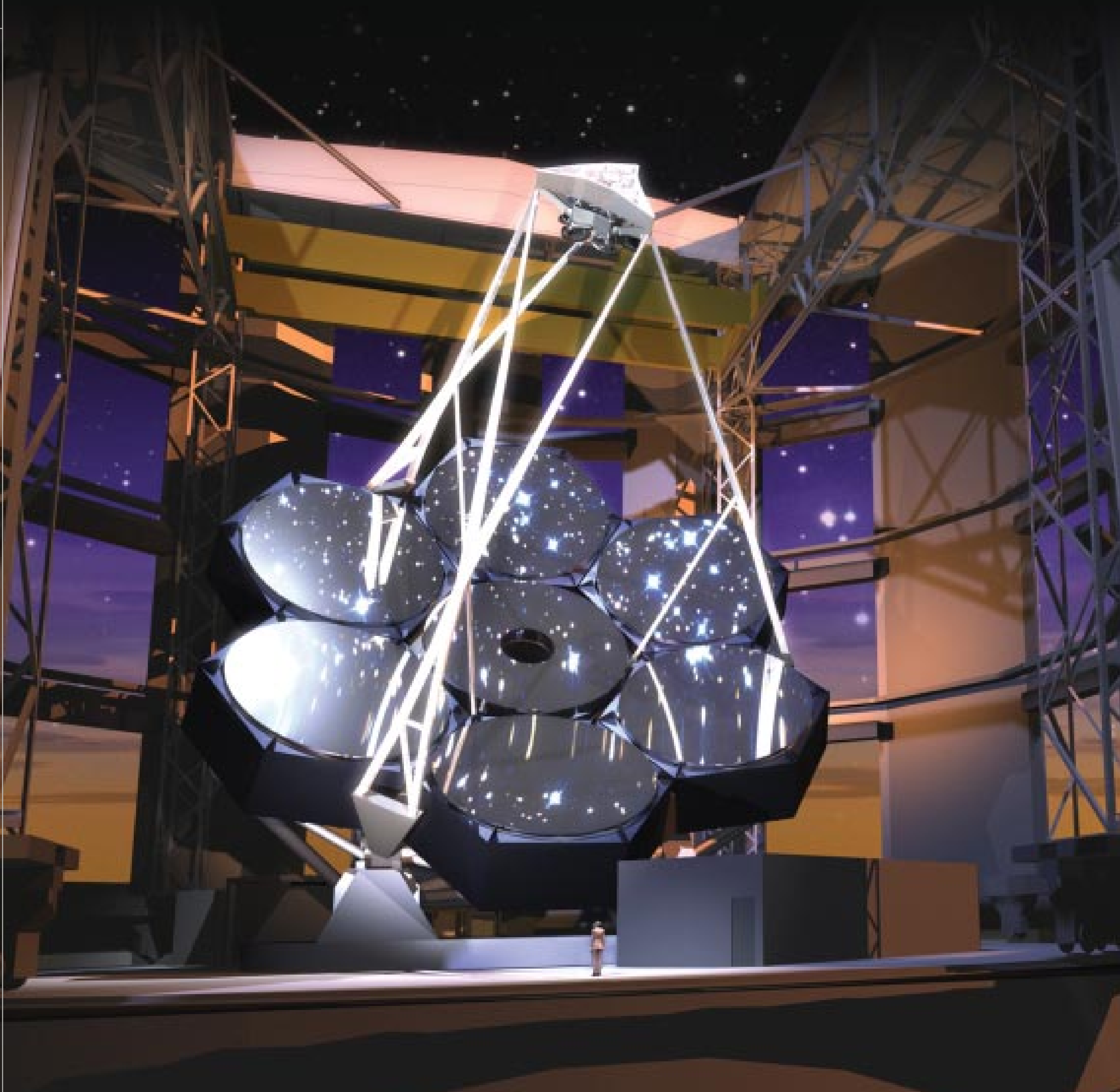


Carnegie president
Richard A. Meserve
Image courtesy Jim Johnson

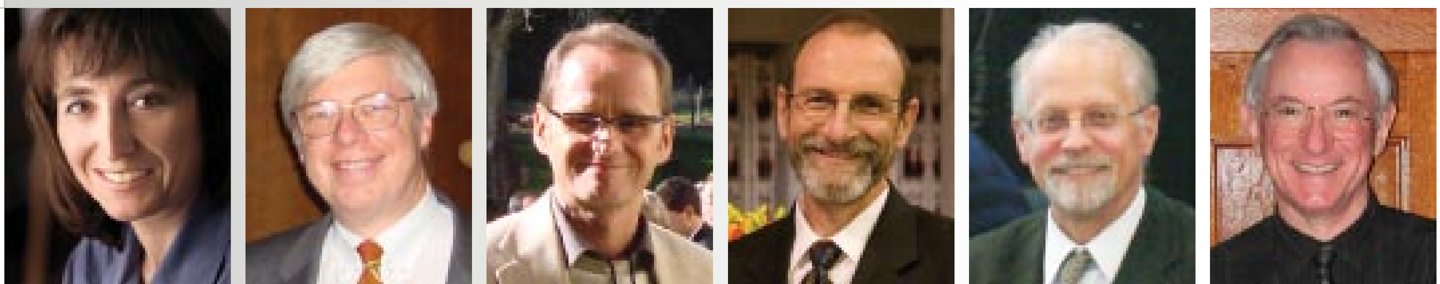
At the November 2010 meeting of our board of trustees, we heard from the institution's directors about their scientific aspirations for the Carnegie departments. This exhilarating meeting revealed the potential for paradigm-shifting discoveries in several scientific disciplines, albeit with significant challenges that must be overcome if we are to realize them. I share some of these discussions here, borrowing liberally from the presentations of the Carnegie directors.

In astronomy, we reviewed the findings of a new report by the National Research Council to identify a program that will "set the astronomy and astrophysics community firmly on the path to answering profound questions about the cosmos."[1] Panels were established covering five scientific frontiers, resulting in the definition of 20 key scientific questions that should be pursued over the next decade. Carnegie scientists, in reviewing the report, noted that the Giant Magellan Telescope (GMT) project, which Carnegie is spearheading with institutions of higher education in the United States and entities in Australia and Korea, addresses fully 18 of the 20 key scientific questions and 4 of the 5 frontier areas. The GMT telescope, which has now completed its design phase, is a telescope with a primary mirror, made of segments, with an aperture of 25 meters—far larger than any telescope now in existence. It will have the capability to study distant objects with unprecedented resolution. It promises to have a major impact in key areas such as understanding the connections between dark and luminous matter, tracking the baryon cycle in galaxies and the intergalactic medium, and identifying the first objects to light up the universe. The GMT, which will be equipped with adaptive optics to compensate for the disruptive effects of the Earth's atmosphere, will also have the capability to identify and determine the properties of nearby planets outside our own Solar System.

With these big opportunities in astronomy come some big challenges. There are technical hurdles to overcome in constructing a telescope of unprecedented size and capabilities, difficulty in raising capital in a time of constrained private and public resources, and the need to forge an international partnership that harnesses the capacities of several countries and institutions. I am pleased that Carnegie and our partners are facing these challenges directly, and we are optimistic that we will meet and overcome them in the coming decade.

The 25-meter Giant Magellan Telescope (left) will give astronomers unprecedented access to distant celestial objects enabling them to unravel some of the most vexing mysteries of the era, from the nature of dark matter and dark energy to how the universe evolved.
Image courtesy the GMTO

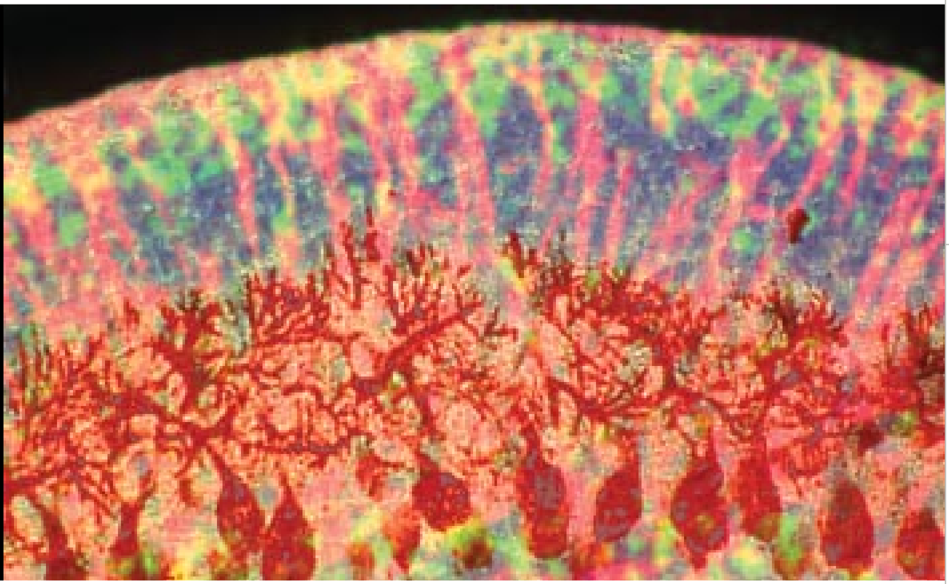
[1]Committee for a Decadal Survey of Astronomy and Astrophysics, Board on Physics and Astronomy, Space Studies Board, Division on Engineering and Physical Sciences, *New Worlds, New Horizons in Astronomy and Astrophysics* (Washington, D.C. National Research Council of the National Academies, The National Academies Press, 2010)

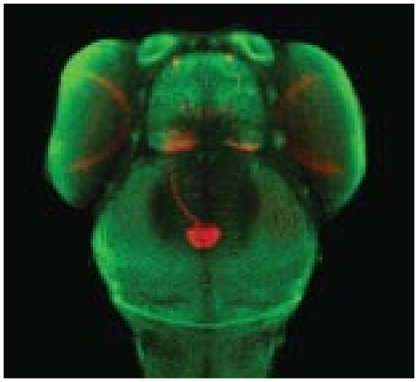


Department directors discussed their visions for their departments at the November board meetings. From left to right: Observatories' Wendy Freedman; Embryology's Allan Spradling; Plant Biology's Wolf Frommer; Global Ecology's Chris Field; the Geophysical Laboratory's Rus Hemley; and Terrestrial Magnetism's Sean Solomon.

Carnegie's Department of Embryology seeks to develop a greater understanding of the fundamental mechanisms governing the development of living organisms. Its scientists expect, along the way, to find that some of the fundamental assumptions about the genome are incomplete. For example, they expect we will find that there are novel biological mechanisms using parts of the genome whose significance is not currently understood (only about 2% of the human genome constitutes genes). They seek to identify new ways in which the genomes of somatic cells systematically acquire differences during development from each other and from germ line cells. They seek to expand our understanding of the operation of stem cells. And they seek to discover new mechanisms for the regulation of genome replication, new means for information storage and retrieval in the neural system, and new mechanisms involved in cancer and evolution.

In addition to these revolutionary tasks, Carnegie scientists will continue to carry out more predictable research. They seek to understand the structure at single-cell resolution of all tissues (including the nervous system) of the model organisms (e.g., mice, fruit flies, zebrafish) that are the focus of the department's research. They seek to understand intercellular communication within tissues. They seek to develop new means to understand physiological cellular activities and metabolism. And finally, they seek to document the underlying unity of these various processes between species, as well as exceptions, in order to understand how the biological world evolved from a common Precambrian ancestor.



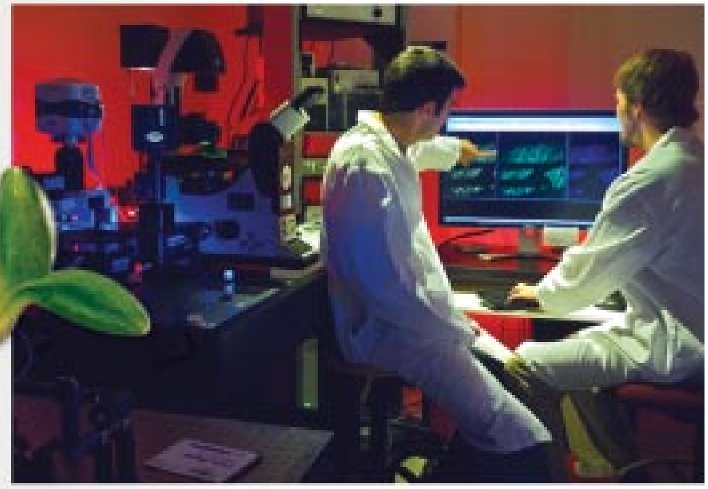


The above image from Embryology's Halpern lab, shows molecular differences between left and right sides of a larval zebrafish brain in red.
Image courtesy Marnie Halpern

Department of Embryology scientist Chen-Ming Fan uses the mouse as a model organism. The image (above right) is a developing cerebellum in a mouse. The top green layer is the proliferating granule stem cells; the blue cells below them are the differentiating granule cells. Pink fibers through the granules are the Bergmann glial fibers, which guide the differentiating granule cells to climb down into the inner chamber. The dark trees with bulbs are the Purkinje cells, to which the granule cells make connections. The yellow cells between the bulbs are the proliferating Bergmann glia stem cells. The granule cells and the Purkinje cells work together to modulate the body's fine motor activity.

Realizing these dreams will require new equipment for sequencing, microscopy, and biochemistry, along with some renovation and expansion of the department's animal facilities. This is a time of extraordinary advance in biology and the department is at the forefront.

The quest of the Department of Plant Biology is to unlock the mysteries of plant life, organisms that constitute the foundation for all life on Earth. They use advanced technologies in biology to address a myriad of mysteries: How sunlight is absorbed and used by plants to produce biomass, how inorganic nutrients are captured and converted into organic matter using the energy from light, how single cells and the plant body are formed, how the environment shapes plant growth and development and, in turn, how plants interact with and shape the environment. Our researchers seek to extend our knowledge of the fundamental biological mechanisms critical for plant growth and development through basic research, a hallmark of all Carnegie science. In addition, the department's scientists are pursuing several overarching research initiatives. They explore how plants evolved on Earth, focusing on the emergence of novel plant-specific features. And they are studying the "hidden" half of plants—namely, the underground root system—and its interaction with the environment. Finally, they seek to harness sophisticated bioinformatics tools to develop a deeper understanding of the genes that regulate critical plant functions. The opportunities are tremendous, yet, to achieve their goals, we must raise funds to renovate research facilities and to enhance technological infrastructure in the areas of advanced imaging and bioinformatics.

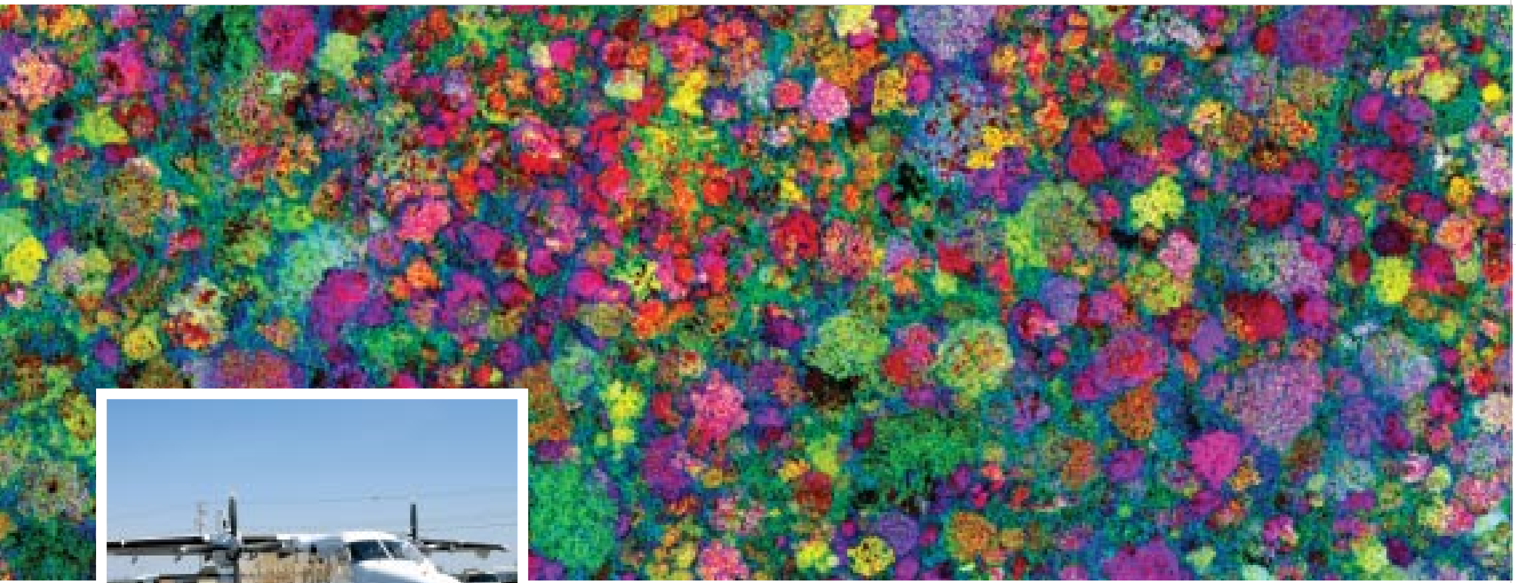


Arabidopsis thaliana (above left) is a tiny, mustard-like weed with a rapid 6-week life cycle making it ideal for studying development, photosynthesis, disease defenses, and plant behaviors. The genome sequence of this model plant was completed in 2000.

Plant Biology researchers use advanced imaging techniques, such as spinning disk microscopes (above) with superior sensitivity.

The Department of Global Ecology, founded in 2002, has already established itself as one of the leading enterprises pursuing integrated Earth-system science. Its aim is to answer fundamental questions about major components of the Earth's system, including such complex issues as the consequences of changes in the atmospheric concentration of greenhouse gases. It thereby seeks to establish the scientific foundations for a sustainable future for the planet. Some of the recent contributions of the department's scientists include a study of the impacts of recent global warming on agricultural yields, measurement by sophisticated remote-sensing techniques of the scale of global forest degradation, assessment of the impacts of ocean acidification, study of the impacts of various techniques to counteract some of the effects of growing greenhouse gas accumulation (termed geoengineering), and a study of the climate feedbacks resulting from changes in forests. The overall goal of this research is to understand the forces that shape the behavior of the Earth's systems. Our challenge is to build a department that has resources that are commensurate with the scope of the problems it is tackling.

One remarkable tool developed at Global Ecology is the Carnegie Airborne Observatory. This system, which is mounted on an aircraft, enables rapid broad-scale ecological assessments of the surveyed terrain. It combines a laser-ranging instrument that enables the measurement of canopy structure, along with a spectroscopic instrument that enables the remote identification of plant species. This tool could provide a critical and unique capability to understand the changing conditions in, for example, tropical forests.

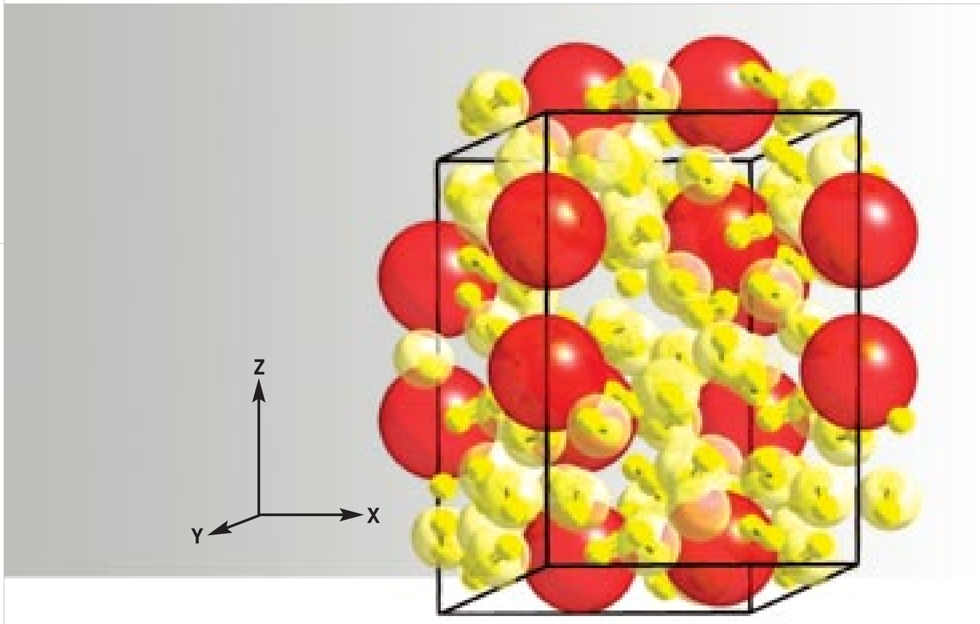


The Carnegie Airborne Observatory (inset) makes large-scale ecological assessments of tropical forests. At right is a high-resolution map of the chemical diversity of vegetation in Panama.
Image courtesy Greg Asner

The scientists at the Geophysical Laboratory have shown repeatedly that breakthroughs in our understanding of materials and of geophysics arise when we explore the behavior of materials under extreme conditions, such as extremes of temperature or pressure. They seek to explore fundamental questions: What new physics will appear when atoms are brought and kept extremely close together? What are the extremes of chemistry—i.e., reactivity, inertness, bonding, strength, and kinetics? How far can we extend the limits of material behavior and make new materials for efficient yet benign energy generation, conversion, and transfer? How can we understand the formation and evolution of Earth, super-Earths, and other celestial bodies in terms of the full range of their extreme environments? What is the fate of elements such as carbon deep within planets? What are the extreme limits of biology? What roles do extreme environments play in the origin and evolution of life? How do they enlighten our search for life beyond Earth's surface?

The Geophysical Laboratory pursues its research through a growing network of relationships, laboratories, and field sites. It has successful programs at Argonne National Laboratory, Brookhaven National Laboratory, and most recently, Oak Ridge National Laboratory, for the conduct of research using unique tools at these laboratories that were developed in partnership with Carnegie scientists. It seeks to expand these relationships and establish new ones in a network of observatories as it strengthens the instrumentation base and capabilities at our facilities on Broad Branch Road.

The Department of Terrestrial Magnetism pursues a broad sweep of questions that address the formation and evolution of planets, including our own. Scientists in that department are grouped in three broad areas—astronomy, geochemistry and cosmochemistry, and geophysics. Within these groups, fundamental theoretical and obser-

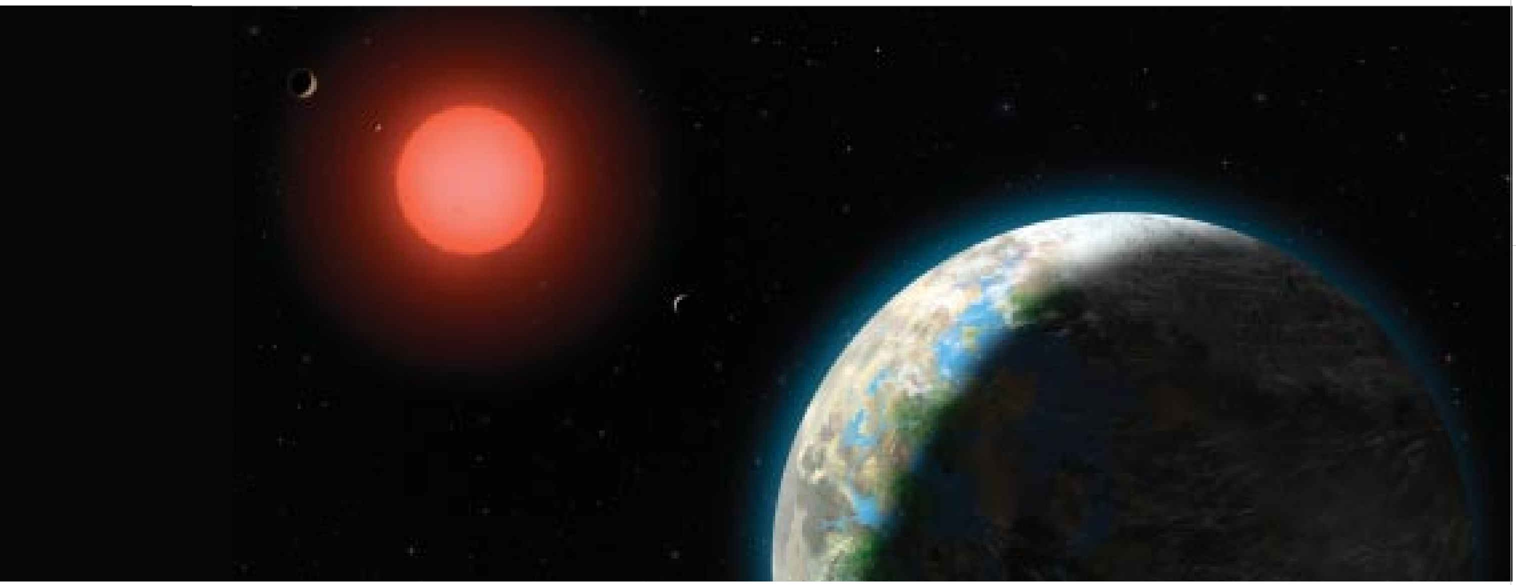


Scientists at the Geophysical Laboratory (GL) found for the first time that high pressure can be used to make a unique hydrogen-storage material (left). They found that the normally unreactive, noble gas xenon combines with molecular hydrogen (H_2) under pressure to form a previously unknown solid with unusual bonding chemistry. The discovery debuts a new family of materials. Other GL researchers were able to watch nanoparticles grow from the earliest stages of their formation (right). Nanoparticles are the foundation of nanotechnology and their performance depends on their structure, composition, and size. Researchers will now be able to develop ways to control the conditions under which they are grown.

vational questions abound, such as the theory of formation of gas-giant, ice-giant, and rocky planets; the chemistry and chronology of early Solar System material, including meteorites, interplanetary dust particles, and samples from cometary and planetary bodies; and those aspects of Earth structure relating to the formation and evolution of continents. Challenges for that department include the need for additional fellows, equipment, computational resources, and skilled technical support.

As the foregoing shows, the scientific dreams of our staff are varied and exciting. It nonetheless is important to note that we do not aim to script our future projects in ways that constrain us. During our discussion, Allan Spradling, the director of the Department of Embryology, provided a view that I share: "[Our] departments do not exist to solve specific [scientific] problems . . . . Instead, they strive to do the most important work in their field at a particular moment in time, work that will maximally advance the field's internal development. Unfortunately, it is usually not clear what that work is until it is almost completed. . . .[T]he flexible Carnegie style has allowed small departments to have an outsized influence, and arguably has been the secret of the institution's success over most of its history." While constantly setting ambitious scientific targets, we seek to maintain the flexibility to pursue the unexpected. Indeed, it is the startling moment of clarity arising from a surprising result that often yields the greatest scientific advance.

Of course, the achievement of the ambitious dreams of our scientists requires resources. Our endowment is recovering from the economic decline of 2008, but not sufficiently as yet to enable significant new spending. We have fared well in support from the federal government and from foundations—a testament to the skills of our scientists—



Terrestrial Magnetism's Paul Butler and team find planets around other stars. Their ultimate goal is to find other Earths. This artist's rendition shows the potentially habitable Earth-sized planet his team recently found. It is one of two new planets discovered around the star Gliese 581, some 20 light-years away.
Image courtesy NASA, artwork by Lynette Cook

but we should not expect handsome future growth from these sources. We are clearly entering a period of fiscal stringency at all levels of government. And foundations are recovering from the same endowment declines suffered by Carnegie and most universities, so prudence in their future commitment of resources seems probable.

Nonetheless, I am optimistic that the expansion of our scientific reach will be achieved. I observe the remarkable success of Carnegie science, as revealed by the steady flow of remarkable discoveries from all our departments. (One measure of this success is the extensive listing of scientific publications in major journals that is set out elsewhere in this volume.) Despite our small size, we are very significant contributors in the fields in which we work. Given the important role of science in building a sustainable and productive future, I am confident that the necessary resources will be found.

Andrew Carnegie founded the institution with the intention that it shall "in the broadest and most liberal manner, encourage investigation, research, and discovery." We are filling the role that Andrew Carnegie intended for us. We will continue to enrich the storehouse of scientific knowledge on into the future, as we have in the past. As the conversation with Carnegie directors has revealed, we do not lack exciting new scientific terrain to explore.

Richard A. Meserve

Friends, Honors & Transitions

Carnegie Friends

Annual Giving

The Barbara McClintock Society

An icon of Carnegie science, Barbara McClintock was a Carnegie plant biologist from 1943 until her retirement. She was a giant in the field of maize genetics and received the 1983 Nobel Prize in Physiology/Medicine for her work on patterns of genetic inheritance. She was the first woman to win an unshared Nobel Prize in this category. To sustain researchers like McClintock, annual contributions to the Carnegie Institution are essential. The McClintock Society thus recognizes generous individuals who contribute $10,000 or more in a fiscal year, making it possible to pursue the highly original research for which Carnegie is known.

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Trustee Robert G. Goelet has been a guiding force on the Carnegie board of trustees for more than a quarter of the institution's existence. When he was elected in 1980, he was president of Goelet Realty Company, vice president of Goelet Estate Company, director of the Chemical Bank, and president of the American Museum of Natural History. His unique blend of business and nonprofit experience, along with his love of biology, made him a perfect fit for Carnegie.

Goelet is a member of the Finance Committee, a post he has held since 1981. In the early 1980s he was also a member of the Nominating Committee, chairing it in 1984. He has been an integral part of the institution's history and a contributor to its scientific prosperity, helping steer it through the business challenges of the Observatories' Magellan Telescope Project. He was involved with the relocation of the Geophysical Laboratory (GL) and the Department of Terrestrial Magnetism to one site, and has watched GL become a driving force in a half dozen major international research alliances and Terrestrial Magnetism evolve into a powerhouse for planetary studies. He saw the launching of Carnegie's educational programs, First Light and the Carnegie Academy for Science Education, witnessed the construction of the Maxine Singer Building at Embryology, and was party to establishing the first new department in over 80 years, the Department of Global Ecology.

For three decades, Goelet has consistently supported the institution's initiatives. He has generously contributed to every capital campaign, challenge grant, and annual fund drive, and he has supported instrumentation, buildings, the Global Ecology fund, and more. He is a member of the Edwin Hubble Society.

★ *Robert Goelet*

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François and Linda Schweizer
Malcolm Scully
Nobumichi Shimizu
Ray Shoenfelt
Walter Shropshire
Tom M. Siegel
Randolph Sim
Helen Simms
Mary E. Simon
Frederick J. Simons
David W. Simpson
Virginia B. Sisson
Brian G. Smith
Christine D. Smith
John T. Smith
Michael Smith
Jordan Sorensen
Phillip K. Sotel
Jean Stadel
Seth Stein
Erich W. Steiner
Susan Strain
Nathan Strug
Joan T. Suwalsky
Thomas H. Symons
Kathleen Taimi
Gary R. Tanigawa
Constance P. Tate
Lawrence A. Taylor
Leslie C. Taylor
Mack Taylor
Thomas M. Tekach
Jerilyn Teplin
Mira Thompson
Norbert Thonnard
Tom Thornbury
Kristy Tiampo
Peter A. Tinsley
Charles H. Townes
Mary S. Travis
Kay Tremaine
Jonathan Tuerk
Michael S. Turner
Frits Van Beek
Suzan van der Lee
W. K. VanNewkirk
Arthur H. Vaughan
David Velinsky
Clayton Vickland
Daniel and Eloise Vitiello
Richard J. Walker
Jessica M. Warren
Linda Warren
Wayne H. Warren
Johannes Weertman
James H. Whitcomb
Edward White
Evan Williams
James E. Williams
Ian Wilson
Evelyn M. Witkin
James A. Wood
Julianne Worrell
Michael J. Worth
Frank K. Wyatt
Robert Yamartino
Charles Yanofsky
Irving and Carol Yoskowitz
Richard S. Young
Robert A. Young
Violet K. Young
Judith P. Zauderer
Timothy A. Zimmerlin
Wanna M. Zinsmaster

Foundations and Corporations

$1,000,000 or more

Anonymous
Gordon and Betty Moore Foundation
Alfred P. Sloan Foundation

$100,000 to $999,999

The Ahmanson Foundation
The Gayden Family Foundation
The Hearst Foundation, Inc.
Andrew W. Mellon Foundation
Ambrose Monell Foundation
The San Simeon Fund, Inc.

$10,000 to $99,999

Anonymous (2)
Association of American Medical Colleges
Baltimore Community Foundation
The Bodman Foundation
The Brinson Foundation
The Margaret A. Cargill Foundation
Carnegie Institution of Canada/Institution Carnegie du Canada
Chesapeake Bay Trust
Dow AgroSciences LLC
Fondation de France
Herman Frasch Foundation for Chemical Research
Golden Family Foundation
Robert and Margaret Hazen Foundation
Richard W. Higgins Foundation
The Hoffberger Foundation
The G. Harold and Leila Y. Mathers Charitable Foundation
The McMurtry Family Foundation
Shippy Foundation
Sun Microsystems, Inc.
Syngenta Biotechnology, Inc.
The William and Nancy Turner Foundation
The Sidney J. Weinberg, Jr., Foundation

William K. Gayden

In 1998 David Swensen, then chairman of the Finance Committee, recommended that Bill Gayden, founder, chairman, and chief executive officer of Merit Energy Company, present information about his company to the board as a possible Carnegie investment. Merit, founded in 1989, is a privately owned oil and gas company that acquires and exploits mature petroleum reserves. Little did anyone suspect that Gayden harbored a passionate interest in astronomy and would later become a valued board member. Everyone on the Finance Committee was captivated by Gayden's presentation, not just because of the success of the company, but because they found him to be an independent and creative thinker.

Some years after Gayden's presentation, the Nominating Committee invited him to join the board. By that time Gayden had become familiar with Carnegie's high-risk, high-reward science—a natural fit for a successful entrepreneur. Gayden was elected to the board in 2002. Since then he has served as a member of the Research and Budget and Operations committees. He also served as a member and then chairman of the Audit Committee. His business instincts and insights were critical as he helped the institution navigate the rough waters it encountered as it modified its new business practices.

From the very beginning, Gayden has been a particularly strong advocate for the bold and ambitious Giant Magellan Telescope project. The one-of-a-kind venture, on course for completion in 2019, has benefited tremendously from his gifted counsel and support. Gayden has consistently supported other high-priority needs at Carnegie over the years. He is a member of the Vannevar Bush Society.

★ *William K. Gayden*

$500 to $9,999

The Abell Foundation
Peter and Julia Brennan Fund
Cavalieri-Look Fund
Ernst Charities
Field-Chiariello Family Revocable Trust
Arthur and Linda Gelb Charitable Foundation
Michael E. Gellert Trust
Hicks Family Charitable Foundation
Incorporated Research Institutions for Seismology
The Marion I. and Henry J. Knott Foundation, Inc.
Laubach Family Fund
Linden Trust for Conservation
Maverick Capital Foundation
Robert W. and Gladys S. Meserve Charitable Trust
Mulago Foundation
Omenn-Darling Family Advised Fund
Pfizer Foundation Matching Gifts Program
The T. Rowe Price Program for Charitable Giving
Prince Charitable Trusts
Society for Developmental Biology
The Spradling/Griffin Charitable Gift Fund
The Lee and Carol Tager Family Charitable Fund
Unavco, Inc.
VWR Charitable Foundation
The Weathertop Foundation
YSI Foundation
Zimmer Gunsul Frasca Architects LLP
The Zoback Trust

Government

Over $1,000,000

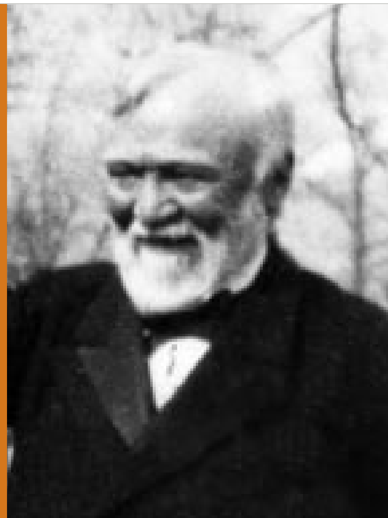
National Aeronautics and Space Administration
National Science Foundation
U.S. Department of Energy
U.S. Public Health Services-National Institutes of Health

$100,000 to $1,000,000

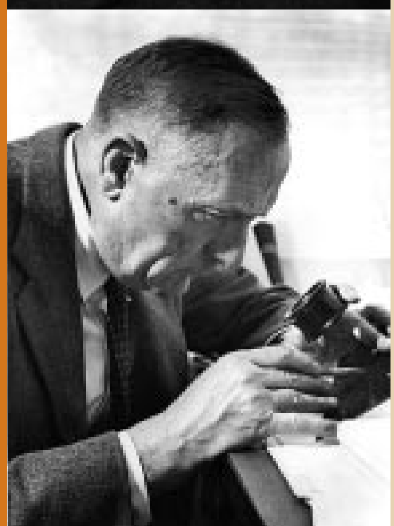
U.S. Office of Naval Research

$10,000 to $99,999

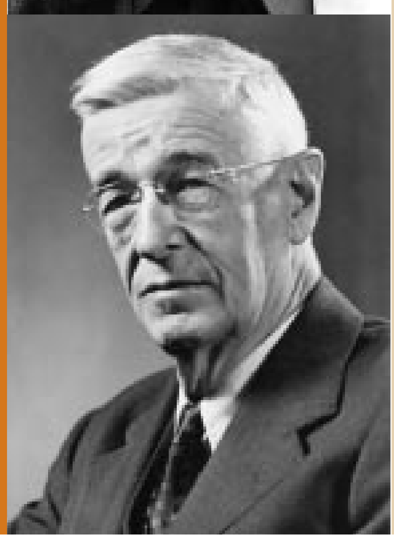
U.S. Department of Agriculture, Forest Service
U.S. Army



★ *Andrew Carnegie*



★ *Edwin Hubble*



★ *Vannevar Bush*

Lifetime Giving Societies

The Carnegie Founders Society

Andrew Carnegie, the founder of the Carnegie Institution, established it with a gift of $10 million. Although he ultimately gave a total of $22 million to the institution, his initial $10 million gift represents a special level of giving. In acknowledgment of the significance of this initial contribution, individuals who support Carnegie's scientific mission with lifetime contributions of $10 million or more are recognized as members of the Carnegie Founders Society.

Caryl P. Haskins*
William R. Hewlett*

The Edwin Hubble Society

The most famous astronomer of the 20th century, Edwin Hubble, joined the Carnegie Institution in 1919. Hubble's observations shattered our old concept of the universe. He proved that the universe is made of collections of galaxies and is not just limited to our own Milky Way—and that it is expanding. This work redefined the science of cosmology. Science typically requires years of work before major discoveries like these can be made. The Edwin Hubble Society honors those whose lifetime support has enabled the institution to continue fostering such long-term, paradigm-changing research by recognizing those who have contributed between $1,000,000 and $9,999,999.

D. Euan and Angelica Baird
Michael and Mary Gellert
Robert G. and Alexandra C. Goelet
William R. Hearst III
Richard E. Heckert*
Kazuo and Asako Inamori
Burton and Deedee McMurtry
Jaylee M. Mead
Cary Queen
Deborah Rose, Ph.D.
William J. Rutter
Thomas and Mary Urban
Sidney J. Weinberg, Jr.*

The Vannevar Bush Society

Vannevar Bush, the renowned leader of American scientific research of his time, served as Carnegie's president from 1939 to 1955. Bush believed in the power of private organizations and wrote in 1950, "It was Andrew Carnegie's conviction that an institution which sought out the unusual scientist, and rendered it possible for him to create to the utmost, would be worth while [sic] . . ." He further said that "the scientists of the institution . . . seek to extend the horizons of man's knowledge of his environment and of himself, in the conviction that it is good for man to know." The Vannevar Bush Society recognizes individuals who have made lifetime contributions of between $100,000 and $999,999.

Anonymous (3)
Bruce and Betty Alberts
Daniel Belin and Kate Ganz
Didier and Brigitte Berthelemot
Gary P. and Suzann A. Brinson
Donald and Linda Brown
A. James Clark
Tom and Anne Cori
Jean and Leslie Douglas
Bruce Ferguson and Heather Sandiford
Stephen and Janelle Fodor
William and Cynthia Gayden
Robert and Margaret Hazen
Antonia Ax:son Johnson and Goran Ennerfelt
Gerald Laubach
Lawrence H. Linden
John D. Macomber
Steven L. McKnight
Richard A. and Martha R. Meserve
Al and Honey Nashman
Evelyn Stefansson Nef*
Vera C. Rubin
Allan R. Sandage*
Christopher and Margaret Stone
William and Nancy Turner

Second Century Society

The Carnegie Institution is now in its second century of supporting scientific research and discovery. The Second Century Society recognizes individuals who have remembered, or intend to remember, the Carnegie Institution in their estate plans and those who have supported the institution through other forms of planned giving.

Bradley F. Bennett*
Richard Buynitzky*
Eleanora K. Dalton
Nina V. Fedoroff
Kirsten H. Gildersleeve
Robert and Margaret Hazen
Paul and Carolyn Kokulis
Gilbert and Karen Levin
Evelyn Stefansson Nef*
Allan R. Sandage*
Leonard Searle*
Maxine and Daniel Singer
John R. Thomas, Ph.D.
Hatim A. Tyabji

** Deceased*
Members were qualified with gift records we believe to be accurate.
If there are any questions, please call Mira Thompson at 202.939.1122.

Honors & Transitions

Honors

Administration

Carnegie president **Richard Meserve** was appointed to the Blue Ribbon Commission on America's Nuclear Future by Secretary of Energy Steven Chu in 2009. He also received an honorary doctorate from Washington College.

Toby Horn, codirector of the Carnegie Academy for Science Education, received the 2009 Bruce Alberts Award for Excellence in Science Education from the American Society of Cell Biology in December 2009.

Embryology

Staff member **Douglas Koshland** was elected to the National Academy of Sciences in April 2010.

Research technician **Dianne Williams** received Carnegie's Service to Science Award in May 2010.

Geophysical Laboratory

Director Emeritus **Charles Prewitt** received the first IMA Medal for Excellence in Mineralogy from the International Mineralogical Association at the Goldschmidt Conference in 2009.

Staff member **Yingwei Fei** was elected a 2010 fellow of the American Geophysical Union.

Global Ecology

Department director **Christopher Field** was elected to the American Academy of Arts and Sciences in April 2010. He was also awarded the Heinz Award in September 2009.

Staff member **Kenneth Caldeira** was elected a 2010 fellow of the American Geophysical Union.

Observatories

Frank Perez, site manager/telescope engineer, received Carnegie's Service to Science Award in May 2010.

Plant Biology

Director Emeritus **Winslow Briggs** was awarded the 2009 International Prize for Biology by the Japan Society for the Promotion of Science.

Terrestrial Magnetism

Staff member **Steven Shirey** was elected a 2010 fellow of the American Geophysical Union.

Transitions

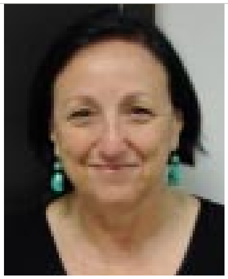
Trustee emeritus **Richard Heckert** died in January 2010.

Staff member **Paul Silver** of Terrestrial Magnetism died in a car accident with his daughter on August 7, 2009.

Embryology staff associate **Judith Yanowitz** became an assistant professor at the Magee-Womens Research Institute in Pittsburgh in November 2009.

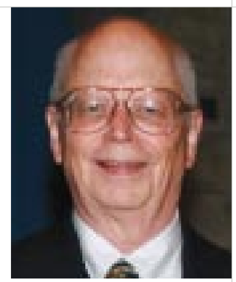
Martin Jonikas joined the Department of Plant Biology as a young investigator in 2010.


★ *Richard Meserve*

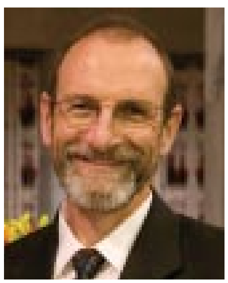

★ *Toby Horn*


★ *Douglas Koshland*


★ *Dianne Williams*


★ *Charles Prewitt*


★ *Yingwei Fei*


★ *Christopher Field*


★ *Kenneth Caldeira*

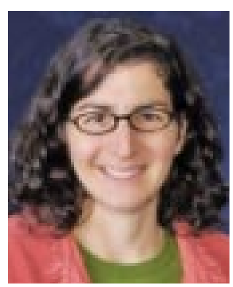

★ *Frank Perez*

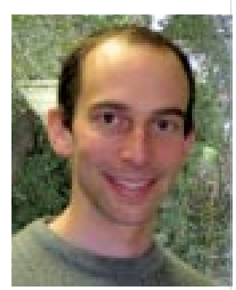

★ *Winslow Briggs*


★ *Steven Shirey*


★ *Richard Heckert*


★ *Paul Silver*


★ *Judith Yanowitz*


★ *Martin Jonikas*

Research Highlights

Embryology

Deciphering the Complexity of Cellular, Developmental, and Genetic Biology

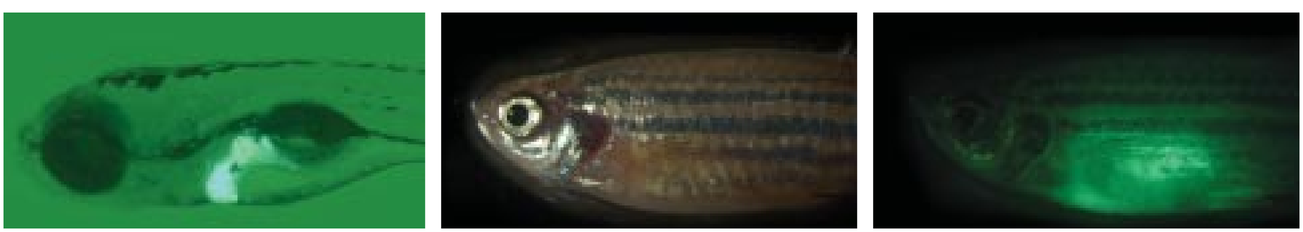
Watching Estrogen Turn On

Sex hormones bind to receptors, activating genes that play roles in many physiological activities. For example, estrogen receptors are activated when bound by naturally occurring estrogens as well as by synthetic chemicals that mimic estrogen. In turn, bound receptors enter the cell's nucleus, where they bind to specific sequences of DNA and activate genes. Carnegie scientist Daniel Gorelick in Marnie Halpern's laboratory has developed a new method for observing estrogen-receptor activity in live fish. The tool could help scientists understand the reason for the high number of intersex fish—males that show female characteristics—recently found in rivers and streams across the United States. Of particular interest to Gorelick and Halpern, however, is the possibility that this tool might also help elucidate currently unappreciated roles of estrogen in brain development and behavior.

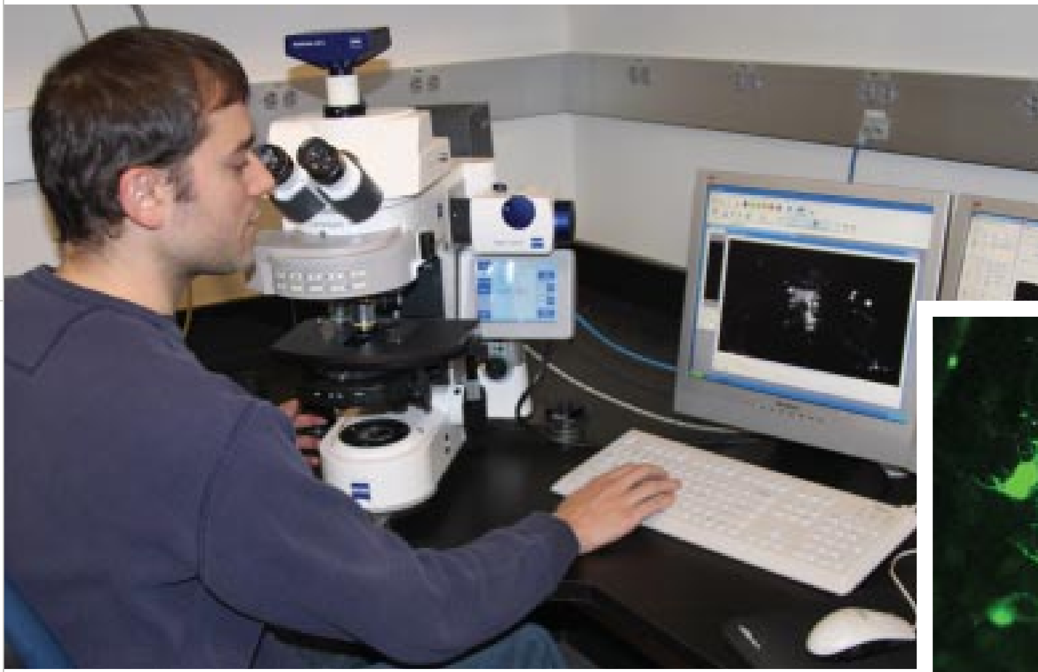
The estrogen-response system is involved in lipid metabolism, bone growth, glucose metabolism, and reproduction. Estrogen and estrogen receptors also modulate mating behaviors and aggression. To understand the physiological effects of estrogen, it is crucial for scientists to develop the best tools and processes for observing when and in which cells receptors become activated and for learning the consequences of activation.

Gorelick created transgenic zebrafish larvae that turn on a green fluorescent protein in cells where estrogen receptors are activated in the presence of estrogen. Activation was observed in the liver and the brain, as expected. Green cells were also found in other tissues, such as olfactory neurons and heart valves, where less sensitive tests have not detected activated estrogen receptors.

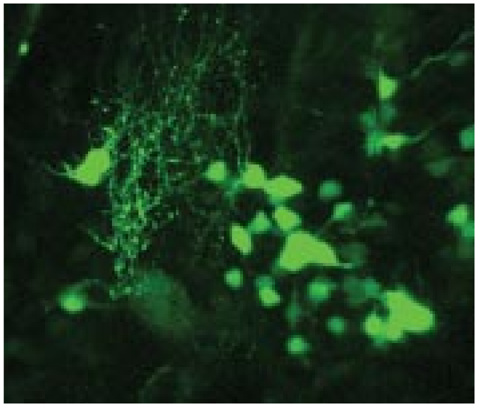
The researchers recognized the importance of proving that the new method was specific as well as sensitive. Fluorescent labeling was activated by natural and synthetic estrogens, but not by other sex hormones. Also, fluorescence was inhibited by compounds that are known



(Left) In a five-day-old zebrafish larva, the liver glows as estrogen receptors are activated. The Gorelick-Halpern method is the first of its kind for observing estrogen signaling in live fish. (Center and right) After swimming in water containing estrogen, the liver glows in an adult fish. On the right, a special fluorescence microscope is used to visualize estrogen receptor activation.



(Above) Daniel Gorelick uses a fluorescence microscope to image estrogen-responsive neurons in the zebrafish brain.
Image courtesy Bill Kupiec



(Right) Neurons sensitive to estrogen are shown in the brain of this live larva.
Image courtesy Daniel Gorelick and Marnie Halpern

to antagonize estrogen receptors. Together these results demonstrate that the system designed by Gorelick and Halpern is specific to estrogen and estrogen receptors.

There are many potential applications for these specially designed zebrafish. One of the most exciting is studying how water pollution by estrogenic compounds acts on susceptible animals, for example, by identifying affected tissues. Another use of these fish of particular interest to Gorelick and Halpern will be to monitor how different populations of nerve cells are activated during behaviors modulated by estrogen.

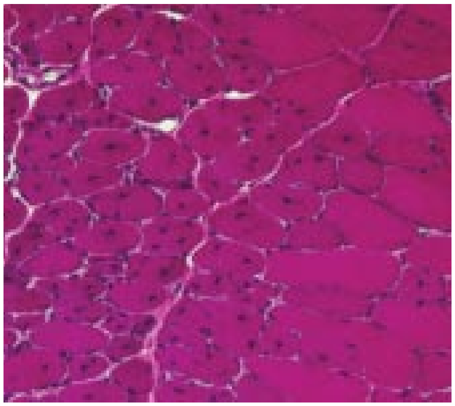
Muscle Stem Cell Surprise

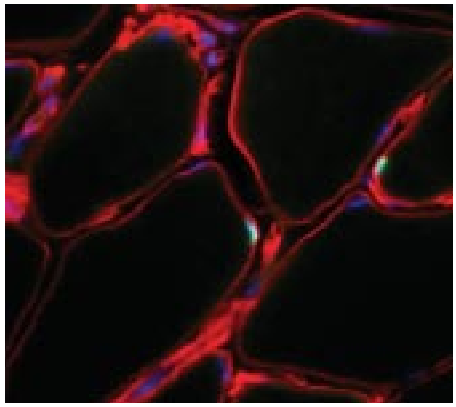
Some surprising results from Carnegie molecular biologists may have important implications for the treatment of muscular dystrophy, aging-related muscle atrophy, and regenerative medicine. Chen-Ming Fan and Christoph Lepper have demonstrated that the genes in charge of regulating the production of embryonic muscle stem cells are not necessary to regenerate adult skeletal muscles after injury or damage.

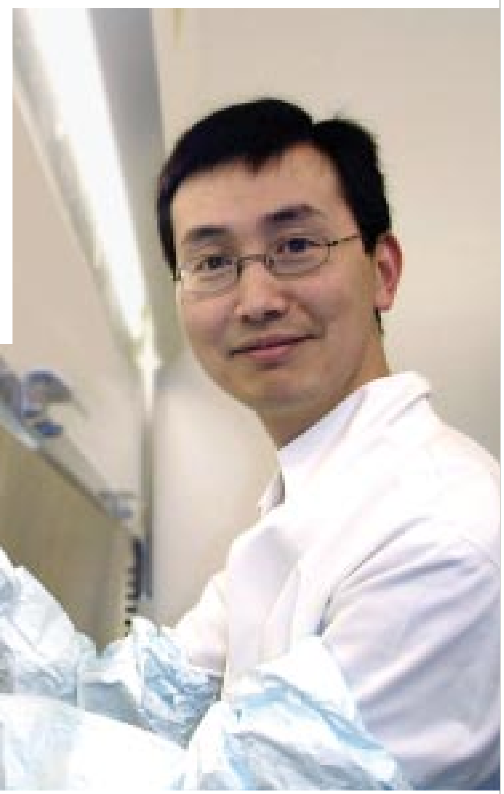
Conventional wisdom had led researchers to believe that regeneration of skeletal muscle tissue would mimic the process of embryonic muscular development. Following this logic, the Carnegie team studied *Pax3* and *Pax7*, two "master regulator" genes that previous research had demonstrated are essential for making embryonic and neonatal muscle stem cells in mice.

Using sophisticated genetic tools, the team was able to look at the activities of these two genes at various stages of muscle growth in live mice. Their results showed that specialized embryonic protomuscle cells directly regulated by *Pax3* and *Pax7* do develop into adult muscle stem cells. But, contrary to expectations, shortly after the mice were born these genes were found to be no longer necessary for adult muscle stems cells to make new muscles. This finding surprised Lepper and Fan, and was a big shock for muscle researchers worldwide.

Further study allowed the team to narrow down the period of time when *Pax3* and *Pax7* are still important for







(Above left) This image is a stained cross section of skeletal muscle tissue 10 days after an intramuscular injection of toxic snake venom. The fibers on the left show centrally located nuclei, a hallmark of regenerative muscle fibers. The fibers on the right are old, mature fibers that weren't injured by the toxin injection.

(Above right) This is a cross section of mature skeletal muscle, which was reacted with antibodies and stained to label all nuclei. The two green nuclei were bound to the Pax7 antibody, indicating that they are so-called satellite cells. Their name comes from their location, which is "orbiting" the muscle fiber.

Images courtesy Christoph Lepper

(Far right) Chen-Ming Fan of the Department of Embryology holds research mice in the laboratory.

Image courtesy Chen-Ming Fan

generating muscle stem cells after birth. It turns out that these embryonic stem cell genes are required only during the first three weeks of life. Afterward, *Pax3* and *Pax7* apparently hand their duties off to a different set of genes.

In mice older than three weeks, this second, unidentified, set of genes would be activated to rebuild muscles after damage due to trauma or exercise. Going forward, the researchers hope to better understand this transitional period when the embryonic genes become inactive and a new set of regulators takes over.

The finding that some adult tissues use genes that are different from the ones juvenile tissues use to repair themselves is fundamentally important. Fan and Lepper's discovery also illustrates the importance of understanding the intricacies of stem cell biology before making clinical decisions about cell-based therapies for muscle diseases. □

Geophysical Laboratory

Probing Planetary Interiors, Origins, and Extreme States of Matter

Whiskers 'n' Water on the Moon

It was a big year for the Moon. Researchers at the Geophysical Laboratory (GL) found evidence for more water in its interior than previously known. They also discovered carbon in the form of graphite "whiskers." The whiskers could have formed only in high temperatures, so presumably they were produced by the impactors from the late heavy bombardment of 3.8 billion years ago. That also means the Moon potentially holds a record of the carbon input to the Earth-Moon system as life was beginning to emerge.

For several decades scientists have thought the Moon was dry. Its bulk water content was thought to be less than 1 part per billion—a million times drier than the interiors of Earth and Mars. The team of scientists examined the mineral apatite in two Apollo samples and in a lunar meteorite. GL postdoctoral fellow Francis McCubbin and team enlisted Erik Hauri of Terrestrial Magnetism to help with the aid of his secondary ion mass spectrometer. The researchers combined their measurements with models that characterize how the material crystallized as the Moon cooled and found that the water content ranged from 64 parts per billion to 5 parts per million.

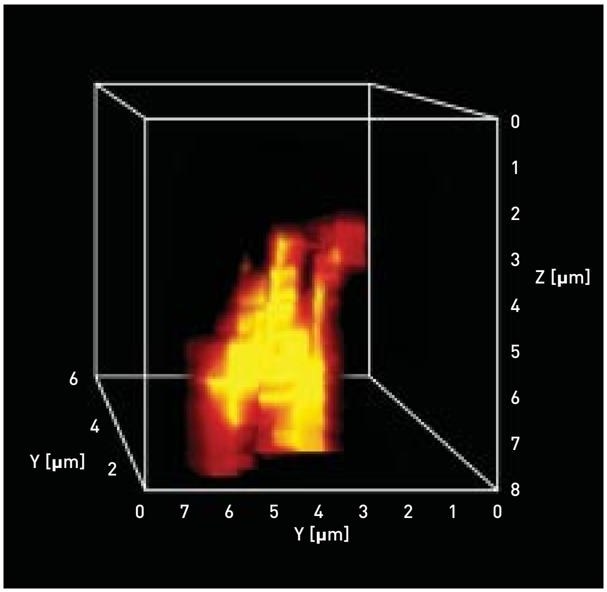
The prevailing belief is that the Moon was created by a giant-impact event; a Mars-sized object hit the Earth some 3.8 billion years ago and the ejected material coalesced into the Moon. The Carnegie scientists determined that water was likely present as the hot magma started to cool and crystallize—meaning water is native to the Moon. This result was unexpected, because volatiles like water and carbon were vaporized under the heat and shock of the impact.

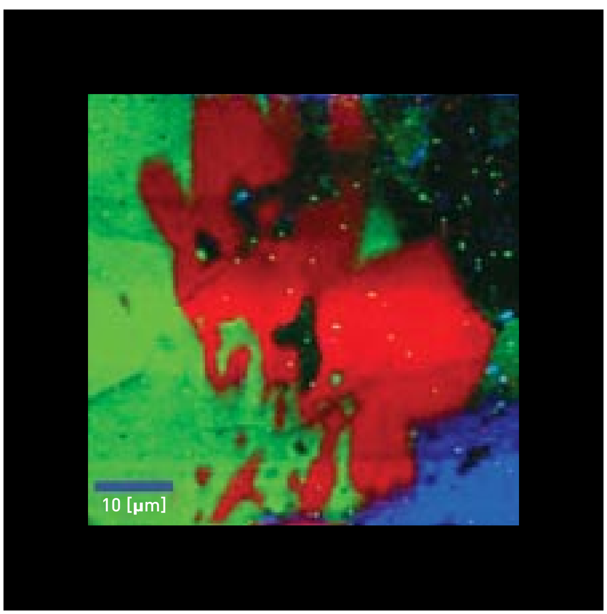
Until now, scientists thought that the trace amounts of carbon on the Moon's surface came from the solar wind. Andrew Steele's team analyzed thin lunar rock slices and determined that carbon also survived the impact. They found minerals and carbon beneath the surface and were very surprised to find graphite and graphite whiskers. Previously, the only carbon identified on the Moon came from solar wind implantation.

The scientists ruled out that the graphite was from contamination because it is imbedded in the minerals and because graphite whiskers in the absence of water form only under very hot conditions, between 1830°F and 6500°F (1273-3900 K). The particles are also much larger than those of any solar-wind-implanted carbon. They think the graphite either came from the impacting object or that it condensed from the carbon-rich gas that was released during impact.

(Top right) This three-dimensional image is a depth profile of graphite from a lunar sample to 8 millionths of a meter. From *Science*, vol. 329, 5987, p. 51, July 2, 2010.
Reprinted with permission from AAAS.

(Bottom right) This is a Raman multispectral image of Apollo sample 15058. The hydroxyl-bearing apatite is shown in red.
Image courtesy American Mineralogist.





Getting to the Core of the Matter

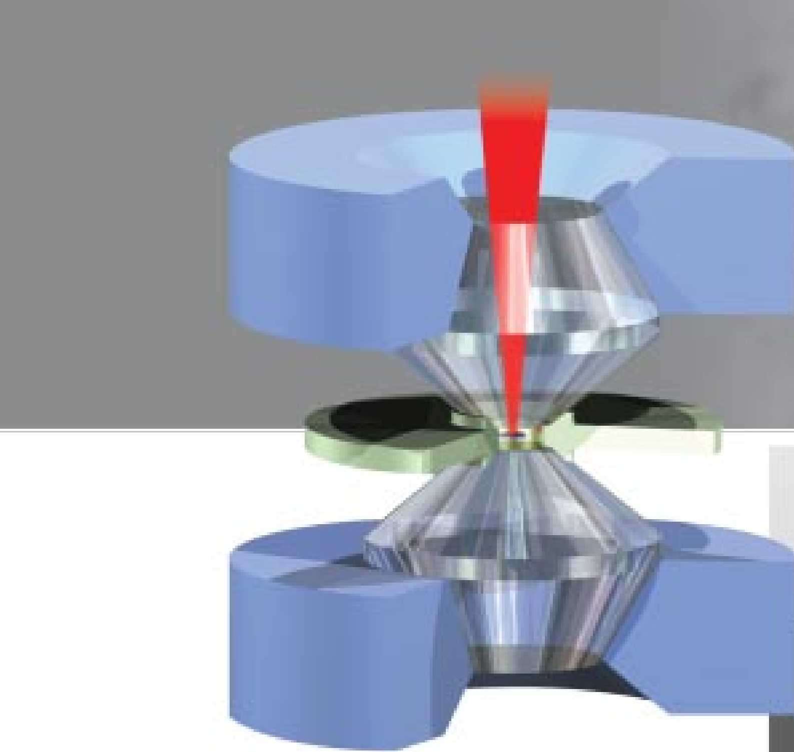
Bizarre behavior emerges when matter is subjected to extreme pressures and temperatures—chemical bonds morph, crowded electrons become erratic, and new materials can be forged. One method for analyzing samples at extreme conditions is squeezing them in a diamond anvil cell and using X-ray diffraction to reveal atomic structure; but X-ray diffraction has its limitations. Currently, a team at the GL is revolutionizing the field by harnessing the next-generation neutron sources for studies of materials at unprecedented pressures and temperatures.

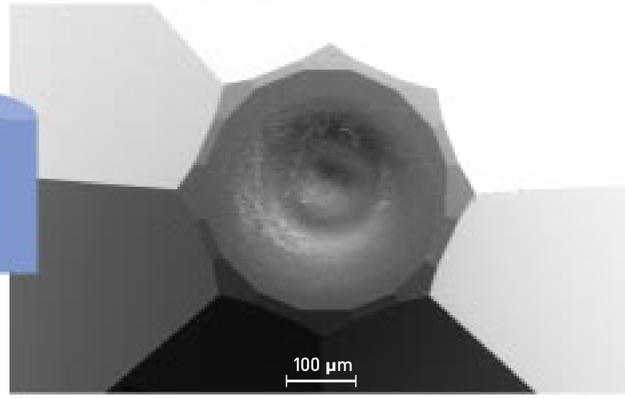
X-ray diffraction works by interacting with the electron cloud surrounding an atom. In contrast, neutrons interact directly with the nucleus, yielding many advantages: enabling the detection of positions of the lighter elements (particularly hydrogen, which is invisible to X-rays) near heavier ones, directly measuring magnetism, and facilitating the study of liquids, nanocrystals, and glasses. Neutrons are not widely used because of the comparative weakness of neutron sources relative to those of X-rays. The neutron landscape changed dramatically in August 2009, however, when the new Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL) exceeded 1 megawatt of power, eclipsing the European 163-kilowatt record. Malcolm Guthrie is leading the Carnegie neutron team at the new source as part of the DOE-supported center for Energy Frontier Research in Extreme Environments at GL.

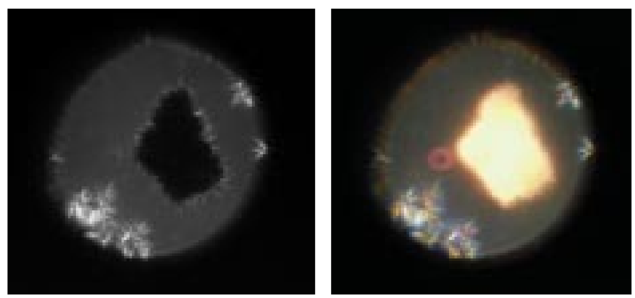
The great potential of this program was recognized by the science directorate of the SNS, which established a formal relationship with GL. The relationship was cemented by the opening of a center for high-pressure science in the newly opened Joint Institute for Neutron Sciences

Geophysical Laboratory, *Continued*

The decades-old tradition of neutron science at Oak Ridge National Laboratory (ORNL) has been catapulted toward new frontiers by the opening of the $1.4 billion Spallation Neutron Source (SNS) facility (top left, image courtesy ORNL). Using a completely new generation of liquid-mercury targets, the SNS is able to generate neutron fluxes greatly in excess of any other neutron scattering source in the world. Inserts: The new Joint Institute for Neutron Sciences building (top middle), the high-pressure beamline at the SNS, which GL scientists help design and build (top right). Malcolm Guthrie (top) and Reinhard Boehler are aligning a cell.







New high-pressure devices for neutron diffraction experiments (above) allow large forces on large samples. This new geometry provides the necessary high diffraction angles. The sample volume is increased by ablating the diamond anvil tip with an excimer laser (right). These diamond anvil cells will allow neutron diffraction experiments on samples heated by a laser to several thousand degrees.
Image courtesy Reinhard Boehler

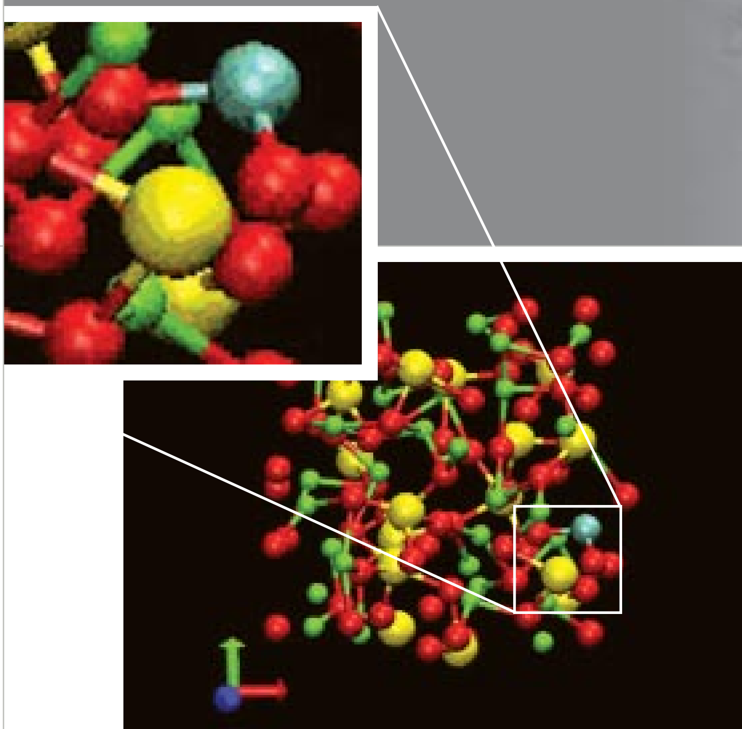
building. The SNS provides office and laboratory space and a generous investment in equipment, while operations are conducted by Carnegie staff.

The endeavor's success depends on the development of novel high-pressure devices tailored for the neutron environment. Reini Boehler is leading this effort, building on the long-standing expertise in extreme-conditions technology at GL. The need for state-of-the-art materials and fabrication techniques maps directly onto existing programs in diamond growth and laser machining.

The very high SNS neutron flux will allow the use of drastically smaller samples than are customary in neutron diffraction studies, and an increase in the pressure range of neutron diffraction experiments. Because these samples are still larger than those in conventional X-ray diamond cell experiments, novel techniques are being developed. For increased anvil strength, the anvil geometry has been completely reconfigured, avoiding the necessity for very large, expensive anvils. Furthermore, the sample size is increased by modifying the anvil shape by ion beam milling or UV laser ablation. A high-power laser will be used to heat these large samples uniformly to several thousand degrees.

From Electrons to Planets

The ability to compute properties of atoms, molecules, crystals, and fluids from fundamental physics is flourishing because of advances in computing. Ronald Cohen and team harness this computer power to understand the behavior of minerals and fluids in the Earth and to design new materials. Simulating the behavior of electrons



(Above) This image is a frame from a movie simulating carbonated melts at roughly 1.3 million times atmospheric pressure (130 gigpascals) and 4900°F (3000 K). The blue is a carbon atom, red is oxygen, yellow is magnesium, and green is silicon.

Image courtesy Razvan Caracas

(Left) The Geophysical Laboratory's Ronald Cohen

Image courtesy Ronald Cohen

with quantum mechanics can reveal properties of minerals, rocks, and even planets.

Two exciting computational capabilities have emerged. One is the ability to simulate large systems as well as dynamical processes in time and at different temperatures. The other is improvements in the accuracy of first-principles methods, especially in systems where conventional methods fail. First-principles methods use only fundamental physics to predict molecular and material properties, without the input of experimental data.

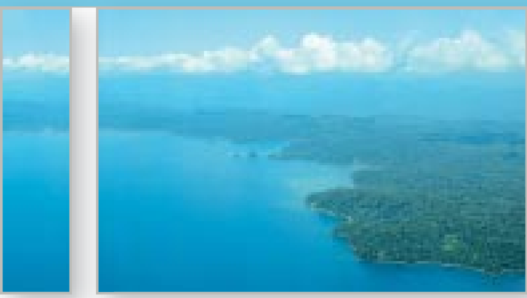
The simulations of large systems use high-performance computers and modern computer codes. For example, with former Carnegie Fellow Razvan Caracas, Cohen is using the QBOX code developed by François Gygi at U.C. Davis to simulate carbonated silicate melts in order to understand how carbon dissolves in the melt and how the melt changes with pressure. These calculations enable Cohen to unravel carbon transport in the Earth and to understand the partial melting of subducted slabs in the Earth's mantle.

Using Quantum Monte Carlo simulations—a more exact numerical solution of the Schrödinger equation—former Carnegie postdoctoral associate Ken Esler, Cohen, and others developed an accurate fundamental pressure scale for ultra-high-pressure experiments. Standard theory predicts that iron oxide (FeO) is a metal, but experiments show that it is an insulator. Some models predict it is an insulator, but those models predict different behavior than is observed under pressure. The researchers consider the problem using the Quantum Monte Carlo method and dynamical mean field theory, which includes the dynamical quantum fluctuations from electrons hopping among orbits. Preliminary results suggest that FeO may become metallic at high temperatures, such as those found in the Earth. In the Earth, FeO mixes with magnesium oxide making ferropericlase, Earth's second most common mineral.

The critical question for the researchers is how metallization depends on composition, pressure, strain, and temperature. Using these powerful tools, Cohen is teasing out a theoretical understanding of these complex materials and is able to confirm his predictions with experimental results by GL colleagues, including Viktor Struzhkin and Yingwei Fei. □

Global Ecology

Linking Ecosystem Processes with Large-scale Impacts



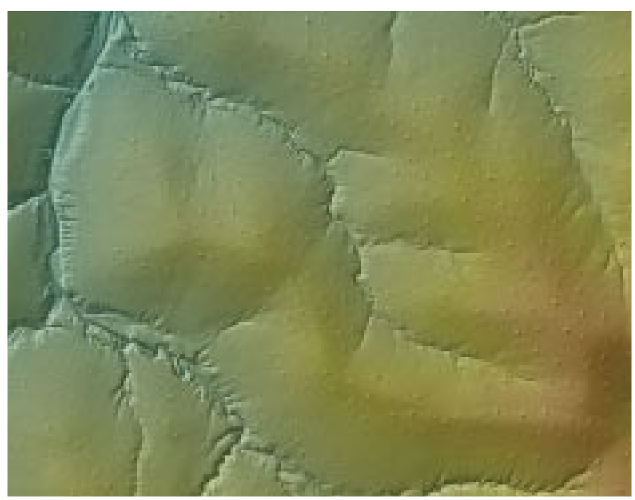
Termites, Big Game, and Fire

Some surprising results about termites, fire, and wildlife browsing in the African savanna are coming out of Greg Asner's lab courtesy the Carnegie Airborne Observatory (CAO). The CAO is a unique airborne mapping system that penetrates the vegetation canopy to map the 3-D structure of the plants. Led by Asner, Shaun Levick and team are using it to reveal how termite mounds, large-animal browsing, and fire affect the vegetation structure and thus the savanna's ecology. The research could revolutionize land management and conservation.

The CAO uses a light detection and ranging (LiDAR) system to map the three-dimensional structure of vegetation. It combines that information with high-fidelity spectroscopic imaging to reveal the chemical fingerprints of the species below, and then renders the data in spectacular 3-D maps. The team conducted a number of different studies in the Kruger National Park in South Africa. They looked at the relationship of termite mounds to vegetation patterns, how the distribution of termite mounds affects browsing by large herbivores, the differences between fire and browsing impacts on the vegetation structure, and how herbivores affect the structural diversity of African savannas.

The CAO revealed that mound-building termites construct their nests in well-drained areas and on the slopes of savanna hills. Woody trees prefer the well-drained upslope side, while grasses dominate the wetter areas downslope. The scientists found that precipitation, elevation, and hydrological and soil conditions determine whether grasses or woody vegetation dominate and that different sizes and densities of termite mounds correlate with these environmental conditions. The spatial distribution of termite mounds is an excellent indicator of hill-slope water properties, thereby providing a unique avenue for monitoring vegetation changes in a changing climate.

In addition, termite mounds create fertile foraging "hotspots." The researchers compared browsed areas with protected areas to see if the mounds were correlated with foraging behavior. They found that animals prefer to consume the higher-quality woody plants at and near



The little dots on this LiDAR map are termite mounds distributed over the African savanna.

Global Ecology, *Continued*

(Left) A team of researchers approaches a termite mound surrounded by grasses and woody vegetation in the African savanna.

(Above) Large herbivores, such as this elephant, prefer to eat higher-quality woody vegetation at and near termite mounds.

Images courtesy Shaun Levick

the mounds and that the difference in vegetation structure between protected and unprotected areas was greatest for plants taller than 9 feet (3 meters), indicating that elephants favor tall plants.

The group also looked at the relative influence of fire and browsing on the vegetation. They found that browsing had a greater influence than fire. Their work is the first to be able to explicitly quantify the extent to which herbivores affect vegetation diversity.

Farming Advances Versus Carbon Emissions

The Green Revolution, which took place in the second half of the 20th century, allowed developing nations to improve agricultural production through the use of pesticides, fertilizers, and high-yield crops, as well as through access to machinery and improved irrigation techniques. This helped feed an expanding global population, but issues such as chemical runoff and water diversion have made the environmental impact of the revolution unclear. New research from Carnegie scientist Steven Davis, along with researchers from Stanford University, shows that since 1961 the high crop yields resulting from the Green Revolution have prevented the release of up to 161 gigatons of carbon dioxide into the atmosphere.

Agriculture is a major source of greenhouse gases. Emissions are caused by the conversion of natural areas into farmland, as well as by fertilizers, livestock, and fires, among other factors. Davis and his co-researchers investigated the effect that the advanced farming techniques promoted during the Green Revolution had on greenhouse gas emissions from 1961 through 2005.

Old-fashioned farming does use fewer pesticides and less fossil-fuel-burning technology than modern agriculture, but feeding the world using old techniques would require converting large swaths of forests, scrubland, and other natural areas to farmland. As a result, feeding the world's population using old-fashioned farming techniques would actually emit more greenhouse gases than agriculture using modern techniques. The picture above shows hooded sprayers directing herbicide between rows of grain sorghum.

Image courtesy courtesy Jack Dykinga and the U.S. Department of Agriculture

Global Ecology's Steve Davis

The research team created two theoretical alternative scenarios for what actually happened agriculturally during that period. One alternative assumed that while the world's population increased and standards of living improved just as they did in the real world, agricultural technology remained at 1961 levels. The second alternative assumed that farm production only increased enough to maintain a 1961 standard of living through 2005.

In both scenarios, the use of fertilizers would have been much lower than is observed today. However, feeding the world without the use of advanced techniques would have required converting vast swaths of natural areas such as forests and scrubland to farmland, which would have drastically increased greenhouse gas emissions. These findings challenge the idea that industrial agriculture, with its use of pesticides and fertilizers, is worse for the environment than the old-fashioned way of farming.

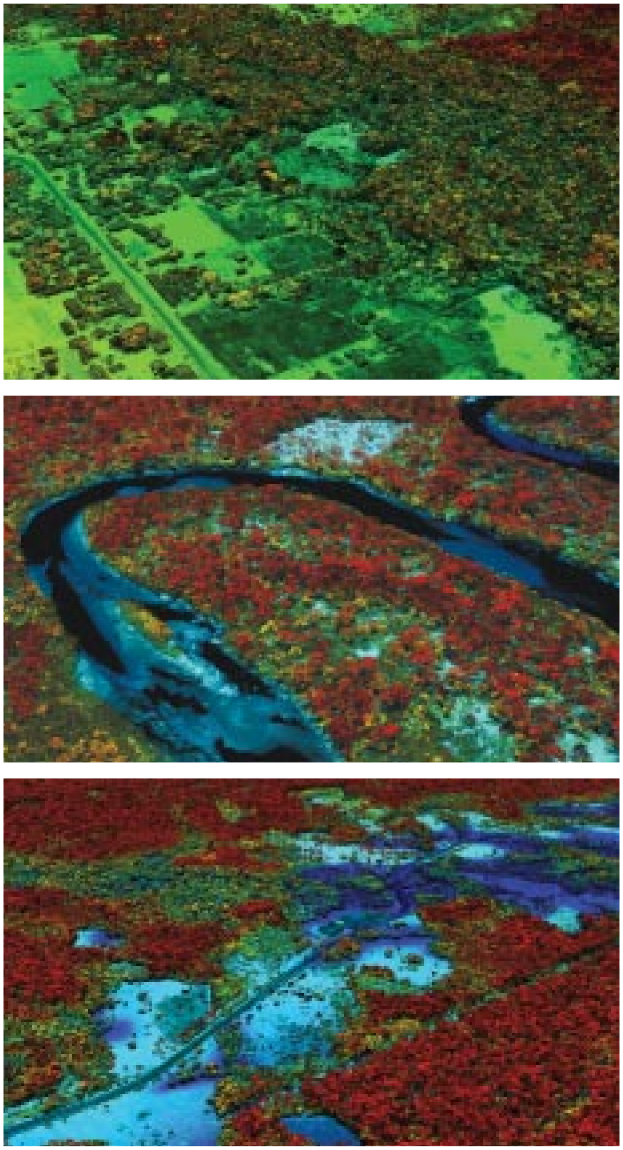
The team also looked at the cost-effectiveness of agricultural research on reducing greenhouse gas emissions. They found that research is one of the cheapest ways of preventing greenhouse gas emissions, particularly compared with improvements in energy efficiency or transportation. What's more, the team says this research shows that efforts to increase agricultural yields are crucial to preventing the conversion of natural areas into farmland going forward, particular in carbon-rich tropical forests.

Road to REDD

Until the Asner team recently developed a new high-resolution 3-D mapping system, there was no way to reliably measure carbon locked up in tropical forest vegetation and emitted by land-use practices—a prerequisite for accurate monitoring of carbon storage and emissions for the new United Nations initiative on Reduced Emissions from Deforestation and Degradation (REDD).

REDD is designed to create financial incentives to reduce carbon emissions from deforestation and degradation so farmers and others in developing countries can be compensated for good climate practices. But carbon monitoring programs have been hindered by a lack of accurate, high-resolution methods.

Asner lab scientists, with colleagues, married satellite mapping, airborne-laser technology, and ground-based plot surveys to yield the first large-area, high-resolution maps of carbon locked up in tropical forest vegetation and emitted by land-use practices. The Asner team also



The colors in these images represent the height above ground in the Peruvian tropical forest. Blue is the ground level. Red areas are the tallest structures. Secondary and/or degraded forests are in greens and yellows; intact forest is red.

(Top) Roads and dwellings dominate the left side of this image in green. The farther away from habitation, the less destruction there is to the forests (red, upper right). (Center) The river (dark blue) dominates this image. (Bottom) The road shown in this image is the highly destructive Interoceanic Highway. Degraded areas appear in light blue; intact trees are red.

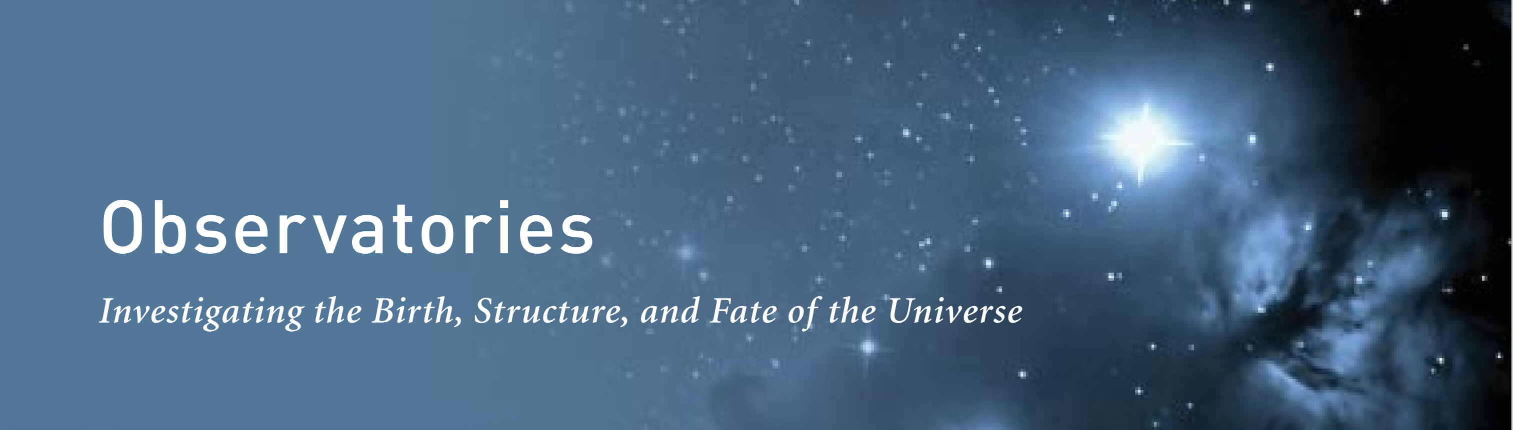
Images courtesy Greg Asner

developed new software for accessing this information so that governments, nongovernmental organizations, and academic institutions can monitor forests.

Their mapping study covered over 16,600 square miles of the Peruvian Amazon—an area about the size of Switzerland. The researchers mapped vegetation types and disturbance by satellite; developed maps of 3-D vegetation structure using a LiDAR system (light detection and ranging) from the Carnegie Airborne Observatory; converted the data into carbon density using a small network of field plots on the ground; and integrated the data to produce high-resolution maps. They combined historical deforestation and degradation data with 2009 carbon stock information to calculate emissions from 1999 to 2009 for the Madre de Dios region.

They found that the total regional forest carbon storage was about 395 million metric tons and that emissions reached about 630,000 metric tons per year. They were surprised by how carbon storage differed depending on forest types and underlying geology, finding important interactions among geology, land use, and emissions—the first such patterns from the Amazon.

Their software package, called CLASlite, automatically identifies deforestation and forest degradation from the satellite imagery, so the detailed maps can be easily searched for problem areas. Carnegie is teaming up with Google.org to provide “CLASlite Online” via Google’s Earth Engine, which greatly extends the ability of users to monitor their forests. The method will have a major impact on the implementation of REDD in tropical regions around the world. □



Observatories

Investigating the Birth, Structure, and Fate of the Universe

Planet Hunting Just Got Better

A collaborative effort between Terrestrial Magnetism's Paul Butler and researchers at the Observatories has created one of the most precise tools for planet hunting in the world. It began in 2004, when then-research associate Jeff Crane joined Steve Shectman, Ian Thompson, and the Observatories team to design the Planet Finder Spectrograph (PFS), now installed and operational on the Magellan Clay telescope.

Radial velocities are the speeds and directions of stars moving away from or toward the Earth. Butler and team use them to detect the telltale wobbles of stars that are gravitationally tugged by orbiting planets. Astronomical spectrographs take collected light from a telescope and disperse it, splitting it into a spectrum of wavelengths. Elements in stellar atmospheres absorb light at specific wavelengths, creating narrow absorption lines in the spectra. The instrument measures shifts in these lines that are caused by changes in the star's motion. Astronomers observe velocity trends and infer planet orbital masses and other parameters. The necessary precision to detect small planets like Earth is very difficult to achieve.

The original goal for the PFS was to measure velocities to within 1 meter per second, currently considered state-of-the-art. Although velocity measurements precise to 3 meters per second had been demonstrated by Butler by the late 1990s, only one other instrument in the world had achieved 1-meter-per-second precision prior to 2010. Results from the PFS have exceeded expectations. The velocity precision may be as good as 66 centimeters per second, making this instrument a superb planet-hunting machine.

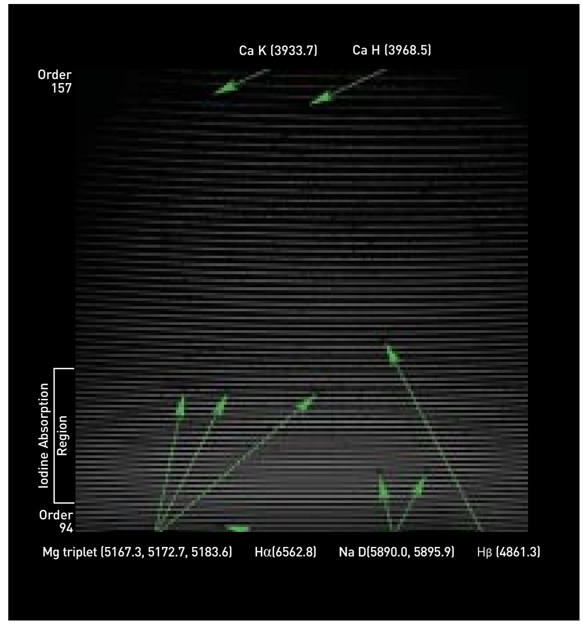
To calibrate the data, the team uses a wavelength reference developed by Butler and collaborators. The starlight collected by the telescope passes through a glass cylinder containing molecular iodine gas. The iodine absorbs light

This photograph shows the Planet Finder Spectrograph on the instrument platform with part of the 6.5-meter-diameter Magellan Clay telescope (blue circular component) behind it. The unique thermal enclosure (white exterior with black interior) is temporarily open on one side.

Image courtesy Jeff Crane

Observatories, *Continued*

Observatories staff associate Jeff Crane modifies the instrument's control electronics enclosure to accept a new component.
Image courtesy Paul Butler



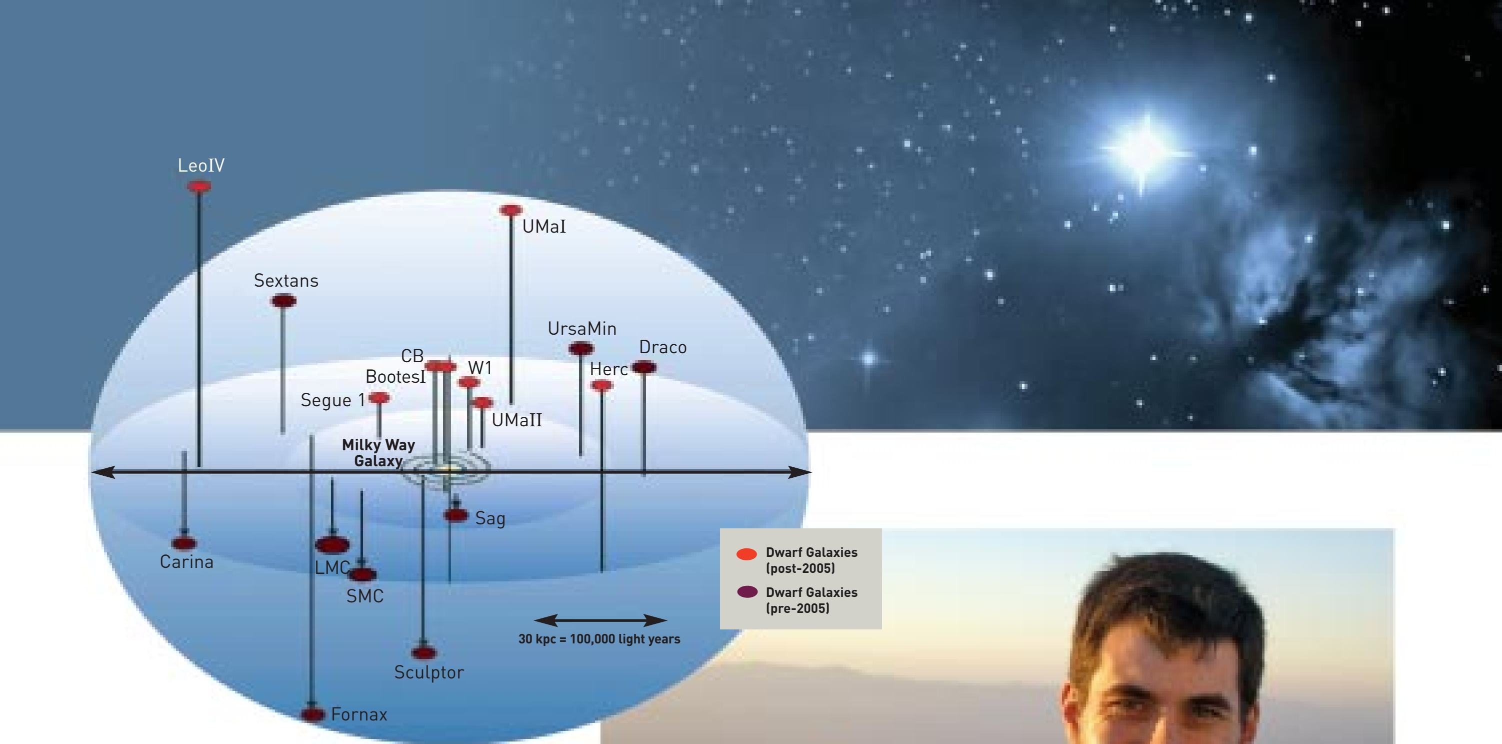
This spectral image was taken by the Planet Finder Spectrograph. Several chemical absorption line signatures are indicated by the green arrows.
Image courtesy Jeff Crane

at specific wavelengths. The iodine spectra—the wavelength reference—are superimposed on the stellar spectra to help establish the velocity shift of the moving star. The iodine lines also help calibrate certain atmospheric and instrumental effects.

The PFS is exceptionally stable. The instrument is in a unique thermally controlled enclosure that keeps it near 77°F, regardless of the outside temperature, stabilizing the spectra constant over time. Shectman's optical design has yielded superior image quality, and the spectra are widely spread out so that fine features can be measured more easily.

The Darkest Galaxy Known

Some galaxies are so dark they glow with the light of just a few hundred Suns. Josh Simon and colleagues have determined that a tiny, very dim galaxy orbiting the Milky Way, called Segue 1, is the darkest galaxy ever found and has the highest dark matter density currently known. His team has also laid to rest a debate about whether Segue 1 really is a galaxy or a globular cluster—a smaller group of stars that lacks dark matter. Their findings make Segue 1 a promising laboratory to study dark matter, particularly the possibility that dark matter



Dwarf galaxies neighboring the Milky Way are depicted in this diagram. Segue 1 is the darkest and densest galaxy discovered so far.

Image courtesy Marla Geha

Josh Simon (right) is at Carnegie's Las Campanas Observatory.

Image courtesy Wendy Simon

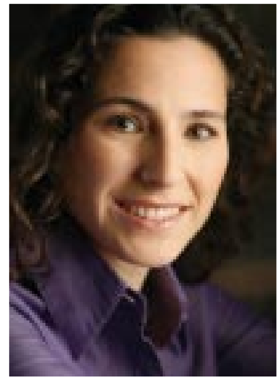
can be seen by the detection of gamma rays emanating from colliding dark matter particles.

Dark matter is the mysterious nonluminous material that makes up about 25% of the universe. Nearby dwarf galaxies have the highest measured densities of dark matter, making them ideal for dark matter studies, but that proximity also has a downside. Star systems so close to the massive Milky Way are subject to the acceleration of their stars by our galaxy's tidal forces, an effect that can mimic the presence of dark matter. The lack of bright stars in dim dwarfs also makes it difficult to measure the velocities of enough stars for sufficient certainty. Simon and company overcame these hurdles with a comprehensive program that measured and analyzed the speed and chemistry of 393 stars in the vicinity of Segue 1.

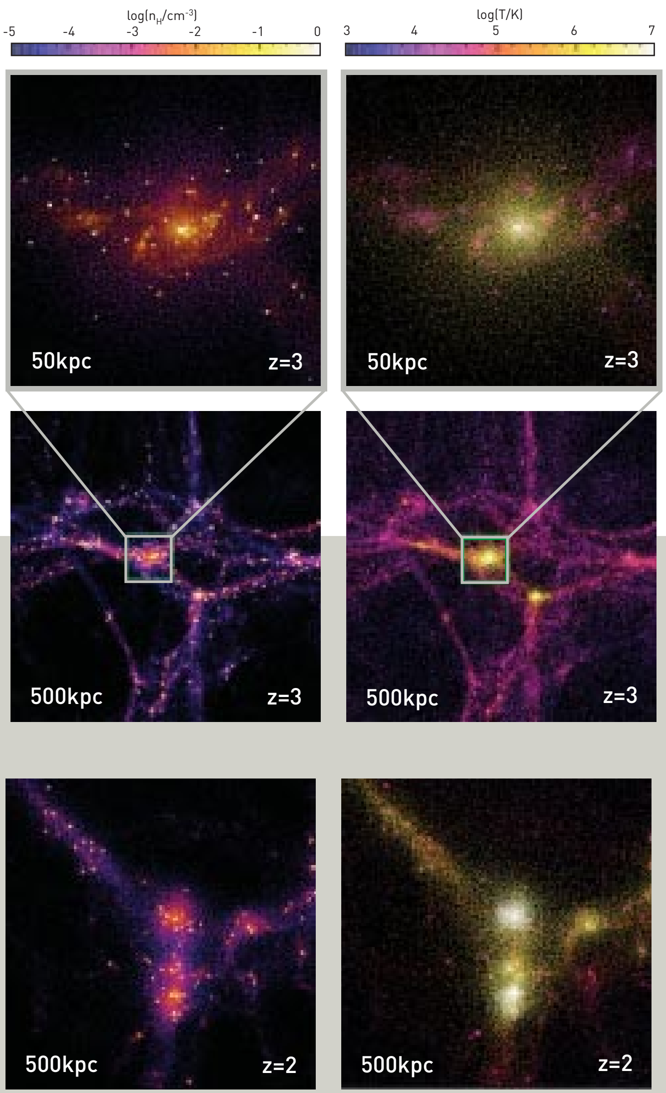
A major difference between galaxies and globular clusters is that the stars in galaxies contain widely varying amounts of iron and other heavy elements, while stars in clusters do not. The new observations revealed that some Segue 1 stars have 50 times less iron than other Segue 1 stars, demonstrating conclusively that Segue 1 cannot be a globular cluster.

In collaboration with astronomers at the University of California, Irvine, Simon also showed that the high speeds of the Segue 1 stars are not caused by invisible binary companion stars, firming up the estimates of the amount of dark matter in the galaxy. Ongoing observations with NASA's Fermi Gamma-ray Space Telescope are searching for signals from Segue 1 and other dwarfs, which would provide astronomers with concrete proof that their dark matter theories are on the right track.

Observatories, *Continued*



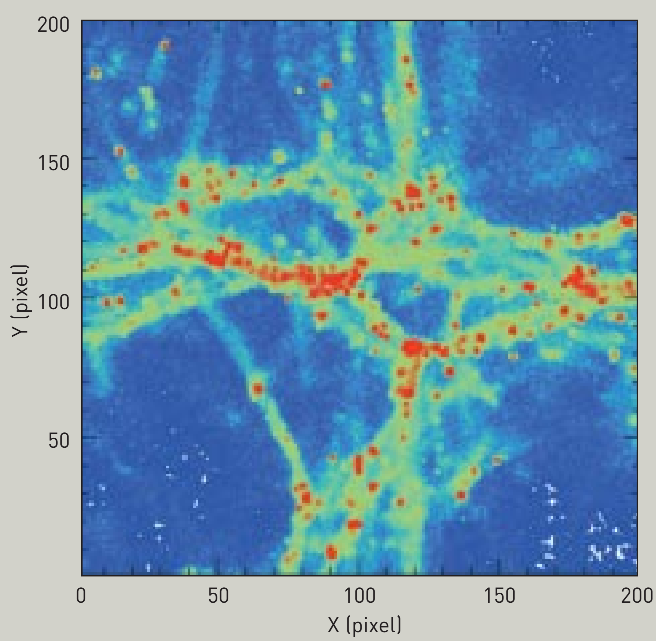
Juna Kollmeier



(Left) This simulation at 2.2 billion years after the Big Bang is for an area that is approximately 4.9 million light-years on a side. The left figures show the gas density and the right show the temperature. The top images are blowups of the central patch in the middle images. They reveal a single galaxy system at the intersection of multiple gas filaments shown at bottom.

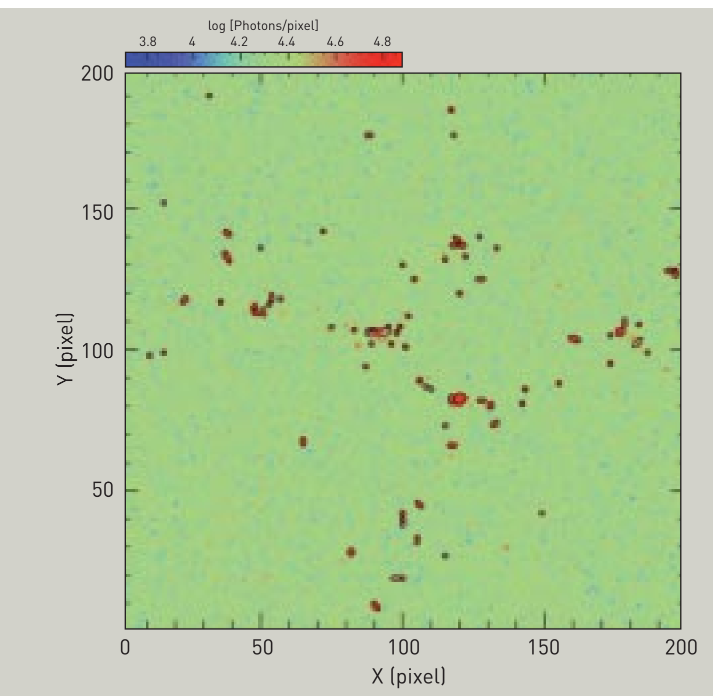
(Below) The image simulates the area of multiple gas filaments from the images at left through Lyman-alpha "eyes."

(Below right) The figure on the right shows what an observer would see with the current generation of telescopes after many hours of integration. It includes foreground noise. Each red dot corresponds to the gaseous regions surrounding simulated galaxies. Kollmeier can compare the simulated images with images obtained by real telescopes and see if her theoretical models are correct.



Unraveling the Cosmic Web

The universe is mayhem. Gravity drags galaxies toward each other, while dark energy pushes them apart. Stars explode as supernovae, ejecting elements and gas, while at the same time enormous filaments resupply material for star formation. Stars are born and stars die. Although visually stunning, the universe is messy. Juna Kollmeier is unraveling the chaos of structure formation by combining state-of-the art cosmological hydrodynamic simulations with astronomical observations of the Intergalactic Medium (IGM). The results are beautiful images showing what the universe once was.



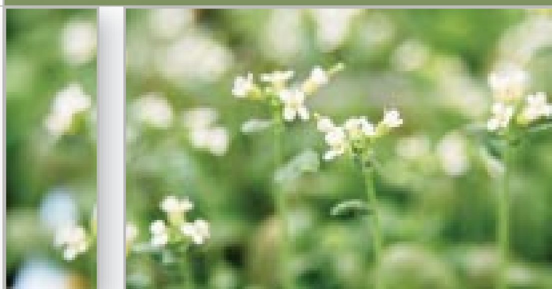
The IGM is the directly observable material that resides between galaxies; it is mostly hydrogen and can be traced by measuring that gas. The IGM is the best-understood component of the currently favored cosmological model of the universe. It is a source for galaxy formation and a sink for its by-products—photons, heavy elements, and kinetic energy. It also reveals the underlying distribution of dark matter—the unobservable material that is more abundant than ordinary matter and is crucial to galaxy formation. These features make the IGM ideal for studying the complex processes of galaxy formation and evolution.

Kollmeier looks at the chemical fingerprints revealed by analyzing light as it passes through the IGM. Each element absorbs or emits light at specific wavelengths, producing unique absorption or emission patterns. One-dimensional absorption studies have been around for a long time. But the future lies with three-dimensional emission-line mapping of the IGM, which will provide a critical new picture of structure formation. Kollmeier has taken the lead in producing predictions for 3-D emission-line maps of the young universe.

Using spectral observations to test cosmological models requires accurate predictions of the emission signature from the IGM. Kollmeier has developed software that makes these predictions possible. She performs radiative transfer calculations of Lyman-alpha photons—the photons that trace the state of intergalactic material as energy from stars and quasars gets reprocessed by the intergalactic gas. Kollmeier's combination of software and computing power provides necessary tools to make accurate predictions that address the most fundamental questions about how galaxies get their fuel and use it over their life cycle. □

Plant Biology

Characterizing the Genes of Plant Growth and Development



Adapting by Computing

In the wake of epic floods and fires, are famines on the horizon? Many say yes and are looking at ways to adapt to climate change. One way may be through faster identification and manipulation of crop genes to resist or tolerate environmental extremes. Sue Rhee and team created a new computational model, called AraNet, to predict the function of uncharacterized plant genes with unprecedented speed and accuracy. She, with colleagues, used it to predict a drought-related function of one previously uncharacterized gene and confirmed with follow-up experiments that it is involved in the drought response.

AraNet encompasses over 19,600 genes of the tiny, experimental mustard plant *Arabidopsis thaliana,* which are associated to each other by over 1 million links. AraNet can increase the discovery rate of new genes affiliated with a trait tenfold. It is based on the notion that genes near each other, or that turn on in concert with one another, are probably associated with similar traits. The model is based on the evidence gathered from some 50 million scientific observations, which enables the map of associations to be made. Researchers propose that uncharacterized genes are linked to specific traits based on the strength of their associations with genes already known to be linked to those characteristics. They then follow up with experiments that suppress the activity of the uncharacterized gene to see what normal characteristics in the plant go awry.

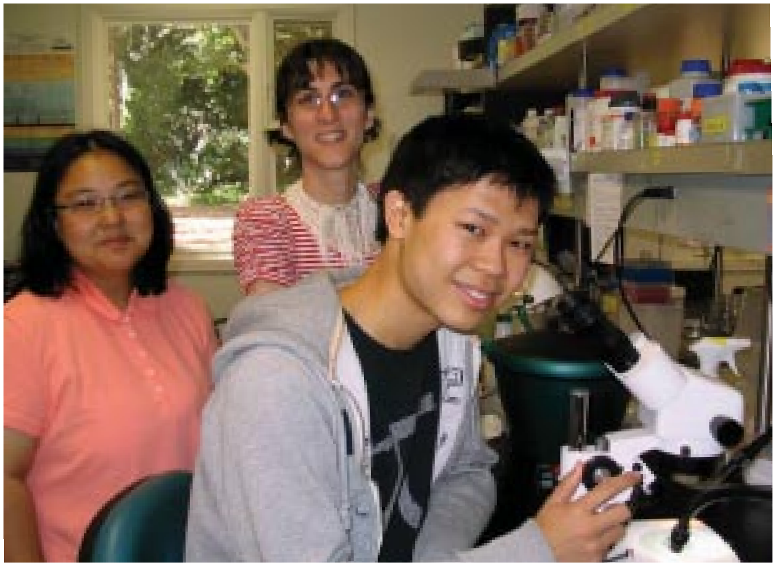
AraNet suggested that a gene called *AT1G80710* could be involved in the response to water deprivation. The researchers found that under drought conditions mutant plants lacking this gene held in only 80% of the water that normal plants did; they were "blind" to drought.

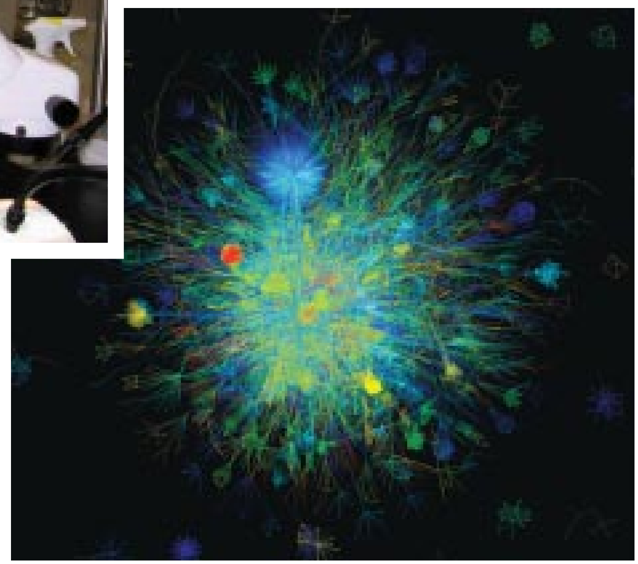
The plant hormone abscisic acid (ABA) controls numerous physiological processes, including responses to stresses. It is also part of a molecular relay that mediates drought response by keeping water loss in check. The researchers looked to see if response to ABA was affected in the mutant plant by examining the effect of the hormone on transpiration—the process of "exhaling" water vapor from leaves to the atmosphere. Transpiration in the mutant was not affected by the hormone, with the result that the mutant lost significantly more water than the normal plants. The experiments confirmed what AraNet identified—that the gene is involved in sensing drought. The group renamed the gene *DROUGHT SENSITIVE 1(DRS 1).*

Watching Molecular Scaffolds Take Shape

For the first time scientists have witnessed how proteins common to both plants and animals build specialized molecular scaffolds that are essential for creating the shapes of plant cells. The study, by David Ehrhardt and Takashi Hashimoto, is important in advancing cell biology research and crop engineering.

Plants, animals, and fungi all use hollow protein rods called microtubules to support cell shape, movement, and





(Above) Team members working on Rhee's research into the mechanisms of the drought response are (left to right) Hye-In Nam, Flavia Bossi, and Nathaniel Leu.
Image courtesy Sue Rhee

(Right) The AraNet model contains some 50 million scientific observations, from which a map of associations is made. Each line of this network represents a functional link between two genes. The colors indicate the strength of the link using a red-blue heat map scheme.
Image courtesy Insuk Lee of Yonsei University

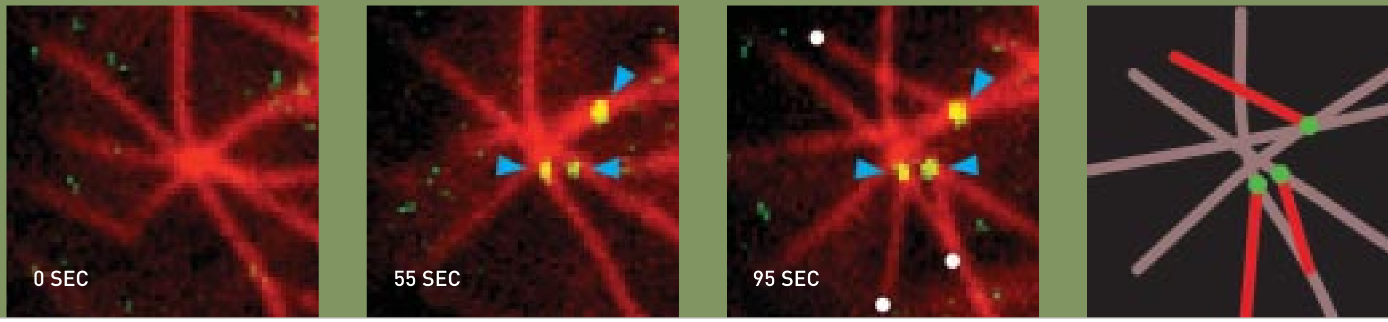
division. These rods are arranged in a specific configuration, a molecular scaffolding, which organizes other proteins and cell processes. Much has been discovered about how microtubules are arranged from a central hub in animals cells known as a centrosome. However, microtubules can be arranged in configurations that do not utilize a central hub. How these other configurations are created has remained a mystery. Plant cells are appropriate for studying this problem because they lack centrosomes.

An essential function of the centrosomal hub is to serve as a platform for nucleating complexes, proteins that give birth to new microtubules. To determine where these nucleating complexes are and how they function in plant cells, the Ehrhardt and Hashimoto team tagged them with a jellyfish fluorescent protein and introduced them into plant cells.

They saw that most nucleating complexes are recruited to the sides of other microtubules and that new microtubules are much more likely to arise from these complexes than from those that are recruited to other locations. These observations suggest that the microtubules are important for locating and regulating their own formation proteins. The researchers also found that the molecular complexes formed newborn microtubules at two distinct orientations. The scientists believe that this orientation choice may play a role in organizing the microtubules.

In a previous study, the Ehrhardt lab discovered that new microtubules are separated from their sites of birth shortly after they are created, after which they migrate to new locations in the cell. The researchers speculated that this process was important for organizing the microtubules.

The scientists thought that a protein called katanin



The Ehrhardt lab previously found that the scaffolding that shapes plant cells, called microtubules, is born along the inside of the cell membrane. To visualize the birthing process, the team tagged molecular complexes that give rise to microtubules and observed the construction of the microtubule network. Red is tubulin, the protein that makes up the microtubules. Green is tagging the molecular complex (which appears yellow where it overlaps the tubulin). The time series shows the recruitment of molecular complexes to the sides of a microtubules (blue arrows) and the birth of new microtubules from the complexes (growing ends marked with white circles at 95 seconds). The diagram highlights the locations of the complexes and new microtubules.

Images courtesy of Viktor Kirik and David Ehrhardt.

might be responsible for the separation process, so they introduced their probes into a mutant plant lacking the katanin protein. Without katanin, the newborn microtubules failed to detach from the nucleating complex, and the complex remained in place. These results demonstrated that katanin is required for freeing new microtubules and liberating the nucleating complex so that it can be used in a new location.

Cutting the Green

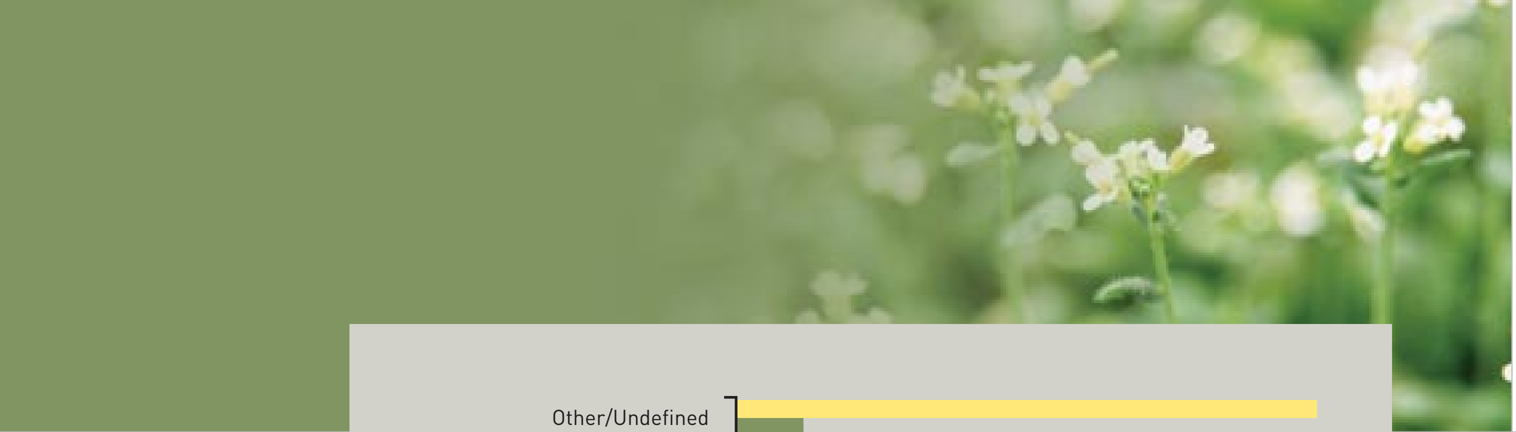
Although scientists have been able to sequence the genomes of many organisms, they still lack a context for identifying the biological processes to which these genes contribute. Furthermore, understanding how groups of genes are shaped by environmental forces, developmental processes, and transfer among species could give researchers important insights into key biological processes. To this end, Arthur Grossman and colleagues generated a list of proteins that are present in members of the plant kingdom and in green algae but not in nonphotosynthetic organisms. Many of these proteins have no known biological function, but are localized to a cellular organelle called the chloroplast and have features that suggest a function in photosynthesis. The researchers hope to reveal the roles of the genes that encode these proteins in green-lineage organisms and learn how these genes might affect photosynthesis.

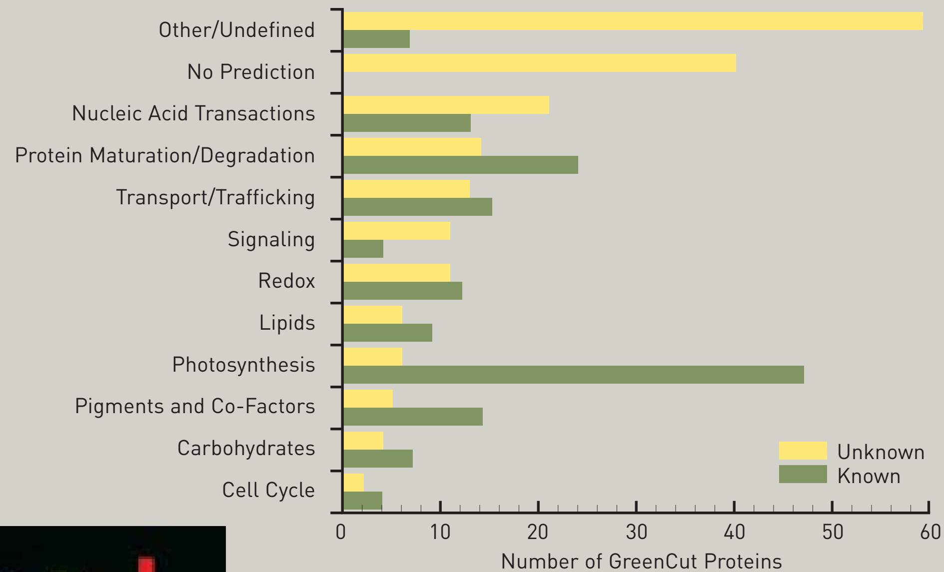
It is believed that chloroplasts originated as photosynthetic, single-celled bacteria (called cyanobacteria), which were engulfed by eukaryotic, nonphotosynthetic cells more than 1.5 billion years ago. While the relationship between the two organisms was originally symbiotic, over evolutionary time the bacterium lost its ability to live without its partner. It eventually turned into a chloroplast, the compartment in the cell that performs photosynthesis.

Using a variety of computational techniques, Grossman and colleagues at UCLA and the Joint Genome Institute were able to generate a list of 597 proteins specifically present in members of the plant kingdom and in green algae but not in nonphotosynthetic organisms. They named these proteins the GreenCut.

The biological functions of a large portion of the 597 GreenCut proteins are not known. However, the team has been able to narrow down potential activities for several by figuring out when and where they are expressed. Genetic and biochemical research is being performed to continue piecing together clues about GreenCut proteins that will reveal their roles in green-lineage organisms, especially how they might affect photosynthetic function.

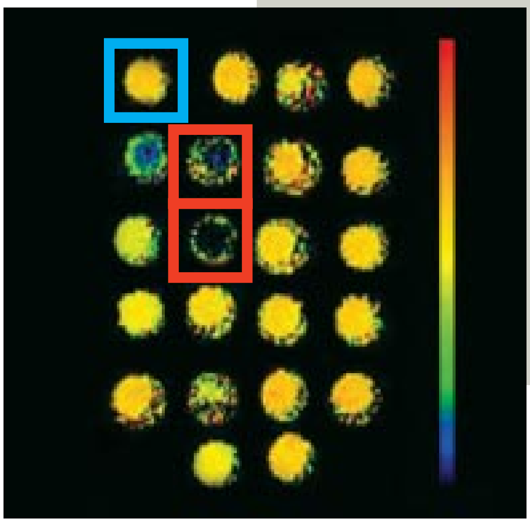
Many GreenCut proteins are in red algae, other single-celled algae called diatoms, and ancient chlorophyll-containing cyanobacteria. Comparisons of GreenCut proteins in these organisms open a window for potential key discoveries about the evolution of chloroplasts and the roles they perform in photosynthetic cells. □





The bars along the y-axis represent the GreenCut proteins classified by function. The number of proteins in each functional classification is shown on the x-axis. Green bars represent proteins with known functions; yellow bars represent proteins of unknown function. Note that while the physiological functions of many proteins in the Photosynthesis and Pigments and Co-Factors sections are known, the functions of many proteins associated in the Signaling and Nucleic Acid Transactions categories are not.

Images courtesy Arthur Grossman



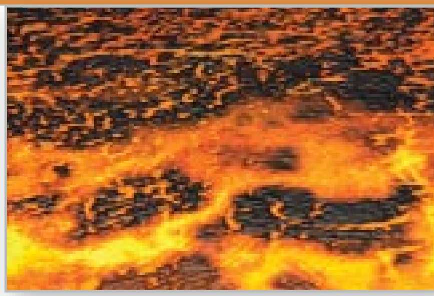
(Above) Strains of algae with mutations in genes encoding GreenCut proteins can have observable characteristics that indicate a defect in the use of the light energy necessary for photosynthesis. Fluorescence-emission tests indicate that some GreenCut-defective mutants have reduced activity in major photosynthetic protein complexes compared with nonmutant algae (blue box). The mutant strains in the red boxes show very low photosynthetic efficiency.

(Right) Plant Biology's Arthur Grossman

Images courtesy Arthur Grossman

Terrestrial Magnetism

Understanding Earth, Other Planets, and Their Place in the Cosmos



The Case of the Mysterious Volcanic Islands

A long-standing geological mystery, the origin of the volcanic Hawaiian Islands, could soon be solved. Plate tectonics explains the existence of volcanoes at boundaries where plates spread apart or collide, but midplate volcanoes, such as those that built the Hawaiian island chain, have been harder to fit into that theory.

New research carried out by Sean Solomon and Erik Hauri and led by former Department of Terrestrial Magnetism (DTM) postdoctoral fellow Cecily Wolfe (now at the University of Hawaii) lends support to one proposed explanation for the Hawaiian volcanoes. This nearly 40-year-old model suggests that magma is supplied to the volcanoes from upwellings of hot rock, called mantle plumes, which originate deep in the Earth's mantle.

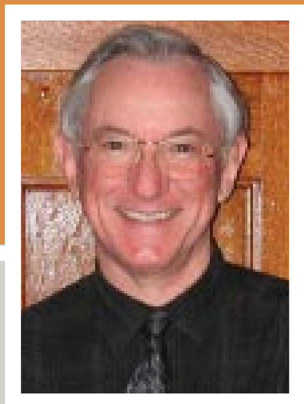
Although evidence for these types of plumes has been sketchy in the past, two years' worth of data from seismometers placed both on land and on the seafloor have provided an unprecedented glimpse of the roots of the Hawaiian hot spot. This sophisticated array of seismometers was able to show the first high-resolution seismic images of a mantle plume extending to depths of at least 900 miles (1,500 kilometers).

The research project is known as PLUME, for Plume-Lithosphere Undersea Melt Experiment. The development of broadband seismic instruments capable of being set on the seafloor for long periods was integral to gathering these new data, since many of the major hot spots are in the oceans and far from major landmasses.

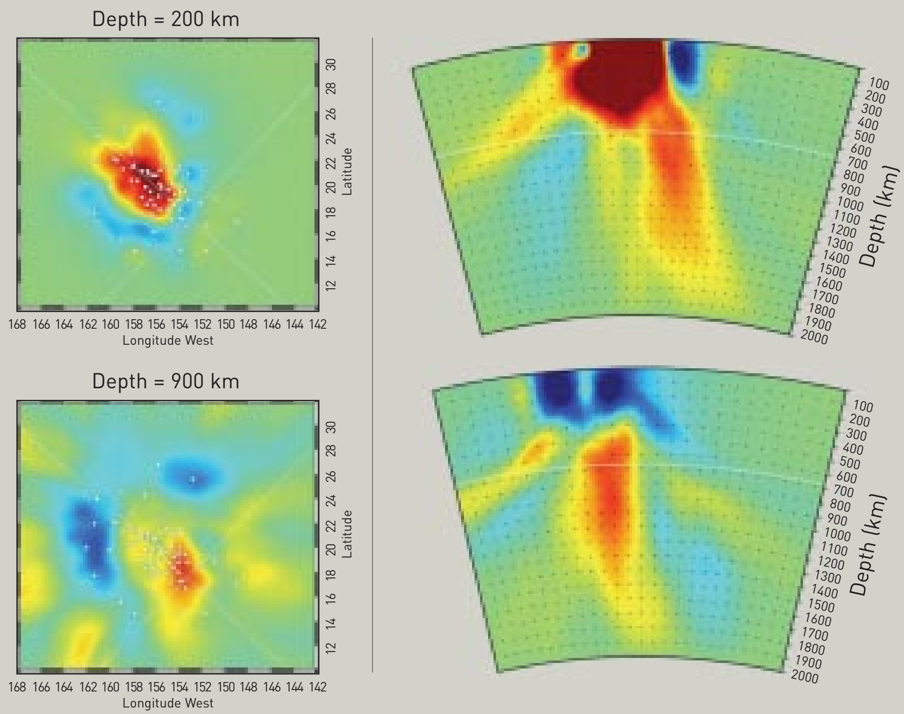
The seismic images show that the volume of low seismic velocities is approximately the size of the island of Hawaii, which is positioned near the center of the upper mantle portion of the velocity anomaly. These results match expectations from the plume model.

Critics of the plume explanation have argued that the magma in hot spot volcanoes comes from relatively shallow depths, not from deep upwellings. But the depth of the hot spot roots observed in this research lends strong support to the plume hypothesis.

Researchers retrieve an ocean-bottom seismometer in May 2007. The dangling silver sphere houses the actual seismic sensor; orange containers house the electronics and batteries.
Image courtesy Gabi Laske, University of California, San Diego



(Above) Sean Solomon is director of the Department of Terrestrial Magnetism.



(Right) These images show anomalous seismic velocities beneath the Hawaiian Islands. The orange and red colors indicate low S-wave velocities, which imply higher rock temperatures. The left two images are horizontal cross sections at depths of about 125 miles (200 kilometers) and nearly 560 miles (900 kilometers); boxes represent the locations of seismometers on the overlying seafloor. The right two images show vertical cross sections through the region. The upper of the two is oriented northwest to southeast, and the lower southwest to northeast.

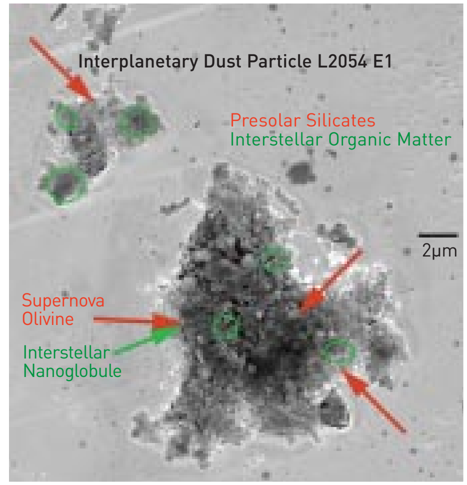
Image from Science 326, *1388, 2009. Reprinted with permission from AAAS.*

Spaced-Out Dust

Particles floating in Earth's upper atmosphere generally come from space—not from the planet's surface—and can help scientists understand the Solar System's history. Collected using specialized NASA planes, these interplanetary dust particles, or IDPs, likely originated from comets and asteroids. Carnegie scientists Larry Nittler and George Cody, with former DTM postdoctoral fellows Henner Busemann (now at the University of Manchester) and Ann Nguyen (now at the Johnson Space Center) and colleagues from the U.S. Naval Research Laboratory, the Lawrence Berkeley National Laboratory, and the Max Planck Institute for Chemistry in Germany, found that a few special IDPs came from the dust trail of a comet called Grigg-Skjellerup and entered our atmosphere as Earth passed through the comet's tail in 2003. This was the first time researchers could tie a single particle of dust found in Earth's stratosphere to a specific comet.

Comets, which come from the frigid outer reaches of the Solar System, are believed to be repositories of unaltered material left over from the system's formation. Their dust, protected from the heating and chemical processing that has affected other bodies such as asteroids

Terrestrial Magnetism, *Continued*



(Left) Larry Nittler inspects the Stardust collection grid at the NASA Johnson Space Center. Interplanetary dust particles gathered by NASA's Stardust mission were compared with dust particles from the Grigg-Skjellerup comet gathered by Nittler's team.

Image courtesy Larry Nittler

(Above) This is a scanning electron image of interplanetary dust particles containing presolar silicate grains and interstellar organic matter.

Image courtesy Henner Busemann

and planets, provides scientists with a glimpse of some of the primitive matter that formed the Sun and the planets.

The stratospheric dust from Grigg-Skjellerup exhibited a number of ultraprimitive characteristics, notably a surprisingly high abundance of presolar grains—minute particles that likely formed inside stars that lived and died long before the Sun's birth. Presolar grains have much more unusual isotopic compositions than anything else in the Solar System. They are extremely rare in meteorites from the asteroid belt and even in most stratospheric IDPs, making their high concentration in Grigg-Skjellerup dust very exciting. The dust also showed an abundance of disordered organic matter with isotopic compositions that point to an origin in interstellar space.

The team compared the Grigg-Skjellerup dust with dust from a comet called 81P/Wild 2, which was collected in space by NASA's Stardust mission and returned to Earth in 2006. Scientists had expected that the Wild 2 dust would be primitive, but the samples included more altered material than expected. The dust from the Grigg-Skjellerup comet was much more primitive than the Wild 2 dust. This result potentially indicates a vast diversity in the materials that make up comets, as well as in the degree of thermal and chemical processing that comets and dust have experienced in the eons since their formation.

Supersonic Ballistic Drag

Alycia Weinberger's lab is light-years away. She probes the dusty disks surrounding nearby young stars—with their own cometary and asteroidal dust—for clues to how our own Solar System formed. Recently, she and her team made multicolor images of a disk around the star HD 32297, which is 365 light-years from the Sun—nearby as disks go. She wanted to learn about the composition of the disk to see what it could teach us about the primitive Solar System. Using the Hubble Space Telescope (HST),

(Left) Terrestrial Magnetism's Alycia Weinberger. (Right) The dusty disk observed around the star HD 32297. Weinberger's team found the density of gas in the Interstellar Medium (ISM) and collision velocity between the star and the ISM cloud that could reproduce the disk's shape. Although not obvious in the image, careful measurements show that starting about 150 astronomical units (AU) from the star (1 AU is the distance from the Earth to the Sun), one side of the disk is curved away from the star creating a warp.This model is presented in the lower panel.
(Left) Image courtesy Alycia Weinberger / (Right) Image courtesy Alycia Weinberger and The Astrophysical Journal

she looked for variations in composition within the disk.

Her team found a complicated color variation in a strangely shaped, warped disk. Former DTM postdoctoral fellow John Debes (now at NASA Goddard) developed a model of gas/grain interactions and showed that the shape probably came from the interactions between disk grains and hydrogen gas in the interstellar medium (ISM). The dust likely experiences supersonic ballistic drag as it hits the ISM gas—similar to what meteorites encounter when they enter Earth's atmosphere—warping the disk's shape. The ISM dust could also sandblast the outer parts of the disk, changing the sizes of the dust grains and their reflective colors.

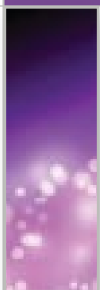
The astronomers used the coronagraph in the near-infrared camera on the HST to block the light of the star so that disk grains scattering starlight would be visible. The color of the scattered light depends on the composition and size of the grains. Their observations probed parts of the disk comparable to the distance between our Sun and Neptune and beyond in our own system. The disk grains are gray in the innermost portion of the image—they scattered all three wavelengths equally. The color gray suggests large silicate grains perhaps coated with water ice. At the disk's warp, the researchers saw a change to a bluer color, suggesting small and eroded grain remnants from collisions with the ISM.

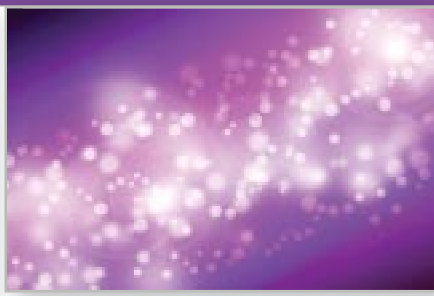
The same processes at work for HD 32297 could have shaped our outer Solar System. For the young stars that Weinberger observes, the interaction of a disk and the ISM is pivotal to understanding the environment in which planets form. □

Weinberger and team use the Hubble Space Telescope for observing dusty disks around nearby stars. This image shows Hubble drifting over Earth in 2009.
Image courtesy NASA

First Light & The Carnegie Academy

Teaching the Art of Teaching Science





DC STARs

The CASE DCBiotech Project and Carnegie's NASA Astrobiology Institute (NAI) team forged a new partnership—Student Teacher Astrobiology Researchers (STARs). Eleven Ballou Senior High School students and their teacher met the NAI team and learned firsthand about the variety of research expeditions to Svalbard, Norway, to prepare for the search for life elsewhere in the universe. During a two-week institute at the Carnegie labs, the STARs learned to apply methods used in the Arctic expeditions to design an expedition to Ballou to collect extremophiles—organisms that live in extreme conditions, such as in a hot water system and on rooftops. Scientists from Andrew Steele's laboratory advised the STARs researchers back at Ballou through computer-mediated videoconferencing. The students presented their findings at an August miniconference.

Branching Out

DC Biotech has established biotechnology career pathways at Ballou and McKinley Technology high schools in Washington. Now, with support from the Shippy Foundation and the Association of American Medical Colleges, students citywide will experience exciting biotech research through a new Lab Loaner Program. Middle and high school science teachers from the D.C. area, trained by CASE, can borrow four different teaching kits for two to three weeks. Each features a biotechnology lesson, complete with curriculum guides.

With support from the National Human Genome Research Institute DNA DAY Program, CASE introduces adults and children to the increasingly accessible world of online bioinformatics research through the simple yet elegant craft of beading bracelets. Four bead colors represent the four DNA bases. The jewelry models real DNA sequence information three ways: by randomly stringing 15 to 18 beads and looking up the DNA sequence on GenBank; by retrieving a selected gene's DNA sequence from GenBank, then beading a segment; or by using the genetic code to bead a secret DNA message.

Going Global

For several years Carnegie has cohosted the Royal Embassy of Norway Transatlantic Science Week. Serendipity sparked a DC Biotech–Norwegian partnership with Ullern High School, Oslo University, and the Oslo Cancer Cluster. The partners visited each other's sites and are designing curricula for students to explore nutrition and diabetes, crime scene investigation, and genomics. Conducting collaborative research projects through videoconferences, the high school students will experience real-world international scientific teamwork while learning about biotechnology careers and each other's cultures. □

for Science Education

(Top left) STARs students Juwanna Douglas and Linda Jamison and teacher John Solano discuss the results of a sampling method they piloted during the two-week institute at Carnegie.
Image courtesy Toby Horn

(Below left) Children bead DNA bracelets at a local science festival. The CASE DNA DAY project sends kits upon request to high schools and community colleges around the country. Kits include beads in the schools' colors along with lessons, teaching PowerPoints, reference materials such as genetic code sheets, and a "Budding Bioinformatician" Certificate of Participation.
Images courtesy Toby Horn

(Above) DCBiotech members went to Oslo, Norway, in May 2010, to visit their Norwegian biotech partners. Members from the U.S. include Marti Jett (in blue jacket, standing on left) and Debra Yourick (sitting second from right) of the Walter Reed Army Institute of Research. They were joined by Ballou teacher John Solano (crouching, right), McKinley teacher Joseph Isaac (standing, right), and J. Craig Venter Institute partner Lisa McDonald (next to Isaac). The Oslo Cancer Cluster and the Royal Norwegian Embassy sponsored CASE codirector Toby Horn (front) and the teachers from the D.C. Public Schools.

Financial Profile

for the year ending June 30, 2010 (unaudited)

Reader's Note: ***In this section, we present summary financial information that is unaudited. Each year the Carnegie Institution, through the Audit committee of its Board of Trustees, engages an independent auditor to express an opinion about the financial statements and the financial position of the institution. The complete audited financial statements are made available on the institution's website at www.CarnegieScience.edu.***

The Carnegie Institution of Washington completed fiscal year 2010 in sound financial condition due to the positive returns (+11.0%) of the diversified investments within its endowment; a disciplined spending policy that balances today's needs with the long-term requirements of the institution and the interests of future scientists; and the continued support of organizations and individuals who recognize the value of nurturing basic science.

The single primary source of support for the institution's activities continues to be its endowment. This reliance on institutional funding provides an important degree of independence in the research activities of the institution's scientists.

Carnegie, like many institutions of higher education and nonprofit organizations, experienced a challenging period financially during fiscal year 2009, when our endowment declined by approximately 27% in value. As a result, over the last two fiscal years Carnegie has had to reduce its expenses while simultaneously ensuring the continuation of a healthy scientific enterprise. During fiscal year 2010, the endowment rebounded partially and grew from $636.4 million to $692.0 million.

Even when taking into account the precipitous decline in 2009, the endowment's value over the last eleven years has grown from $478 million to approximately $692 million as of June 30, 2010. As a result, over the period 2001-2010, average annual increases in endowment contributions to the budget were 5.6%.

Carnegie refinanced the institution's debt in fiscal year 2010 to take advantage of attractive fixed long-term interest rates. During that process, Carnegie's long-term financial strength was reaffirmed by Moody's Investors Service and Standard & Poor's. These rating agencies reviewed Carnegie's financial position and gave the institution their highest and second highest rankings, respectively, a level achieved by only a few nonprofit organizations.

For a number of years, under the direction of the Finance committee of the board, Carnegie's endowment has been allocated among a broad spectrum of asset classes including: fixed-income instruments (bonds), equities (stocks), absolute return investments, real estate partnerships, private equity, and natural resources partnerships. The goal of this diversified approach is to generate attractive overall performance and minimize the volatility that would exist in a less diversified portfolio.

The Finance committee of the board regularly examines the asset allocation of the endowment and readjusts the allocation, as appropriate. The institution relies upon external managers and partnerships to conduct the investment activities, and it employs a commercial bank to maintain custody. The following chart shows the allocation of the institution's endowment among asset classes as of June 30, 2010.

Asset Class	Target	Actual
Common Stock	37.5%	36.1%
Alternative Assets	55.0%	54.1%
Fixed Income and Cash	7.5%	9.8%

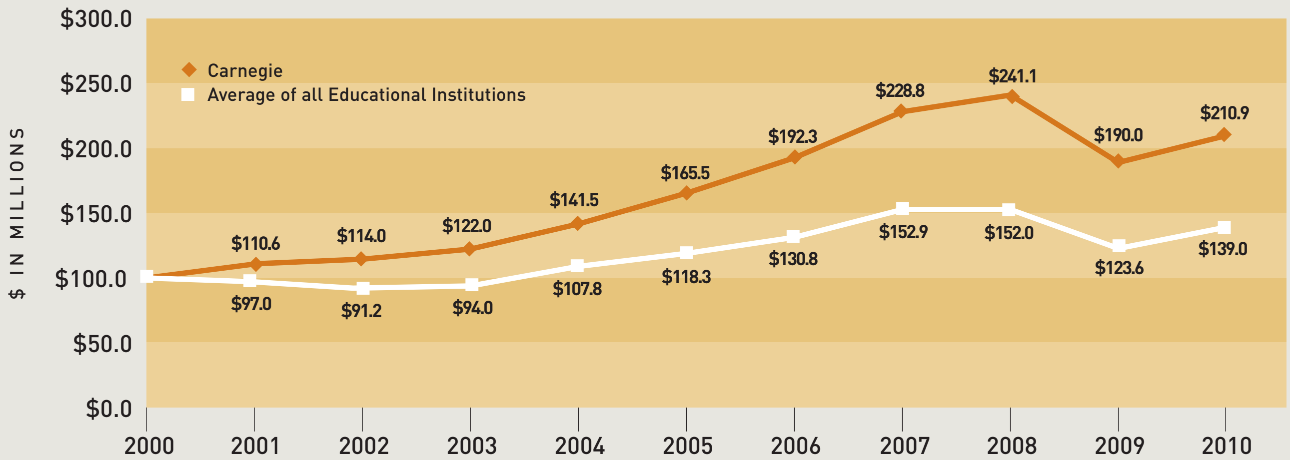
Carnegie's investment goals are to provide high levels of current support to the institution and to maintain the long-term spending power of its endowment. The success of Carnegie's investment strategy is illustrated in the following figure that compares, for a hypothetical investment of $100 million, Carnegie's investment returns with the average returns for all educational institutions for the last eleven years.

Carnegie has pursued a long-term policy of controlling its spending rate, bringing the budgeted rate down in a gradual fashion from 6+ % in 1992 to 5.00% today. Carnegie employs what is known as a 70/30 hybrid spending rule. That is, the amounts available from the endowment in any year is made up of 70% of the previous year's budget, adjusted for inflation, and 30% of the most recently completed year-end endowment value, multiplied by the spending rate of 5.0% and adjusted for inflation and for debt. This method reduces volatility from year-to-year. The figure shown at right (bottom) depicts actual spending as a percentage of ending market value for the last 19 years.

In fiscal year 2010, Carnegie benefitted from continuing increases in federal support. Carnegie's federal support has grown from $24.5 million in 2006 to more than $36 million in new grants in 2010. This is a testament to the high quality of Carnegie scientists and their ability to compete successfully for federal funds.

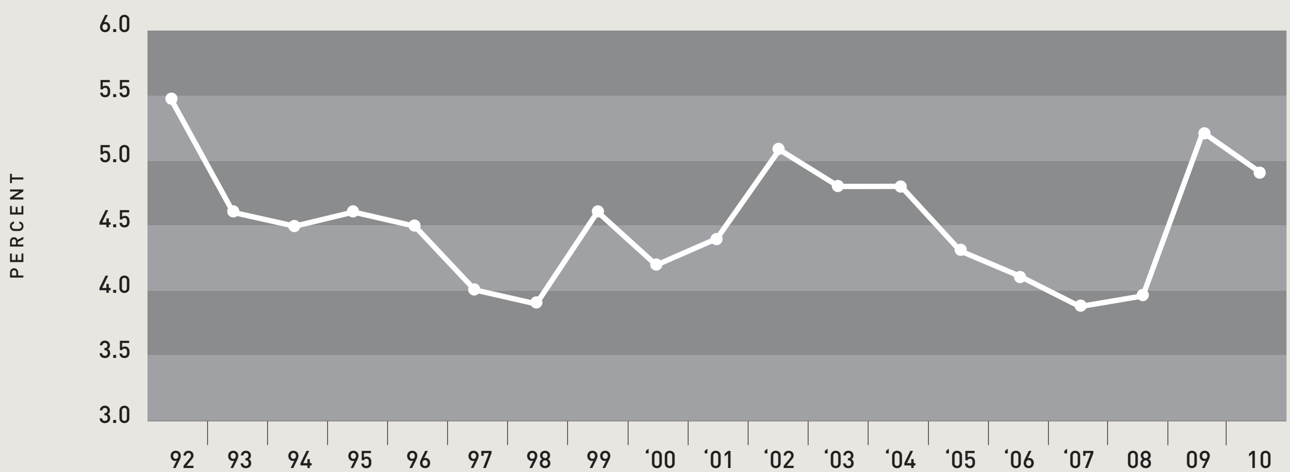
Carnegie also benefits from generous support from foundations and individuals. Funding from foundations has grown from an average of about $3 million/year in the period from 2000 to 2004 to between $5 and 6 million/year from 2006 to 2010. Within Carnegie's endowment, there are a number of "funds" that provide support either in a general way or targeted to a specific purpose. The largest of these is the Andrew Carnegie Fund, begun with the original gift of $10 million. Mr. Carnegie later made additional gifts totaling another $12 million during his lifetime. This tradition of generous support for Carnegie's scientific mission has continued throughout our history, and a list of donors in fiscal year 2010 appears in an earlier section of this yearbook. In addition, Carnegie receives important federal and private grants for specific research purposes, including support from the Howard Hughes Medical Institute for researchers at the Department of Embryology.

Illustration of $100 Million Investment - Carnegie Returns vs. Average Returns for All Educational Institutions (2000-2010)



Average returns for educational institutions are taken from Commonfund reports on endowment performance.

Endowment Spending as a Percent of Ending Endowment Value*



*Includes debt financing.

Statements of Financial Position (unaudited)

June 30, 2010, and 2009

	2010	2009
Assets		
Current assets:		
Cash and cash equivalents	32,359,327	3,587,777
Accrued investment income	46,301	46,430
Contributions receivable	6,342,270	5,519,038
Accounts receivable and other assets	20,411,836	16,750,719
Bond proceeds held by Trustee	26,728	39
Total current assets	$ 59,186,462	$ 25,904,003
Noncurrent assets:		
Investments	688,251,697	633,525,475
Property and equipment, net	156,738,554	157,980,529
Total noncurrent assets	$844,990,251	$791,506,003
Total assets	$904,176,713	$817,410,006
Liabilities and Net Assets		
Accounts payable and accrued expenses	18,579,451	9,759,780
Amount held for others	33,186,239	—
Deferred revenues	33,916,916	40,746,194
Bonds payable	65,800,315	65,358,062
Accrued postretirement benefits	15,246,053	14,560,478
Total liabilities	$166,728,974	$130,424,514
Net assets		
Unrestricted	217,326,563	206,347,417
Temporarily restricted	465,231,580	425,774,379
Permanently restricted	54,889,596	54,863,696
Total net assets	$737,447,739	$686,985,492
Total liabilities and net assets	$904,176,713	$817,410,006

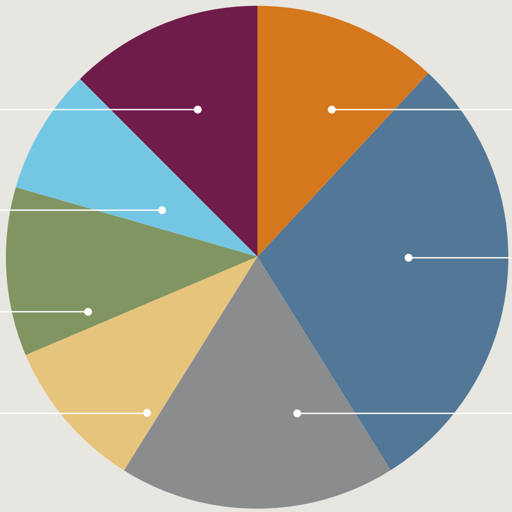
Statements of Activities[1] (unaudited)

Periods ended June 30, 2010 and 2009

	2010	2009
Revenue and support:		
Grants and contracts	$ 42,707,752	$ 34,257,350
Contributions, gifts	14,255,572	10,102,788
Other income	898,225	31,966,105
Net external revenue	$ 57,861,549	$ 76,326,243
Investment income and unrealized gains (losses)	$ 85,323,573	($236,535,117)
Total revenues, gains, other support	$143,185,122	($160,208,874)
Program and supporting services:		
Terrestrial Magnetism	$ 11,210,212	$ 11,584,642
Observatories	26,961,521	19,460,830
Geophysical Laboratory	16,464,866	14,202,009
Embryology	8,959,492	8,925,327
Plant Biology	10,284,361	10,506,356
Global Ecology	7,378,555	8,087,259
Other programs	915,319	1,273,575
Administration and general expenses	10,495,497	8,654,348
Total expenses	$ 92,669,823	$ 82,694,346
Change in net assets before pension related changes	$ 50,515,299	$-242,903,220
Pension Related Changes	(53,052)	808,745
Net assets at the beginning of the period	$686,985,492	$ 929,079,967
Net assets at the end of the period	$737,447,739	$ 686,985,492

[1]Includes restricted, temporarily restricted, and permanently restricted revenues, gains, and other support.

2010 Expenses by Department ($92.7 Million)



Personnel

July 1, 2009-June 30, 2010

Carnegie Administration

Benjamin Barbin, *Manager, Advancement Activities*
Shaun Beavan, *Systems Administrator*
Gloria Brienza, *Manager, Budget and Management Analysis*
Donald Brooks, *Building Maintenance Specialist*
Marjorie Burger, *Financial Manager*
Cady Canapp, *Manager, Human Resources and Insurance*
Alan Cutler, *Science Writer*
Robert Ellis, *Web Developer*
Jason Gebhardt, *Research Assistant*[1]
Michelle Fisher, *Special Events and Facility Coordinator*
Alexis Fleming, *Special Events and Building Assistant*[2]
Shawn Frazier, *Accounting Technician*
Dina Freydin, *Senior Grants Accountant*
Susanne Garvey, *Director, External Affairs*
Darla Keefer, *Special Assistant for Administration and Building Operations*
Ann Keyes, *Payroll Coordinator*
Yang Kim, *Deputy Financial Manager*
Lisa Klow, *Executive Assistant to the President*
George Gary Kowalczyk, *Director, Administration and Finance*
Tina McDowell, *Editor and Publications Officer*
Richard A. Meserve, *President*
June Napoco-Soriente, *Financial Accountant*
Mikhail Pimenov, *Manager, Endowment*
Arnold J. Pryor, *Facilities Coordinator*[3]
Gotthard Sághi-Szabó, *Chief Information Officer*
Harminder Singh, *Financial Systems Accountant*
Henry Spencer, *Information Technology Intern*[4]
John Strom, *Multimedia Designer/Producer*
Mira Thompson, *Manager, Advancement Operations*
Rohan Vanjara, *Web Developer Intern*[4]
Yulonda White, *Human Resources and Insurance Records Coordinator*
Jacqueline Williams, *Assistant to Manager, Human Resources and Insurance*
Bryant Zadegan, *Data Analyst Intern*[4]

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[1]To May 10, 2010
[2]From January 25, 2010
[3]To January 31, 2010
[4]To August 31, 2009

Carnegie Academy for Science Education

Bianca Abrams, *Director, Math for America*
Faith Ajayi, *CASE Intern*[1]
Brianna Anderson, *CASE Intern*[4]
Monica Artis, *CASE Intern*[1]
Suria Bahadue, *CASE Intern*[1]
Sarah Bax, *CASE Mentor*[2]
Brittney Bradley, *CASE Intern*[1]
Guy Brandenburg, *First Light Instructor, CASE and MfA Mentor*
Anne Brooks-Hemphill, *CASE Mentor*[3]
Khalid Bullock, *STARS Program Intern*[4]
Nicole Cherry, *CASE Intern*[4]
Katherine Collins, *Math for America Fellow*
Amy Danks, *Math for America Fellow*
Victoria Davis, *CASE Intern*[4]
Asonja Dorsey, *CASE Mentor*[3]
Lanisha Dorsey, *CASE Intern*[1]
Lauren Dorsey, CASE Intern[4]
Steven Dorsey, *CASE Intern*[4]
Juwanna Douglas, *STARS Program Intern*[4]
VanNessa Duckett, *CASE Mentor*[5]
Julie Edmonds, *Codirector, CASE*
Anne Farrell, *Math for America Fellow*
Ricky Garibay, *Intern and First Light Assistant*[5]
Samuel Goldstein, *Volunteer*
Darcy Hampton, *CASE Mentor*[3]
Tashima Hawkins, *CASE Mentor*[3]
Gayan Hettipola, *CASE Intern*[1]
Krystn Hodge, *Math for America Fellow*
Courtney Holmes, *STARS Program Intern*[4]
Toby Horn, *Codirector, CASE*
Trisha Ibeh, *CASE Intern*[1]
Joseph Isaac, *CASE Fellow*[1]
Matthew James, *CASE Intern*[4]
Linda Jamison, *STARS Program Intern*[4]
Marlena Jones, *Coordinator of Programs*
Molley Kaiyoorowongs, *Math for America Fellow*
M'Heeraw Kennedy, *CASE Intern*[1]
Brian Kim, *Research Assistant*[6]
Yeelan Ku, *CASE Intern*[1]
Sophia Lallinger, *Math for America Fellow*
Kaya Lowery, *CASE Intern*[1]
Shameka Lyles, *STARS Program Intern*[4]
Lindsay Mann, *Math for America Fellow*
Jeanah McCall, *CASE Intern*[7]
Michael McCreary, *CASE Intern*[1]
My'Chelle McCreary, *CASE Intern*
Sunday McIlwain, *CASE Intern*[1]
Maya Meraz-Garcia, *CASE Mentor*[3]
Max Mikulec, *Math for America Fellow*
Devonte Miles, *STARS Program Intern*[4]
Thomas Nassif, *CASE Mentor*[8]
Maximilian Olivier, *Math for America Fellow*
Yolande Paho, *CASE Intern*[1]
Julia Penn, *Math for America Fellow*
Jessica Reynolds, *Math for America Fellow*
Debron Rodney, *CASE Intern*[9]
Corshelle Rowland, *CASE Intern*[10]
Brittney Sims, *CASE Intern*[1]
John Solano, *CASE Fellow*[11]
Liza Styles, *Math for America Fellow*[12]
Dashawn Taylor, *STARS Program Intern*[13]
Jasmine Thomas, *STARS Program Intern*[4]
Tierra Thornton, *STARS Program Intern*[4]
Samuel Trichtinger, *Math for America Fellow*
Meredith Wachs, *Math for America Fellow*
Juna Wallace, *Intern and First Light Assistant*[1]
Brittany Warren, *STARS Program Intern*[4]
Isaiah West, *CASE Intern*[14]
DeVaughn Wilson, *STARS Program Intern*[4]
Heather Zelinsky, *Math for America Fellow*

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[1]To August 31, 2009
[2] From June 1, 2010
[3]To July 31, 2010
[4]From June 28, 2010, to August 5, 2010
[5]From June 1, 2010, to August 24, 2010
[6]From June 21, 2010, to August 5, 2010
[7]From September 08, 2009, to August 5, 2010
[8]From June 1, 2010, to August 24, 2010
[9]From June 18, 2010, to August 5, 2010
[10]From July 20, 2009, to July 30, 2009
[11]From June 28, 2010, to July 31, 2010
[12]To September 26, 2009
[13]From June 28, 2010, to August 4, 2010
[14]From July 20, 2009, to August 31, 2009

EMBRYOLOGY Front row (left to right): Alex Bortvin, Chen-Ming Fan, Allan Spradling, Steve Farber, David MacPherson, Marnie Halpern. Second row: Xiaohong Ma, Brittany Hay, Estela Monge, Ella Jackson, Glenese Johnson, Patricia Cammon, Samantha Satchell. Third row: Erin Gunter, Junqi Zhang, Jianjun Sun, Ming-Chia Lee, Karina Conkrite, Mary Bradford, Michelle Macurak, Rosa Miyares. Fourth row: Eugenia Dikovskaia, Susan Artes, Lydia Li, Lakishia Smith, William Yarosh, Dolly Chin, Ona Martin, Keisha Breland. Fifth row: Alexis Marianes, Svetlana Deryusheva, Allen Strause, Vicki Losick, Itay Onn, Dean Calahan, Dianne Stewart, Becky Frederick. Sixth row: Wilbur Ramos, Amy Kowalski, Alexander Chin, Jen Anderson, Mike Sepanski, Tim Mulligan, Tim Sibiski, Youngjo Kim, Juliana Carten, Katherine Lovette, Valerie Butler, Arash Adeli, Rob Vary, Tagide deCarvalho, Neda Muzaffar, Rejeanne Juste. Seventh row: Maggie Sundby, Pedram Nozari, Pavol Genzor, Bob Levis, Don Fox, Carol Davenport, James Walters, Lei Lei, Ben Goodman, Axel Horn, Lucilla Facchin, Safia Malki, Julio Castaneda. Eighth row: Mahmud Siddiqi, Eugene Gardner, Lucy Morris, Dan Gorelick, Tom McDonaugh, Shusheng Wang.

Embryology

Research Staff Members

Alexsky Bortvin
Donald D. Brown, *Director Emeritus*
Chen-Ming Fan
Steven Farber
Joseph G. Gall
Marnie Halpern
Douglas E. Koshland[1]
Allan C. Spradling, *Director*
Yixian Zheng

Staff Associates

Jeffrey Han
David MacPherson
Judith Yanowitz[2]

Postdoctoral Fellows and Associates

Sang Jung Ahn, *Research Associate, NIH Grant (Halpern)*
Joshua Bembenek, *Howard Hughes Medical Institute Research Associate*
Sandrine Biau, *Carnegie Fellow*[3]
Tagide deCarvalho, *Research Associate, NIH Grant (Halpern)*
Svetlana Deryusheva, *Visiting Scientist, Carnegie*
Lucilla Facchin, *Eppley Foundation Grant (Halpern) and Carnegie Fellow*
Donald Fox, *Jane Coffin Childs Fellowship*
Rebecca Frederick, *American Cancer Society Fellowship*
Mary Goll, *Damon Runyon Cancer Research Fellowship*
Daniel Gorelick, *Carnegie Fellow*
Vinny Guacci, *Howard Hughes Medical Institute Research Specialist*[4]
Mario Izaguirre-Sierra, *Research Associate, NIH Grant (Gall)*[5]
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Youngjo Kim, *Howard Hughes Medical Institute Research Associate*
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Zhonghua Liu, *Howard Hughes Medical Institute Research Associate*
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Sandeep Mukhi, *NIH Grant (Brown)*[7]
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Itay Onn, *Howard Hughes Medical Institute Research Associate*
Jianjun Sun, *Howard Hughes Medical Institute Research Associate*
Frederick Tan, *Howard Hughes Medical Institute Research Associate*[9]
Tina Tootle, *Ruth Kirschstein (NRSA) Fellowship*[10]
Godfried Van der Heijden, *Carnegie Fellow*[11]
James Walters, *American Cancer Society Fellow*

Shusheng Wang, *Research Associate, NIH Grant (Zheng)*
Zheng-an Wu, *Special Investigator, NIH Grant (Gall) and Carnegie Fellow*
Cheng Xu, *Carnegie Fellow and NIH Grant (Fan)*

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Julio Castaneda, *The Johns Hopkins University*
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Pavol Genzor, *The Johns Hopkins University*
Ben Goodman, *The Johns Hopkins University*
Jill Heidinger, *The Johns Hopkins University*[13]
Margaret Hoang, *The Johns Hopkins University*
Kate Lannon, *The Johns Hopkins University*[14]
Christoph Lepper, *The Johns Hopkins University*
Lydia Li, *The Johns Hopkins University*[15]
Peter Lopez, *The Johns Hopkins University*
Alexis Marianes, *The Johns Hopkins University*
David Martinelli, *The Johns Hopkins University*[16]
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Katie McDole, *The Johns Hopkins University*
Katherine Mitchell, *The Johns Hopkins University*
Rosa Miyares, *The Johns Hopkins University*
Tim Mulligan, *The Johns Hopkins University*
Zehra Nizami, *The Johns Hopkins University*
Lori Orosco, *The Johns Hopkins University*[17]
Michelle Rozo, *The Johns Hopkins University*[18]
Andrew Skora, *The Johns Hopkins University*
Abhignya Subedi, *The Johns Hopkins University*[19]
Lamia Wahba, *The Johns Hopkins University*[20]
Aaron Welch, *The Johns Hopkins University*
William Yarosh, *The Johns Hopkins University*[21]

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Tamar Harel, *Student Assistant*[31]
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Amy Herbert, *Student Volunteer*[34]
Brian Hollenback, *Animal Technician*[35]
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Fred Jackson, *P/T Animal Care Technician*
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Victoria Robinson, *Student Assistant*[43]
Lissa Rotundo, *Special Investigator*[44]
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Mahmud Siddiqi, *Research Specialist*
Desiree Simpson, *Research Undergraduate*[46]
Alison Singer, *Research Technician*[47]
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Sarah Stockman, *Predoctoral Research Associate*[48]
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David Gresham, *New York University*
Matthias Hammerschmidt, *Max Planck Institute for Immunobiology, Germany*
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Marko Horb, *Institut de Recherches Cliniques de Montréal (IRCM)*
Roger Hoskins, *Lawrence Berkeley National Laboratory*
Gary Karpen, *Lawrence Berkeley National Laboratory*
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Christine Thisse, *Department of Cell Biology and the Morphogenesis and Regenerative Medicine Institute, University of Virginia*
Milena Vuica, *Department of Pathology, The Johns Hopkins University School of Medicine*

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[1]To June 30, 2010
[2]To October 27, 2009
[3]To October 12, 2009
[4]To June 30, 2010
[5]From May 3, 2010
[6]From March 1, 2010
[7]To June 30, 2010
[8]To August 5, 2009
[9]To December 31, 2009
[10]To June 30, 2009
[11]To May 31, 2010
[12]From May 24, 2010
[13]To May 31, 2010
[14]To October 31, 2009
[15]From May 24, 2010
[16]To September 30, 2009
[17]To May 22, 2010
[18]From May 24, 2010
[19]From May 24, 2010
[20]To June 30, 2010
[21]From May 24, 2010
[22] To September 10, 2009
[23]To September 10, 2009
[24]From May 25, 2010
[25]To September 18, 2009
[26]To June 30, 2010
[27]To July 31, 2009
[28]To June 30, 2010
[29]To July 2, 2009
[30]From May 24, 2010
[31]To September 4, 2009
[32]To April 4, 2010
[33]From May 23, 2010
[34]From January 20, 2010
[35]To June 30, 2010
[36]From April 12, 2010
[37]From August 19, 2009
[38]To July 12, 2009
[39]To December 4, 2009
[40]From March 29, 2010
[41]To April 6, 2010
[42]From May 17, 2010
[43]To August 2009
[44]To August 15, 2009
[45]From October 12, 2009
[46]To July 28, 2009
[47]To August 12, 2009
[48]From June 1, 2010
[49]To October 28, 2009
[50]From October 27, 2009

Geophysical Laboratory

Staff Scientists

George D. Cody
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Yingwei Fei
Marilyn L. Fogel
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Dionysis I. Foustoukos, *NSF*
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Malcolm Guthrie, *Chief Scientist, EFree*[6]
Valerie Hillgren, *NASA*[7]
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Anurag Sharma, *Shell Oil*[8]
Maddury Somayazulu, *CDAC*
Chih Shiue Yan, *CVD Diamond, NSF, Carnegie*
Chang-Sheng Zha, *CDAC*

NSF REU Program Director and CDAC Laboratory Manager

Stephen A. Gramsch

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Richard Ferry, *Technician, HPSynC*
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Yue Meng, *Beamline Scientist, HPCAT*
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Dmitry Popov, *Beamline Scientist, HPCAT*[16]
Eric Rod, *Beamline Technician, HPCAT*
Olga Shebanova, *Postdoctoral Associate, HPCAT*

GEOPHYSICAL LABORATORY Front row (left to right): Yingwei Fei, Neil Irvine, Anat Shahar, George Cody, Robert Hazen, Russell Hemley, Ronald Cohen, Bjørn Mysen, Andrew Steele, Alexander Goncharov. Second row: David Baker, Roxane Bowden, Danielle Appleby, Lauren Cryan, Yufei Meng, Kadek Hemawan, Liwei Deng, Yoko Kebukawa, Takamitsu Yamanaka, Jinfu Shu, Namhey Lee, Dina Bower, Weifu Guo, Nabil Boctor, Yuki Nakamoto. Third row: Constance (Connie) Bertka, Gefei Qian, Andrea Mangum, Dyanne Furtado, Shaun Hardy, Morgan Phillips, Gary Bors, Mihaela Glamoclija, Pamela Woodard, Atsushi Kyono, Joseph Lai, Jeff Lightfield, Trong Nguyen, Reinhard Boehler, Stephen Coley, Valerie Hillgren, Merri Wolf, Douglas Allen Dalton, Li Zhang, Ying Wang, Stewart McWilliams, Christopher Seagle, Timothy Strobel, Liuxiang Yang, Malcolm Guthrie, Robert (Jerry) Potter. Back row: Muhetaer Aihaiti, Shohei Ohara, Henderson James (Jim) Cleaves, Kateryna Klochko, Marilyn (Helen) Venzon, Victor Lugo, Stephen Hodge, Daniel Hummer, Adrian Villegas-Jimenez, Derek Smith, Chi Zhang, Amol Karandikar.

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Stanislav Sinogeikin, *Beamline Scientist, HPCAT*
Junyue Wang, *Postdoctoral Researcher, HPSynC and ANL*[17]
Lin Wang, *Balzan Fellow, Postdoctoral Researcher, HPCAT and HPSynC*[18]
Yuming Xiao, *Postdoctoral Associate, HPCAT*
Wenge Yang, *Beamline Scientist, HPCAT*[19]
Kirill Zhuravlev, *Postdoctoral Associate, GSECARS, APS*[20]

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D. Allen Dalton, *Postdoctoral Associate, CDAC and NSF*[24]
Panchapakesan Ganesh, *Postdoctoral Associate*[25]
Mihaela Glamoclija, *Carnegie Fellow*[26]
Weifu Guo, *Carnegie Fellow*
Sanchayan Neal Gupta, *NAI Fellow*[27]
Daniel Hummer, *Carnegie Fellow*[28]
John Janik, *Carnegie Fellow, CDAC*[29]
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Yoko Kebukawa, *Carnegie Fellow, NAI*
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Kateryna Klochko, *Postdoctoral Associate, NAI and NSF*[33]
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Xuan Luo, *Postdoctoral Associate, NSF*[35]
Francis McCubbin, *Carnegie Fellow*[36]
Yufei Meng, *Postdoctoral Associate*
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Subramanian Natarajan, *Postdoctoral Associate, DOE*[38]
Shohei Ohara, *Postdoctoral Associate, NSF*
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Angèle Ricolleau, *Carnegie Fellow, NSF*[40]
Christopher Seagle, *Carnegie Fellow*[41]
Luke Shulenburger, *Postdoctoral Associate, NSF*[42]
Timothy Strobel, *Carnegie Fellow, NSF*
Ying Wang, *Carnegie Fellow*[43]
Li Zhang, *Postdoctoral Associate, NASA*

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Charlene Estrada, *Predoctoral Fellow, NSF*[45]
Clare Flynn, *Predoctoral Fellow, NSF-NASA*[46]
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Amol Karandikar, *Predoctoral Associate, EFree*[48]
Namhey Lee, *Predoctoral Fellow, The Johns Hopkins University*
Verena Starke, *NASA Marshall Space Flight Center*

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Salima Bahri, *Barnard College*[50]
Alaina Beres, *Elmhurst College*[51]
Thomas Hittinger, *Howard University*[52]
Yasmin Kadry, *Howard University*[53]
Brendan O'Connor, *Montgomery College*[54]
Olaoluwa Omotosho, *Howard University*[55]

Summer Scholar Interns (Summer 2010)

Bethany Chidester, *University of Toledo*
Breana Hashman, *Dickinson College*
Rachael Hoover, *University of Colorado*
Benjamin Horkley, *Wilson High School/Massachusetts Institute of Technology*
Byron Kelly, *Memorial University of Newfoundland*
Kathryn Kumamoto, *Williams College*
Amanda Lindoo, *Augustana College*
Rachel Maxwell, *University of Arizona*
Melissa McMillan, *University of Arizona*
Jennifer Moses, *Franklin and Marshall College*
Donald Plattner, *Centre College*
Michael Wong, *University of California, Berkeley*

High School Interns

Obioma Anomnachi, *The Field School*
Ari-jan Azad, *British School of Washington*
Thomas Gramsch, *Lake Braddock High School*
Winston Liu, *Montgomery Blair High School*
Hannah Moore, *Albert Einstein High School*
William Qian, *Thomas Jefferson High School for Science and Technology*
Maimon Rose, *Melvin J. Berman Hebrew Academy*
Søren Scott, *Bethesda Chevy Chase High School*

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Gary A. Bors, *Building Engineer*[58]
Roxane Bowden, *Lab Manager, Stable Isotope Facility*[59]
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Stephen D. Coley, Sr., *Instrument Shop Supervisor*
Lauren Cryan, *DCO Program Assistant*[61]
Roy R. Dingus, *Facility Manager*[62]
Pablo D. Esparza, *Maintenance Technician*[63]
Dyanne Furtado, *Staff Accountant*
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Shaun J. Hardy, *Librarian*[64]
Stephen Hodge, *Instrument Maker*
Garret W. Huntress, *Systems Administrator, Systems Developer*
Lauren Kerr, *Research Technician, Charles River Grant*[65]
William E. Key, *Building Engineer*[66]
Szczesny (Felix) Krasnicki, *CVD Diamond Senior Engineer*
Joseph Lai, *CVD Diamond Lab Manager*
Jeff Lightfield, *Controller*
Andrea Mangum, *DCO Program Associate*[67]
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Susana Mysen, *Technical Assistant*[69]
Trong T. Nguyen, *Assistant Controller*
Morgan D. Phillips, *Assistant to the Director, Science and CDAC*
Scott Price, *Electronics Specialist*
Gefei Qian, *Systems Administrator*
Pedro J. Roa, *Maintenance Technician*[70]
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Jinfu Shu, *Research Technician, HPCAT*
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Liwei Deng, *Peking University, China*
Joseph Feldman, *U.S. Naval Research Laboratory*
Marc Fries, *NASA JPL*
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Timothy Glotch, *State University of New York, Stony Brook*
Edward Greiner, *University of Wisconsin, Madison*
Valerie Hillgren, *Max Planck Institute for Chemistry, Germany*
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Stewart McWilliams, *Howard University*
Sami Mikhail, *University College London, UK*
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Nora Noffke, *Old Dominion University*
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Qing Peng, *California State University, Northridge*
Kate Pinkerton, *American University*
Laurie Raymundo, *University of Guam*
Jamey Redding, *American University*
Aidan Ross, *University College London, UK*
K.V. Shanavas, *Bhabha Atomic Research Centre, Mumbai, India*
Surinder Sharma, *Bhabha Atomic Research Centre, Mumbai, India*
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Jack Tossell, *University of Maryland*
Alekos Tsamaloukas, *Rensselaer Polytechnic Institute*
Cynthia Tselepsis, *Miami University*
Norman Wainwright, *Charles River Laboratories*
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Jiang Zhang, *South China University of Technology*
Bo Zou, *Jilin University, China*
Guangtian Zou, *Jilin University, China*

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Matt Armentrout, *University of California, Los Angeles, HPCAT*
Bruce Baer, *Lawrence Livermore National Laboratory, HPCAT*
Jason Baker, *University of Nevada, Las Vegas, HPCAT*
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Pamela Bumley, *University of Nevada, Las Vegas, HPCAT*
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Adam Cadien, *George Mason University, HPCAT*
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B. Li, *Seoul National University, HPCAT*
F. Li, *Jilin University, HPCAT*
Q. Li, *Jilin University, NSLS*
Jung-Fu Lin, *University of Texas, Austin, HPCAT*
Yu Lin, *Stanford University, HPCAT*
Kristina Lipinska-Kalita, *University of Nevada, Las Vegas, HPCAT*
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Zhu Mao, *University of Texas, Austin, HPCAT*
F. Mark, *Northern Illinois University, HPCAT*
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H. D. Nguyen, *Delft University of Technology, HPCAT*
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Kazuhiko Otsuka, *Yale University, NSLS*
Wendy Panero, *Ohio State University, HPCAT*, *NSLS*
M. Patten, *Western Michigan University, HPCAT*
Jeffrey Pigott, *Ohio State University, HPCAT, NSLS*
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Walter Pravica, *University of Nevada, Las Vegas, HPCAT*
Charles Prewitt, *University of Arizona, HPCAT*
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Yang Ren, *Argonne National Laboratory, HPCAT*
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John Smedley, *Brookhaven National Laboratory, NSLS*
Hillary Smith, *California Institute of Technology, HPCAT*
Emmanuel Soignard, *Arizona State University, HPCAT*
Yang Song, *University of Western Ontario, HPCAT*
Narcizo Souza-Neto, *Advanced Photon Source, HPCAT*
David Sprouster, *Australian National University, HPCAT*
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Saurabh Virkar, *Western Michigan University, HPCAT*
Yogesh Vohra, *University of Alabama, Birmingham, HPCAT*
Shibing Wang, *Stanford University, HPCAT*
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Y. Wang, *Yale University, HPCAT*
Y. Wang, *State University of New York, Stony Brook*

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Kirill Zhuravlev, *University of Western Ontario, HPCAT*

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[1]From July 1, 2009
[2]From August 17, 2009
[3]From September 1, 2009
[4]To September 30, 2009; EFree neutron scientist from October 1, 2009
[5]From March 1, 2010
[6]From September 21, 2009
[7]From January 4, 2010
[8]To September 4, 2009
[9]To August 21, 2009
[10]From January 18, 2010
[11]From September 1, 2009
[12]From August 2009, to January 2010
[13]To February 21, 2010
[14] From September 15, 2009
[15]To October 8, 2009
[16]From April 15, 2010
[17]From July 2009
[18]To April 14, 2010; research scientist at HPSynC from April 15, 2010
[19]To September 30, 2009; HPSynC co-project manager from October 1, 2009
[20]From April 1, 2010
[21]From January 4, 2010
[22]To April 25, 2010
[23]From November 1, 2007, to July 30, 2009; visiting investigator from August 1, 2009
[24]From August 26, 2009
[25]To June 30, 2010
[26]To February 28, 2010
[27]From August 31, 2009
[28]From March 22, 2010
[29]To October 26, 2009
[30]To October 31, 2009
[31]To June 30, 2010; moved to HPSynC
[32]To October 30, 2009
[33]From July 14, 2009
[34]To August 31, 2009
[35]To September 9, 2009; visiting investigator from April 15, 2010
[36]From July 1, 2009, to June 30, 2010
[37]To January 31, 2010
[38]To March 10, 2010
[39]From July 1, 2009
[40]To September 19, 2009; joint IMPMC-GL Fellow from March 1, 2009, to September 18, 2009
[41]From August 7, 2009
[42]To June 30, 2010
[43]From November 20, 2009
[44]To July 31, 2009
[45]From June 1, 2010
[46]To August 31, 2009
[47]To August 31, 2009; research assistant from September 1, 2009
[48]From March 26, 2010
[49]From June 16, 2010
[50]From January 4, 2010, to January 18, 2010
[51]From June 8, 2010
[52]From June 15, 2010
[53]From June 15, 2010
[54]To August 31, 2009
[55]From May 24, 2010
[56]Joint appointment with DTM
[57]January 1, 2010, to April 21, 2010
[58]Joint appointment with DTM
[59]From September 23, 2009
[60]To May 10, 2010
[61]From October 20, 2009
[62]Joint appointment with DTM
[63]Joint appointment with DTM
[64]Joint appointment with DTM
[65]To August 17, 2009
[66]Joint appointment with DTM
[67]From June 1, 2010
[68]Joint appointment with DTM
[69]To July 30, 2009; EFree project administrator from August 1, 2009
[70]Joint appointment with DTM
[71]Joint appointment with DTM
[72]From September 1, 2009

Global Ecology

Research Staff Members

Gregory Asner
Joseph A. Berry
Kenneth Caldeira
Christopher B. Field, *Director*

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Shaun Levick, *University of Witwatersrand, Johannesburg, South Africa*
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Robin Martin, *University of Colorado*
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Ho-Jeong Shin, *Yonsei University, Seoul, South Korea*
Jacob Silverman, *Hebrew University of Jerusalem*[4]

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Eben Broadbent, *Stanford University*
Matthew Colgan, *Stanford University*
Kyla Dahlin, *Stanford University*

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Luis Fernandez, *Stanford University*[5]
Eve-Lyn Hinckley, *Stanford University*[6]
Jennifer Johnson, *Stanford University*
Claire Lunch, *Stanford University*[7]
Alex Nees, *Stanford University*
Carolyn Snyder, *Stanford University*[8]
Adam Wolf, *Stanford University*

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Elliot Brenner, *Intern*[10]
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Albert Cortes, Jr., *Laboratory Technician*[14]
Ruth Emerson, *Laboratory Technician*[15]
Yuka Estrada, *Laboratory Technician*
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Mona Houcheime, *Laboratory Technician*
James Jacobson, *Laboratory Technician*
Iwikauikaua Joaquin, *Laboratory Technician*[18]
Mokila Joaquin, *Laboratory Technician*[19]
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David Knapp, *Senior Laboratory Technician*
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Linda Longoria, *Administrative Assistant*
Reid Loo, *Laboratory Technician*[21]
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Kevin Smith, *Laboratory Technician*[22]
Michael Spieler, *Intern*[23]
Todd Tobeck, *Laboratory Coordinator*
Angela Torney, *Laboratory Assistant*
C. Parker Weiss, *Laboratory Technician*

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[1]To June 1, 2010
[2]From February 16, 2010
[3]From July 1, 2009
[4]To September 1, 2009
[5]From October 1, 2009
[6]To September 15, 2009
[7]To June 15, 2010
[8]To March 31, 2010
[9]From July 1, 2009, to April 30, 2010
[10]To September 30, 2009
[11]To June 30, 2010
[12]From May 1, 2010
[13]From October 1, 2009
[14]To October 31, 2009
[15]To June 22, 2010
[16]To August 31, 2009
[17]To February 15, 2010
[18]To December 31, 2009
[19]To August 30, 2009
[20]To November 1, 2009
[21]To December 31, 2009
[22]From February 16, 2010
[23]From August 11, 2009, to September 15, 2009

The Observatories

Research Staff Members
Alan Dressler
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Juna Kollmeier
Patrick McCarthy
Andrew McWilliam
John Mulchaey
Augustus Oemler, Jr., *Director Emeritus*
Eric Persson
George Preston, *Director Emeritus*
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Allan Sandage, *Staff Member Emeritus*
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Leonard Searle, *Director Emeritus*
Stephen Shectman
Ian Thompson
Ray Weymann, *Director Emeritus*

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Jeffrey Crane, *Staff Associate*[3]
Ivo Labbé, *Hubble Fellow*
Janice Lee, *Carnegie Fellow*[4]
Zhao-Yu Li, *Research Assistant*
Karín Menéndez-Delmestre, *NSF Fellow*
Ivelina Momcheva, *Postdoctoral Associate*
Andy Monson, *Postdoctoral Associate*
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José Prieto, *Carnegie-Princeton-Hubble Fellow*[5]
Jesper Rasmussen, *Chandra Fellow*
Jane Rigby, *Carnegie Fellow*[6]
Victoria Scowcroft, *Postdoctoral Associate*[7]
Mark Seibert, *Postdoctoral Associate*
Joshua Simon, *Carnegie-Vera Rubin Fellow*
Laura Sturch, *Research Assistant*[8]
Violet Taylor, *Postdoctoral Associate*[9]
Rik Williams, *Postdoctoral Associate*[2]

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Miguel Roth, *Director, Las Campanas Observatory*

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Francisco Di Mille, *AAO Magellan Fellow*[11]
David Floyd, *Magellan Fellow*[12]
Gaston Folatelli, *Postdoctoral Fellow*
Maximilian Stritzienger, *Postdoctoral Fellow*[13]
Shane Walsh, *AAO Magellan Fellow*[14]

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Nidia Morrell, *Visiting Scientist*

Support Scientist
David Murphy, *Instrument Scientist*

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Arnold Phifer, *Regional Director of Advancement*[15]

Giant Magellan Telescope Organization (GMTO)
John Bagnasco, *Senior Opto-Mechanical Engineer*[16]
Antonin Bouchez, *Adaptive Optics Scientist*[17]
Steven Dolmseth, *Chief Financial Officer*[18]
Richard Haley, *Contracts Officer*[19]
Charlie Hull, *Project Mechanical Engineer*
George Jacoby, *Instrumentation Scientist*[19]
Matthew Johns, *Project Manager*
Johnathan Kern, *Telescope Engineering Manager*
Leni Malherbe, *Document Control Specialist*[19]
Patrick McCarthy, *Director*
Stephen Shectman, *Project Scientist*
Eli Slawson, *GMT Assistant*
Carey Smith, *Optomechanical Engineer*[20]
Amnon Talmor, *Project Engineer*
Michael Ward, *Senior Systems Engineer*[21]
Charmeen Wing, *Joint Development Officer*[22]

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Jerson Castillo, *Instrument Maker*
Ken Clardy, *Programmer*
Paul Collison, *Computer Systems Manager*
Jorge Estrada, *Electronics Technician*
John Grula, *Head Librarian, Information Services/Publications Manager*
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Sharon Kelly, *Buyer*
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Becky Lynn, *Secretary*
Luis Ochoa Ramirez, *Accounts Payable Specialist*
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Robert Pitts, *Assistant, Buildings and Grounds*
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Edward Villanueva, *Data Analyst and Programmer*
Gregory Walth, *Data Analyst*
Steven K. Wilson, *Facilities Manager*

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Juan Alfaro, *Magellan Site Maintenance Support*
Hernán Ángel, *Driver/Purchaser*
Jorge Araya, *Magellan Telescope Operator*
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Jilberto Carvajal, *El Pino Guard*
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Juan Espoz, *Mechanic*
Glenn Eychaner, *Telescope Systems Programmer*
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Javier Rivera, *Paramedic*
Herman Rojas, *Web Page Specialist*
Honorio Rojas, *Water Pump Operator*[13]
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Mauricio Rojas, *Janitor*[29]
Felipe Sanchez, *Telescope Controls Programmer*
Agustin Sarmiento, *Chef*[5]
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Gabriel Tolmo, *El Pino Guard*
Manuel Traslaviña, *Heavy Equipment Operator*
Geraldo Vallardes, *Magellan Telescope Operator*
Sergio Vera, *Magellan Telescope Operator*
David Verdugo, *Chef*

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POSTDOCTORAL STAFF From left to right: José Prieto, Victoria Scowcroft, Jane Rigby, Rik Williams, Ivelina Momcheva, Karín Menéndez-Delmestre, Lei Bai, T.J. Cox, Mark Seibert, Janice Lee, Andrew Monson.

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Eric Bell, *University of Michigan*
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Matias Gomez, *Universidad Andrés Bello, Chile*
Anthony Gonzalez, *University of Florida*
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Chad Greene, *University of Waterloo, Canada*
Jenny Greene, *University of Texas, Austin*
Steve Groh, *Harvard University, CfA*
Michael Gully, *University of Texas at Austin*
Guillermo Gunthardt, *Universidad de La Serena, Chile*
Gail Gutowski, *Haverford College*
Tolga Guver, *University of Arizona*
Alex Hagen, *Harvey Mudd College*
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Jessie Hart, *University of Michigan*
Joel Hartman, *Harvard University, CfA*
Raoul Haschke, *University of Heidelberg, ARI, Germany*
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Jennifer Helsby, *University of Chicago*
Pascale Hibon, *Arizona State University*
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Laura Ingleby, *University of Michigan*
Inese Ivans, *Princeton University*
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James Jenkins, *Universidad de Chile*
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Linhua Jiang, *University of Arizona*
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[1]From July 1, 2009; formerly postdoctoral associate
[2]From October 1, 2009
[3]From April 1, 2010; formerly Carnegie Fellow
[4]From October 1, 2009; formerly Hubble Fellow
[5]From September 1, 2009
[6]From January 1, 2010; formerly Spitzer Fellow
[7]From October 15, 2009
[8]To July 24, 2009
[9]To August 14, 2009
[10]To November 14, 2009
[11]From August 3, 2009
[12]To August 12, 2009
[13]To June 30, 2010
[14]From July 20, 2009
[15]To March 1, 2010
[16]To December 31, 2009
[17]From April 1, 2010
[18]From January 4, 2010
[19]From May 3, 2010
[20]From May 24, 2010
[21]From July 14, 2009
[22]From April 15, 2010
[23]To August 31, 2009
[24]To April 30, 2010
[25]From June 7, 2010
[26]To April 16, 2010
[27]To May 10, 2010
[28]To March 31, 2010
[29]From November 23, 2009

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[1]From February 1, 2010
[2]To March 10, 2010
[3]From January 8, 2010
[4]From June 1, 2010
[5]To May 31, 2010
[6]From February 1, 2010
[7]To August 14, 2009
[8]To November 30, 2009
[9]From December 1, 2009
[10]To June 22, 2010
[11]To May 28, 2010
[12]From August 1, 2009
[13]To December 21, 2009
[14]To December 17, 2009
[15]From February 22, 2010
[16]To October 31, 2009
[17]From November 1, 2009
[18]From September 1, 2009
[19]To July 31, 2009
[20]To September 15, 2009
[21]To March 26, 2010
[22]To November 24, 2009
[23]From May 3, 2010
[24]To July 1, 2009
[25]From July 6, 2009
[26]To August 17, 2009
[27]To June 9, 2010
[28]From August 13, 2009
[29]From March 1, 2010
[30]From October 27, 2009
[31]From May 16, 2010
[32]To August 31, 2009
[33]To September 1, 2009
[34]From June 22, 2010
[35]From July 1, 2009, to August 31, 2009
[36]From July 1, 2009, to September 18, 2009
[37]From June 30, 2010
[38]From June 8, 2010
[39]From June 12, 2010
[40]From June 10, 2010
[41]To January 31, 2010
[42]From January 18, 2010
[43]To April 22, 2010
[44]From January 6, 2010
[45]To June 30, 2010
[46]To April 30, 2010
[47]From July 1, 2009
[48]From November 16, 2009

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[1]Deceased August 7, 2009
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[3]From October 19, 2009
[4]To December 31, 2009
[5]From September 1, 2009
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[7]From October 1, 2009
[8]To April 21, 2010
[9]From January 11, 2010
[10]To December 31, 2009
[11]Deceased November 22, 2009
[12]From June 1, 2010
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[15]Deceased May 6, 2010

Bibliography

July 1, 2009 - June 30, 2010

EMBRYOLOGY

Aravin, A. A., G. W. van der Heijden, J. Castaneda, V. V. Vagin, G. J. Hannon, and A. Bortvin, Cytoplasmic compartmentalization of the fetal piRNA pathway in mice, *PLoS Genet. 5*, e100764.

Carten, J. D., and S. A. Farber, A new model system swims into focus: using the zebrafish to visualize intestinal lipid metabolism in vivo, *Clin. Lipidol. 4*, 501-515, 2009.

Cox, R. T., and A. C. Spradling, Clueless, a conserved *Drosophila* gene required for mitochondrial subcellular localization, interacts genetically with parkin, *Dis. Model. Mech. 2*, 490-499, 2009.

Deryusheva, S., and J. G. Gall, Small Cajal body-specific RNAs of *Drosophila* function in the absence of Cajal bodies, *Mol. Biol. Cell 20*, 5250-5259, 2009.

Feng, S., S. J. Cokus, X. Zhang, P. Y. Chen, M. Bostick, M. G. Goll, J. Hetzel, J. Jain, S. H. Strauss, M. E. Halpern, C. Ukomadu, K. C. Sadler, S. Pradhan, M. Pellegrini and S. E. Jacobsen, Conservation and divergence of methylation patterning in plants and animals, *Proc. Natl. Acad. Sci. USA, 107*, 8689-8694, 2010.

Fox, D. T., L. X. Morris, T. Nystul, and A. C. Spradling, Lineage analysis of stem cells, in *Stembook*, L. Girard, ed., p. 32, Harvard Stem Cell Institute, Cambridge, Mass., 2009.

Fox, D. T., and A. C. Spradling, The *Drosophila* hindgut lacks constitutively active adult stem cells but proliferates in response to tissue damage, *Cell Stem Cell 5*, 290-297, 2009.

Gall, J. G., and Z. Wu, Examining the contents of isolated *Xenopus* germinal vesicles, *Methods 51*, 45-51, 2010.

Goll, M. G., R. Anderson, D. Y. Stainier, A. C. Spradling, and M. E. Halpern, Transcriptional silencing and reactivation in transgenic zebrafish, *Genetics 182*, 747-755, 2009.

Han, J. S., Non-long terminal repeat (non-LTR) retrotransposons: mechanisms, recent developments, and unanswered questions, *Mob. DNA 1*, 15, 2010.

Hoang, M. L., F. J. Tan, D. C. Lai, S. E. Celniker, R. A. Hoskins, M. J. Dunham, Y. Zheng, and D. Koshland, Competitive repair by naturally dispersed repetitive DNA during non-allelic homologous recombination, *PLoS Genet.*, *6*, e1001228, 2010

Lepper, C., S. J. Conway, and C. M. Fan, Adult satellite cells and embryonic muscle progenitors have distinct genetic requirements, *Nature 460*, 627-631, 2009.

Lepper, C., and C. M. Fan, Inducible lineage tracing of Pax7-descendant cells reveals embryonic origin of adult satellite cells, *Genesis 48*, 424-436, 2010.

Liu, Z., and Y. Zheng, A requirement for epsin in mitotic membrane and spindle organization, *J. Cell Biol. 186*, 473-480, 2009.

Malki, S., B. Boizet-Bonhoure, and F. Poulat, Shuttling of SOX proteins, *Int. J. Biochem. Cell B. 42*, 411-416, 2009.

Mukhi, S., L. Cai, and D. D. Brown, Gene switching at *Xenopus laevis* metamorphosis, *Dev. Biol. 338,* 117-126, 2010.

Mulligan, T., H. Blaser, E. Raz, and S. A. Farber, Prenylation-deficient G protein gamma subunits disrupt GPCR signaling in the zebrafish, *Cell. Signal. 22*, 221-233, 2010.

Nizami, Z., S. Deryusheva, and J. G. Gall, The Cajal body and histone locus body, *Cold Spring Harb. Perspect. Biol. 2*, a000653, 2010.

Nystul, T., and A. Spradling, Regulation of epithelial stem cell replacement and follicle formation in the *Drosophila* ovary, *Genetics 184*, 503-515, 2010.

Onn, I., V. Guacci, and D. E. Koshland, The zinc finger of Eco1 enhances its acetyltransferase activity during sister chromatid cohesion, *Nucl. Acids Res. 37*, 6126-6134, 2009.

Skora, A. D., and A. C. Spradling, Epigenetic stability increases extensively during *Drosophila* follicle stem cell differentiation, *Proc. Natl. Acad. Sci. USA 107*, 7389-7394, 2010.

Spradling, A., and C. M. Fan, Counterfeiting the family jewels, *Cell Stem Cell 6*, 405-406, 2010.

van der Heijden, G. W., and A. Bortvin, Defending the genome in tudor style, *Dev. Cell 17*, 745-746, 2009.

Vong, Q. P., Z. Liu, J. G. Yoo, R. Chen, W. Xie, A. A. Sharov, C. M. Fan, C. Liu, M. S. Ko, and Y. Zheng, A role for borg5 during trophectoderm differentiation, *Stem Cells 28*, 1030-1038, 2010.

Zheng, Y., A membranous spindle matrix orchestrates cell division, *Nat. Rev. Mol. Cell Biol. 11*, 529-535, 2010.

GEOPHYSICAL LABORATORY

Here updated through September 30, 2010. The list is regularly updated on the Geophysical Laboratory web site (http://www.gl.ciw.edu).

4170 Åberg, D., P. Erhart, J. Crowhurst, J. M. Zaug, A. F. Goncharov, and B. Sadigh, Pressure-induced phase transition in the electronic structure of palladium nitride, *Phys. Rev. B 82,* 104116, 2010.

4104 Ahart, M., H. K. Mao, R. E. Cohen, R. J. Hemley, G. A. Samara, Y. Bing, Z.-G. Ye, and S. Kojima, Pressure effects on relaxor ferroelectricity in disordered $Pb(Sc_{1/2}Nb_{1/2})O_3$, *J. Appl. Phys. 107,* 074110, 2010.

4146 Alexander, C. M. O'D., S. D. Newsome, M. L. Fogel, L. R. Nittler, H. Busemann, and G. D. Cody, Deuterium enrichments in chondritic macromolecular material–Implications for the origin and evolution of organics, water and asteroids, *Geochim. Cosmochim. Acta 74,* 4417-4437, 2010.

4066 Aurioles-Gamboa, D., S. D. Newsome, S. Salazar-Pico, and P. L. Koch, Stable isotope differences between sea lions (*Zalophus*) from the Gulf of California and Galápagos Islands, *J. Mammal. 90,* 1410-1420, 2009.

4072 Baldini, M., G. Aquilanti, H. K. Mao, W. Yang, G. Shen, S. Pascarelli, and W. L. Mao, High-pressure EXAFS study of vitreous GeO_2 up to 44 GPa, *Phys. Rev. B 81,* 024201, 2010.

4052 Bekker, A., M. E. Barley, M. L. Fiorentini, O. J. Rouxel, D. Rumble, and S. W. Beresford, Atmospheric sulfur in Archean komatiite-hosted nickel deposits, *Science 326,* 1086-1089, 2009.

4080 Benmore, C. J., E. Soignard, S. A. Amin, M. Guthrie, S. D. Shastri, P. L. Lee, and J. L. Yarger, Structural and topological changes in silica glass at pressure, *Phys. Rev. B 81,* 054105, 2010.

4048 Busemann, H., A. N. Nguyen, G. D. Cody, P. Hoppe, A. L. D. Kilcoyne, R. M. Stroud, T. J. Zega, and L. R. Nittler, Ultra-primitive interplanetary dust particles from the comet 26P/Grigg-Skjellerup dust stream collection, *Earth Planet. Sci. Lett. 288,* 44-57, 2009.

4094 Catalli, K., S.-H. Shim, V. B. Prakapenka, J. Zhao, W. Sturhahn, P. Chow, Y. Xiao, H. Liu, H. Cynn, and W. J. Evans, Spin state of ferric iron in $MgSiO_3$ perovskite and its effect on elastic properties, *Earth Planet. Sci. Lett. 289,* 68-75, 2010.

4073 Chellappa, R. S., T. Autrey, M. Somayazulu, V. V. Struzhkin, and R. J. Hemley, High-pressure hydrogen interactions with polyaminoborane and polyiminoborane, *ChemPhysChem 11,* 93-96, 2010.

4078 Chellappa, R. S., M. Somayazulu, and R. J. Hemley, Rhenium reactivity in H_2O-O_2 supercritical mixtures at high pressures, *High Pressure Res. 29,* 792-799, 2009.

4067 Chellappa, R. S., M. Somayazulu, V. V. Struzhkin, T. Autrey, and R. J. Hemley, Pressure-induced complexation of NH_3BH_3-H_2, *J. Chem. Phys. 131,* 224515, 2009.

4138 Chen, H., F. Peng, H. K. Mao, G. Shen, H.-P. Liermann, Z. Li, and J. Shu, Strength and elastic moduli of TiN from radial x-ray diffraction under nonhydrostatic compression up to 45 GPa, *J. Appl. Phys. 107,* 113503, 2010.

4163 Chen, X.-J., V. V. Struzhkin, Y. Yu, A. F. Goncharov, C.-T. Lin, H. K. Mao, and R. J. Hemley, Enhancement of superconductivity by pressure-driven competition in electronic order, *Nature 466,* 950-953, 2010.

4046 Cheng, Y. Q., M. Xu, H. W. Sheng, Y. Meng, X. D. Han, and E. Ma, A body-centered-cubic polymorph of the $Ge_2Sb_2Te_5$ phase change alloy, *Appl. Phys. Lett. 95,* 131904, 2009.

____ Ciezak, J. A., T. A. Jenkins, and R. J. Hemley, Optical and Raman microspectroscopy of nitrogen and hydrogen mixtures at high pressures, in *Shock Compression of Condensed Matter 2009,* M. L. Ellert, M. D. Furnish, W. W. Anderson, W.G. Proud and W. T. Butler, eds., AIP Conference Proceedings 1195, American Institute of Physics, in press.

4084 Cleaves, H. J., II, The origin of the biologically coded amino acids, *J. Theor. Biol. 263,* 490-498, 2010.

____ Cleaves, H. J., II, and J. L. Bada, The prebiotic chemistry of alternative nucleic acids, in *Genesis: Origin of Life on Earth and Planets,* J. Seckbach and R. Gordon, eds., Springer, Berlin, in press.

4109 Cleaves, H. J., II, C. M. Jonsson, C. L. Jonsson, D. A. Sverjensky, and R. M. Hazen, Adsorption of nucleic acid components on rutile (TiO_2) surfaces, *Astrobiology 10,* 311-323, 2010.

4088 Cleaves, H. J., II, and A. Lazcano, The origin of biomolecules, in *Chemical Evolution II: From Origins of Life to Modern Society,* L. Zaikowski, J. M. Friedrich, and S. R. Seidel, eds., pp. 17-43, ACS Symposium Series 1025, Oxford University Press, New York, 2009.

4041 Cockell, C. S., A. L. Gronstal, M. A. Voytek, J. D. Kirshtein, K. Finster, W. E. Sanford, M. Glamoclija, G. S. Gohn, D. S. Powars, and J. W. Horton, Jr., Microbial abundance in the deep subsurface of the Chesapeake Bay impact crater: relationship to lithology and impact processes, in *The ICDP-USGS Deep Drilling Project in the Chesapeake Bay Impact Structure: Results from the Eyreville Core Holes,* G. S. Gohn et al., eds., pp. 941-950, Special Paper 458, Geological Society of America, Boulder, Colorado, 2009.

4122 Cuk, T., D. A. Zocco, H. Eisaki, V. Struzhkin, F. M. Grosche, M. B. Maple, and Z.-X. Zhen, Signatures of pressure-induced superconductivity in insulating $Bi_{1.98}Sr_{2.06}Y_{0.68}CaCu_2O_{8+\delta}$, *Phys. Rev. B 81,* 184509, 2010.

4117 Debessai, M., T. Matsuoka, J. J. Hamlin, W. Bi, Y. Meng, K. Shimizu, and J. S. Schilling, Pressure-induced superconductivity in europium metal, *J. Phys.: Conf. Ser. 215,* 012034, 2010.

4124 Degtyareva, O., and V. F. Degtyareva, Modulated structure of β-brass CuZn compressed to 90 GPa, *J. Phys.: Conf. Ser. 226,* 012018, 2010.

4063 Deifel, N. P., and C. L. Cahill, The uranyl tetrachloride anion as a tecton in the assembly of U(VI) hybrid materials, *CrystEngComm 11,* 2739-2744, 2009.

4100 Delaire, O., M. S. Lucas, A. M. dos Santos, A. Subedi, A. S. Sefat, M. A. McGuire, L. Mauger, J. A. Muñoz, C. A. Tulk, Y. Xiao, M. Somayazulu, J. Y. Zhao, W. Sturhahn, E. E. Alp, D. J. Singh, B. C. Sales, D. Mandrus, and T. Egami, Temperature and pressure dependence of the Fe-specific phonon density of states in $Ba(Fe_{1-x}Co_x)_2As_2$, *Phys. Rev. B 81,* 094504, 2010.

4059 Dobrzhinetskaya, L. F., R. Wirth, D. Rhede, Z. Liu, and H. W. Green, Phlogopite and quartz lamellae in diamond-bearing diopside from marbles of the Kokchetav massif, Kazakhstan: exsolution or replacement reaction? *J. Metamorph. Geol. 27,* 607-620, 2009.

____ Dohm, J. M., H. Miyamoto, G. G. Ori, A. G. Fairen, A. F. Davila, G. Komatsu, W. C. Mahaney, J.-P. Williams, S. B. Joye, G. Di Achille, D. Oehler, G. Marzo, D. Schulze-Makuch, V. Acocella, M. Glamoclija, M. Pondrelli, P. Boston, C. R. Allen, R. C. Anderson, V. R. Baker, W. Fink, A. R. Frazer, R. Furfaro, C. H. Gross, T. M. Hare, K. M. Hart, F. Ip, B. P. Kelleher, K. J. Kim, S. Maruyama, P. C. McGuire, D. Netoff, J. Parnell, L. Wendt, S. Wheelock, and A. Steele, An inventory of potentially habitable environments on Mars: geological and biological perspectives, in *Analogs for Planetary Exploration,* B. Gerry and J. Bleacher, eds., Special Paper, Geological Society of America, Boulder, Colorado, in press.

4131 Dorfman, S. M., F. Jiang, Z. Mao, A. Kubo, Y. Meng, V. B. Prakapenka, and T. S. Duffy, Phase transitions and equations of state of alkaline earth fluorides CaF_2, SrF_2, and BaF_2 to Mbar pressures, *Phys. Rev. B 81,* 174121, 2010.

4130 Driver, K. P., R. E. Cohen, Z. Wu, B. Militzer, P. López Ríos, M. D. Towler, R. J. Needs, and J. W. Wilkins, Quantum Monte Carlo computations of phase stability, equations of state, and elasticity of high-pressure silica, *Proc. Natl. Acad. Sci. USA 107,* 9519-9524, 2010.

4154 Ehm, L., M. Vaughan, T. Duffy, Z. Liu, L. Wang, B. Li, D. J. Weidner, Z. Chen, S. Ghose, and Z. Zhong, High-pressure research at the National Synchrotron Light Source, *Synchrotron Radiation News 23 (no. 3),* 24-30, 2010.

4103 Emmons, E. D., J. C. Fallas, V. K. Kamisetty, W.-M. Chien, A. M. Covington, R. S. Chellappa, S. A. Gramsch, R. J. Hemley, and D. Chandra, High-pressure Raman spectroscopy of tris (hydroxymethyl)aminomethane, *J. Phys. Chem. B 114,* 5649-5656, 2010.

4108 Esler, K. P., R. E. Cohen, B. Militzer, J. Kim, R. J. Needs, and M. D. Towler, Fundamental high-pressure calibration from all-electron quantum Monte Carlo calculations, *Phys. Rev. Lett. 104,* 185702, 2010.

4149 Fallas, J. C., W.-M. Chien, D. Chandra, V. K. Kamisetty, E. D. Emmons, A. M. Covington, R. Chellappa, S. A. Gramsch, R. J. Hemley, and H. Hagemann, Raman spectroscopy measurements of the pressure-temperature behavior of $LiAlH_4$, *J. Phys. Chem. C 114,* 11991-11997, 2010.

4043 Foustoukos, D. I., N. J. Pester, K. Ding, and W. E. Seyfried, Jr., Dissolved carbon species in associated diffuse and focused flow hydrothermal vents at the Main Endeavour Field, Juan de Fuca Ridge: phase equilibria and kinetic constraints, *Geochem. Geophys. Geosyst. 10,* Q10003, 10.1029/2009GC002472, 2009.

____ Friedrich, J. M., S. F. Wolf, D. Rumble III, J. Troiano, C. J. L. Gagnon, P. Jenniskens, and M. H. Shaddad, The elemental composition of Almahata Sitta, *Meteorit. Planet. Sci.,* in press.

4070 Fries, M., M. Burchell, A. Kearsley, and A. Steele, Capture effects in carbonaceous material: a Stardust analogue study, *Meteorit. Planet. Sci. 44,* 1465-1474, 2009.

____ Gaillou, E., J. E. Post, N. D. Bassim, A. M. Zaitsev, T. Rose, M. D. Fries, R. M. Stroud, A. Steele, and J. E. Butler, Spectroscopic and microscopic characterizations of color lamellae in natural pink diamonds, *Diamond Rel. Mater.,* in press.

4107 Ganesh, P., E. Cockayne, M. Ahart, R. E. Cohen, B. Burton, R. J. Hemley, Y. Ren, W. Yang, and Z.-G. Ye, Origin of diffuse scattering in relaxor ferroelectrics, *Phys. Rev. B 81,* 144102, 2010.

4050 Gao, L., B. Chen, M. Lerche, E. E. Alp, W. Sturhahn, J. Zhao, H. Yavaş, and J. Li, Sound velocities of compressed Fe_3C from simultaneous synchrotron X-ray diffraction and nuclear resonant scattering measurements, *J. Synchrotron Rad. 16,* 714-722, 2009.

____ Glamoclija, M., L. Marinangeli, and G. Komatsu, Harmakhis Vallis source region, Mars: insights into the recent geothermal history based on geological mapping, *Planet. Space Sci.,* in press.

4044 Goncharov, A. F., J. A. Montoya, N. Subramanian, V. V. Struzhkin, A. Kolesnikov, M. Somayazulu, and R. J. Hemley, Laser heating in diamond anvil cells: developments in pulsed and continuous techniques, *J. Synchrotron Rad. 16,* 769-772, 2009.

____ Goncharov, A. F., V. B. Prakapenka, V. V. Struzhkin, I. Kantor, M. L. Rivers, and D. A. Dalton, X-ray diffraction in the pulsed laser heated diamond anvil cell, *Rev. Sci. Instrum.,* in press.

4126 Goncharov, A. F., V. V. Struzhkin, J. A. Montoya, S. Kharlamova, R. Kundargi, J. Siebert, J. Badro, D. Antonangeli, F. J. Ryerson, and W. Mao, Effect of composition, structure, and spin state on the thermal conductivity of the Earth's lower mantle, *Phys. Earth Planet. Inter. 180,* 148-153, 2010.

4187 Graham, B. S., P. L. Koch, S. D. Newsome, K. W. McMahon, and D. Aurioles, Using isoscapes to trace the movements and foraging behavior of top predators in oceanic ecosystems, in *Isoscapes: Understanding Movement, Pattern, and Process on Earth through Isotope Mapping,* J. B. West et al., eds., pp. 299-318, Springer, Dordrecht, 2010.

4097 Grocholski, B., S.-H. Shim, W. Sturhahn, J. Zhao, Y. Xiao, and P. C. Chow, Spin and valence states of iron in $(Mg_{0.8}Fe_{0.2})SiO_3$ perovskite, *Geophys. Res. Lett. 36,* L24303, 10.1029/2009GL041262, 2009.

____ Gupta, N. S., ed., *Chitin: Formation and Diagenesis,* Springer, in press.

____ Gupta, N. S., Transformation of chitinous tissues in elevated pressure-temperature conditions: additional insights from experiments on plant tissues, in *Chitin: Formation and Diagenesis,* N. S. Gupta, ed., Springer, in press.

____ Gupta, N. S., and G. D. Cody, Identification and characterization of chitin in organisms, in *Chitin: Formation and Diagenesis,* N. S. Gupta, ed., Springer, in press.

4116 Halevy, I., S. Salhov, M. L. Winterrose, A. Broide, A. F Yue, A. Robin, O. Yeheskel, J. Hu, and I. Yaar, High pressure study and electronic structure of the super-alloy $HfIr_3$, *J. Phys.: Conf. Ser. 215,* 012012, 2010.

4110 Han, W.-Q., Z. Liu, and H.-G. Yu, Synthesis and optical properties of GaN/ZnO solid solution nanocrystals, *Appl. Phys. Lett. 96,* 183112, 2010.

4123 Hanson, N., M. Fogel, D. W. Fong, and S. E. MacAvoy, Marine nutrient transport: anadromous fish migration linked to the freshwater amphipod *Gammarus fasciatus*, *Can. J. Zool. 88,* 546-552, 2010.

4075 Hazen, R. M., Evolution of minerals, *Sci. Am. 302 (no.3),* 58-65, 2010.

4087 Hazen, R. M., Chemical evolution: an introduction, in *Chemical Evolution II: From Origins of Life to Modern Society,* L. Zaikowski, J. M. Friedrich, and S. R. Seidel, eds., pp. 3-13, ACS Symposium Series 1025, Oxford University Press, New York, 2009.

4152 Hazen, R. M., How old is the Earth, and how do we know? *Evol. Educ. Outreach 3,* 198-205, 2010.

____ Hazen, R. M., Geochemical origins of life, in *A Geobiology Reader,* A. H. Knoll, K. O. Konhauser, and D. E. Canfield, eds., Wiley-Blackwell, in press.

4092 Hazen, R. M., and N. Eldredge, Themes and variations in complex systems, *Elements 6,* 43-46, 2010.

4042 Hazen, R. M., R. C. Ewing, and D. A. Sverjensky, Evolution of uranium and thorium minerals, *Am. Mineral. 94,* 1293-1311, 2009.

4089 Hazen, R. M., and J. M. Ferry, Mineral evolution: mineralogy in the fourth dimension, *Elements 6,* 9-12, 2010.

____ Hazen, R. M., and D. Papineau, Mineralogical co-evolution of the geo- and biospheres, in *A Geobiology Reader,* A. H. Knoll, K. O. Konhauser, and D. E. Canfield, eds., Wiley-Blackwell, in press.

4159 Hazen, R. M., and D. A. Sverjensky, Mineral surfaces, geochemical complexities, and the origins of life, in *The Origins of Life,* D. Deamer and J. W. Szostak, eds., pp. 157-177, Perspectives in Biology, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., 2010.

4056 Hemley, R. J., G. W. Crabtree, and M. V. Buchanan, Materials in extreme environments, *Phys. Today 63 (no.11),* 32-37, 2009.

____ Jacobsen, S. D., Z. Liu, T. Boffa Ballaran, E. F. Littlefield, L. Ehm, and R. J. Hemley, Effect of water on high-pressure phase transitions in $MgSiO_3$-clinoenstatite: implications for estimating the mantle water content at 270-330 km from the depth of the X-discontinuity, *Phys. Earth Planet. Inter.,* in press.

4181 Janney, P. E., S. B. Shirey, R. W. Carlson, D. G. Pearson, D. R. Bell, A. P. Le Roex, A. Ishikawa, P. H. Nixon, and F. R. Boyd, Age, composition and thermal characteristics of South African off-craton mantle lithosphere: evidence for a multi-stage history, *J. Petrol. 51,* 1849-1890, 2010.

4106 Jiao, Y., G. D. Cody, A. K. Harding, P. Wilmes, M. O. Schrenk, K. E. Wheeler, J. F. Banfield, and M. P. Thelen, Characterization of extracellular polymeric substances from acidophilic microbial biofilms, *Appl. Environ. Microbiol. 76,* 2916-2922, 2010.

4133 Jin, X., X. Meng, Z. He, Y. Ma, B. Liu, T. Cui, G. Zou, and H. K. Mao, Superconducting high-pressure phase of disilane, *Proc. Natl. Acad. Sci. USA 107,* 9969-9973, 2010.

4085 Jonsson, C. M., C. L. Jonsson, C. Estrada, D. A. Sverjensky, H. J. Cleaves, II, and R. M. Hazen, Adsorption of L-aspartate to rutile (α-TiO_2): experimental and theoretical surface complexation studies, *Geochim. Cosmochim. Acta 74,* 2356-2367, 2010.

4055 Jonsson, C. M., C. L. Jonsson, D. A. Sverjensky, H. J. Cleaves, and R. M. Hazen, Attachment of L-glutamate to rutile (α-TiO_2): a potentiometric, adsorption, and surface complexation study, *Langmuir 25,* 12127-12135, 2009.

4168 Kalita, P. E., S. V. Sinogeikin, K. Lipinska-Kalita, T. Hartmann, X. Ke, C. Chen, and A. Cornelius, Equation of state of TiH_2 up to 90 GPa: a synchrotron x-ray diffraction study and *ab initio* calculations, *J. Appl. Phys. 108,* 043511, 2010.

4076 Kim, D. Y., R. H. Scheicher, H. K. Mao, T. W. Kang, and R. Ahuja, General trend for pressurized superconducting hydrogen-dense materials, *Proc. Natl. Acad. Sci. USA 107,* 2793-2796, 2010.

4111 Klepeis, J.-H. P., H. Cynn, W. J. Evans, R. E. Rudd, L. H. Yang, H. P. Liermann, and W. Yang, Diamond anvil cell measurement of high-pressure yield strength of vanadium using *in situ* thickness determination, *Phys. Rev. B 81,* 134107, 2010.

4083 Komabayashi, T., and Y. Fei, Internally consistent thermodynamic database for iron to the Earth's core conditions, *J. Geophys. Res. 115,* B03202, 10.1029/2009JB006442, 2010.

4184 Kumar, R. S., M. Balasubramanian, M. Jacobsen, A. Bommannavar, M. Kanatzidis, S. Yoneda, and A. Cornelius, Structural phase transitions and thermoelectric properties of $AgPb_{18}SbTe_{20}$ under compression, *J. Electron. Mater. 39,* 1828-1831, 2010.

4135 Kumar, R. S., D. Dandekar, A. Leithe-Jasper, T. Tanaka, Y. Xiao, P. Chow, M. F. Nicol, and A. L. Cornelius, Inelastic X-ray scattering experiments on B_4C under high static pressures, *Diamond Rel. Mater. 19,* 530-532, 2010.

4174 Kumar, R. S., X. Ke, J. Zhang, Z. Lin, S. C. Vogel, M. Hartl, S. Sinogeikin, L. Daemen, A. L. Cornelius, C. Chen, and Y. Zhao, Pressure induced structural changes in the potential hydrogen storage compound ammonia borane: a combined X-ray, neutron, and theoretical investigation, *Chem. Phys. Lett. 495,* 203-207, 2010.

____ Kumar, R. S., Y. Zhang, S. Sinogeikin, Y. Xiao, S. Kumar, P. Chow, A. L. Cornelius, and C. Chen, Crystal and electronic structure of FeSe at high pressure and low temperature, *J. Phys. Chem. B,* in press.

____ Kyono, A., Growth and Raman spectroscopic characterization of As_4S_4 (II) single crystals, *J. Crystal Growth,* in press.

4081 Lacomba-Perales, R., D. Errandonea, Y. Meng, and M. Bettinelli, High-pressure stability and compressibility of APO_4 (*A*=La, Nd, Eu, Gd, Er, and Y) orthophosphates: an x-ray diffraction study using synchrotron radiation, *Phys. Rev. B 81,* 064113, 2010.

4158 Lavina, B., P. Dera, R. T. Downs, O. Tschauner, W. Yang, O. Shebanova, and G. Shen, Effect of dilution on the spin pairing transition in rhombohedral carbonates, *High Pressure Res. 30,* 224-229, 2010.

4165 Lavina, B., P. Dera, R. T. Downs, W. Yang, S. Sinogeikin, Y. Meng, G. Shen, and D. Schiferl, Structure of siderite $FeCO_3$ to 56 GPa and hysteresis of its spin-pairing transition, *Phys. Rev. B 82,* 064110, 2010.

4096 Lazicki, A., Y. Fei, and R. J. Hemley, High pressure differential thermal analysis measurements of the melting curve of lithium, *Solid State Commun. 150,* 625-627, 2010.

____ Lazicki, A., R. J. Hemley, W. E. Pickett, and C.-S. Yoo, Structural study of LiB to 70 GPa, *Phys. Rev. B,* in press.

4093 Li, Q., B. Liu, L. Wang, D. Li, R. Liu, B. Zou, T. Cui, G. Zou, Y. Meng, H. K. Mao, Z. Liu, J. Liu, and J. Li, Pressure-induced amorphization and polyamorphism in one-dimensional single-crystal TiO_2 nanomaterials, *J. Phys. Chem. Lett. 1,* 309-314, 2010.

____ Liang, Z., P. Mohanty, Y. Fei, and K. Landskron, Synthesis of coesite nanocrystals from ethane bridged periodic mesoporous organosilica at low temperature and extreme pressure, *Chem. Commun.,* in press.

4186 Liermann, H.-P., A. Jain, A. K. Singh, and S. K. Saxena, Compression of silver in a diamond anvil cell: pressure dependences of strength and grain size from X-ray diffraction data, *J. Phys. Chem. Solids 71,* 1088-1093, 2010.

4045 Liermann, H.-P., S. Merkel, L. Miyagi, H.-R. Wenk, G. Shen, H. Cynn, and W. J. Evans, Experimental method for *in situ* determination of material textures at simultaneous high pressure and high temperature by means of radial diffraction in the diamond anvil cell, *Rev. Sci. Instrum. 80,* 104501, 2009.

4179 Lin, J.-F., Z. Mao, I. Jarrige, Y. Xiao, P. Chow, T. Okuchi, N. Hiraoka, and S. D. Jacobsen, Resonant X-ray emission study of the lower-mantle ferropericlase at high pressures, *Am. Mineral. 95,* 1125-1131, 2010.

4062 Lin, J.-F., H.-R. Wenk, M. Voltolini, S. Speziale, J. Shu, and T. S. Duffy, Deformation of lower-mantle ferropericlase (Mg,Fe)O across the electronic spin transition, *Phys. Chem. Minerals 36,* 585-592, 2009.

4169 Lin, Z. J., L. Wang, J. Zhang, X.-Y. Guo, W. Yang, H. K. Mao, and Y. Zhao, Nanoscale twinning-induced elastic strengthening in silicon carbide nanowires, *Scr. Mater. 63,* 981-984, 2010.

4058 Lin, Z. J., L. Wang, J. Zhang, H. K. Mao, and Y. Zhao, Nanocrystalline tungsten carbide: as incompressible as diamond, *Appl. Phys. Lett. 95,* 211906, 2009.

4185 Litasov, K. D., A. Shatskiy, Y. Fei, A. Suzuki, E. Ohtani, and K. Funakoshi, Pressure-volume-temperature equation of state of tungsten carbide to 32 GPa and 1673 K, *J. Appl. Phys. 108,* 053513, 2010.

4069 Lucas, M. S., O. Delaire, M. L. Winterrose, T. Swan-Wood, M. Kresch, I. Halevy, B. Fultz, J. Hu, M. Lerche, M. Y. Hu, and M. Somayazulu, Effects of vacancies on phonon entropy of *B*2 FeAl, *Phys. Rev. B 80,* 214303, 2009.

4160 Lucas, M. S., J. A. Muñoz, L. Mauger, C. W. Li, A. O. Sheets, Z. Turgut, J. Horwath, D. L. Abernathy, M. B. Stone, O. Delaire, Y. Xiao, and B. Fultz, Effects of chemical composition and *B*2 order on phonons in bcc Fe-Co alloys, *J. Appl. Phys. 108,* 023519, 2010.

4105 Ma, H., X. Zhang, B. Liu, Q. Li, Q. Zeng, S. Yu, B. Zou, T. Cui, G. Zou, Z. Liu, T. Wågberg, B. Sundqvist, and D. Noreus, Synchrotron x-ray diffraction and infrared spectroscopy studies of $C_{60}H_{18}$ under high pressure, *J. Phys. Chem. Lett. 1,* 714-719, 2010.

____ Mao, H. K., E. L. Shirley, Y. Ding, P. Eng, Y. Q. Cai, P. Chow, Y. Xiao, J. Shu, R. J. Hemley, C. Kao, and W. L. Mao, Electronic structure of crystalline ^{4}He at high pressures, *Phys. Rev. Lett.,* in press.

4141 Mao, W. L., Y. Meng, and H. K. Mao, Elastic anisotropy of ferromagnesian post-perovskite in Earth's D″ layer, *Phys. Earth Planet. Inter. 180,* 203-208, 2010.

4132 Mao, W. L., L. Wang, Y. Ding, W. Yang, W. Liu, D. Y. Kim, W. Lou, R. Ahuja, Y. Meng, S. Sinogeikin, J. Shu, and H. K. Mao, Distortions and stabilization of simple-cubic calcium at high pressure and low temperature, *Proc. Natl. Acad. Sci. USA 107,* 9965-9968, 2010.

____ Marshall-Bowman, K., S. Ohara, D. A. Sverjensky, R. M. Hazen, and H. J. Cleaves, Catalytic peptide hydrolysis by mineral surface: implications for prebiotic chemistry, *Geochim. Cosmochim. Acta,* in press.

4129 Mattesini, M., A. B. Belonoshko, E. Buforn, M. Ramírez, S. I. Simak, A. Udías, H. K. Mao, and R. Ahuja, Hemispherical anisotropic patterns of the Earth's inner core, *Proc. Natl. Acad. Sci. USA 107,* 9507-9512, 2010.

4053 Maule, J., N. Wainwright, A. Steele, L. Monaco, H. Morris, D. Gunter, M. Damon, and M. Wells, Rapid culture-independent microbial analysis aboard the International Space Station (ISS), *Astrobiology 9,* 759-775, 2009.

4086 McCubbin, F. M., A. Smirnov, H. Nekvasil, J. Wang, E. Hauri, and D. H. Lindsley, Hydrous magmatism on Mars: a source of water for the surface and subsurface during the Amazonian, *Earth Planet. Sci. Lett. 292,* 132-138, 2010.

4140 McCubbin, F. M., A. Steele, E. H. Hauri, H. Nekvasil, S. Yamashita, and R. J. Hemley, Nominally hydrous magmatism on the Moon, *Proc. Natl. Acad. Sci. USA 107,* 11223-11228, 2010.

4178 McCubbin, F. M., A. Steele, H. Nekvasil, A. Schnieders, T. Rose, M. Fries, P. K. Carpenter, and B. L. Jolliff, Detection of structurally bound hydroxyl in fluorapatite from Apollo Mare basalt 15058,128 using TOF-SIMS, *Am. Mineral. 95,* 1141-1150, 2010.

4176 McMahon, K. W., M. L. Fogel, T. S. Elsdon, and S. R. Thorrold, Carbon isotope fractionation of amino acids in fish muscle reflects biosynthesis and isotopic routing from dietary protein, *J. Anim. Ecol. 79,* 1132-1141, 2010.

4125 Mei, Q., S. Sinogeikin, G. Shen, S. Amin, C. J. Benmore, and K. Ding, High-pressure x-ray diffraction measurements on vitreous GeO_2 under hydrostatic conditions, *Phys. Rev. B 81,* 174113, 2010.

4077 Mohanty, P., Y. Fei, and K. Landskron, On the high-pressure behavior of periodic mesoscale SBA-16 silica/carbon composites: studies at 10 GPa between 25 and 1800°C, *High Pressure Res. 29,* 754-763, 2009.

4120 Mohanty, P., V. Ortalan, N. D. Browning, I. Arslan, Y. Fei, and K. Landskron, Direct formation of mesoporous coesite single crystals from periodic mesoporous silica at extreme pressure, *Angew. Chem. Int. Ed. 49,* 4301-4305, 2010.

4139 Mysen, B., Structure of H_2O-saturated peralkaline aluminosilicate melt and coexisting aluminosilicate-saturated aqueous fluid determined *in-situ* to 800°C and ~800 MPa, *Geochim. Cosmochim. Acta 74,* 4123-4139, 2010.

____ Mysen, B. O., Speciation and mixing behavior of silica-saturated aqueous fluid at high temperature and pressure, *Am. Mineral.,* in press.

4150 Mysen, B. O., and M. L. Fogel, Nitrogen and hydrogen isotope compositions and solubility in silicate melts in equilibrium with reduced (N+H)-bearing fluids at high pressure and temperature: effects of melt structure, *Am. Mineral. 95,* 987-999, 2010.

4147 Mysen, B. O., and S. Yamashita, Speciation of reduced C-O-H volatiles in coexisting fluids and silicate melts determined *in-situ* to ~1.4 GPa and 800°C, *Geochim. Cosmochim. Acta 74,* 4577-4588, 2010.

4180 Newsome, S. D., G. B. Bentall, M. T. Tinker, O. T. Oftedal, K. Ralls, J. A. Estes, and M. L. Fogel, Variation in $\delta^{13}C$ and $\delta^{15}N$ diet-vibrissae trophic discrimination factors in a wild population of California sea otters, *Ecol. Appl. 20,* 1744-1752, 2010.

4172 Newsome, S. D., M. T. Clementz, and P. L. Koch, Using stable isotope biogeochemistry to study marine mammal ecology, *Mar. Mamm. Sci. 26,* 509-572, 2010.

4127 Newsome, S. D., P. W. Collins, T. C. Rick, D. A. Guthrie, J. M. Erlandson, and M. L. Fogel, Pleistocene to historic shifts in bald eagle diets on the Channel Islands, California, *Proc. Natl. Acad. Sci. USA 107,* 9246-9251, 2010.

4148 Newsome, S. D., J.-S. Park, B. W. Henry, A. Holden, M. L. Fogel, J. Linthicum, V. Chu, and K. Hooper, Polybrominated diphenyl ether (PBDE) levels in peregrine falcon (*Falco peregrinus*) eggs from California correlate with diet and human population density, *Environ. Sci. Technol. 44,* 5248-5255, 2010.

4079 Ojwang, J. G. O., S. Chaudhuri, A. C. T. van Duin, Y. J. Chabal, J.-F. Veyan, R. van Santen, G. J. Kramer, and W. A. Goddard, Multiscale modeling of interaction of alane clusters on Al(111) surfaces: a reactive force field and infrared absorption spectroscopy approach, *J. Chem. Phys. 132,* 084509, 2010.

4090 Papineau, D., Mineral environments of the earliest Earth, *Elements 6,* 25-30, 2010.

4102 Papineau, D., Global biogeochemical changes at both ends of the Proterozoic: insights from phosphorites, *Astrobiology 10,* 165-181, 2010.

____ Papineau, D., B. T. De Gregorio, G. D. Cody, M. D. Fries, S. J. Mojzsis, A. Steele, R. M. Stroud, and M. L. Fogel, Ancient graphite in the Eoarchean quartz-pyroxene rock from Akilia in southern West Greenland I: petrographic and spectroscopic characterization, *Geochim. Cosmochim. Acta,* in press.

____ Papineau, D., B. T. De Gregorio, R. M. Stroud, A. Steele, E. Pecoits, K. Konhauser, J. Wang, and M. L. Fogel, Ancient graphite in the Eoarchean quartz-pyroxene rock from Akilia in southern West Greenland II: isotopic and chemical compositions and comparison with Paleoproterozoic banded iron formations, *Geochim. Cosmochim. Acta,* in press.

4136 Pinsky, M. L., S. D. Newsome, B. R. Dickerson, Y. Fang, M. Van Tuinen, D. J. Kennett, R. R. Ream, and E. A. Hadly, Dispersal provided resilience to range collapse in a marine mammal: insights from the past to inform conservation biology, *Mol. Ecol. 19,* 2418-2429, 2010.

4101 Pravica, M., E. Kim, S. Tkachev, P. Chow, and Y. Xiao, High-pressure studies of melamine, *High Pressure Res. 30,* 65-71, 2010.

4118 Pravica, M., E. Romano, S. N. Tkachev, and Z. Liu, High pressure infrared study of 1,3,5,7-cyclooctatetraene (COT), *J. Phys.: Conf. Ser. 215,* 012050, 2010.

____ Qin, L., D. Rumble, C. M. O'D. Alexander, R. W. Carlson, P. Jenniskens, and M. H. Shaddad, The chromium composition of Almahata Sitta, *Meteorit. Planet. Sci.,* in press.

4156 Ravindran, T. R., A. F. Goncharov, M. Somayazulu, and R. J. Hemley, Melting curve of oxygen at high pressure, in *Proceedings of the 54th DAE Solid State Physics Symposium,* A. K. Rajarajan, A. B. Garg, and G. P. Kothiyal, eds., pp. 181-182, Board of Research in Nuclear Sciences, Department of Atomic Energy, Mumbai, India, 2009.

____ Riches, A. J. V., Y. Liu, J. M. D. Day, I. Puchtel, D. Rumble III, H. Y. McSween, R. J. Walker, and L. A. Taylor, Petrology and geochemistry of Yamato 984028: a cumulate lherzolitic shergottite with affinities to Y 000027, Y 000047, and Y 000097, *Polar Sci.,* in press.

____ Riner, M. A., F. M. McCubbin, P. G. Lucey, G. J. Taylor, and J. J. Gillis-Davis, Mercury surface composition: integrating petrologic modeling and remote sensing data to place constraints on FeO abundance, *Icarus,* in press.

4143 Ruiz-Fuertes, J., A. Karandikar, R. Boehler, and D. Errandonea, Microscopic evidence of a flat melting curve of tantalum, *Phys. Earth Planet. Inter. 181,* 69-72, 2010.

____ Rumble, D., M. E. Zolensky, J. M. Friedrich, P. Jenniskens, and M. H. Shaddad, The oxygen isotope composition of Almahata Sitta, *Meteorit. Planet. Sci.,* in press.

4173 Sandford, S. A., S. Bajt, S. J. Clemett, G. D. Cody, G. Cooper, B. T. De Gregorio, V. de Vera, J. P. Dworkin, J. E. Elsila, G. J. Flynn, D. P. Glavin, A. Lanzirotti, T. Limero, M. P. Martin, C. J. Snead, M. K. Spencer, T. Stephan, A. Westphal, S. Wirick, R. N. Zare, and M. E. Zolensky, Assessment and control of organic and other contaminants associated with the Stardust sample return from comet 81P/Wild 2, *Meteorit. Planet. Sci. 45,* 406-433, 2010.

4134 Santamaría-Pérez, D., G. D. Mukherjee, B. Schwager, and R. Boehler, High-pressure melting curve of helium and neon: deviations from corresponding states theory, *Phys. Rev. B 81,* 214101, 2010.

4166 Schwager, B., M. Ross, S. Japel, and R. Boehler, Melting of Sn at high pressure: comparisons with Pb, *J. Chem. Phys. 133,* 084501, 2010.

4099 Sha, X., and R. E. Cohen, First-principles thermal equation of state and thermoelasticity of hcp Fe at high pressures, *Phys. Rev. B 81,* 094105, 2010.

4121 Sha, X., and R. E. Cohen, Elastic isotropy of ε-Fe under Earth's core conditions, *Geophys. Res. Lett. 37,* L10302, 10.1029/2009GL042224, 2010.

4182 Sha, X., and R. E. Cohen, Finite-temperature magnetism in bcc Fe under compression, *J. Phys.: Cond. Matter 22,* 372201, 2010.

4047 Shahar, A., K. Ziegler, E. D. Young, A. Ricolleau, E. A. Schauble, and Y. Fei, Experimentally determined Si isotope fractionation between silicate and Fe metal and implications for Earth's core formation, *Earth Planet. Sci. Lett. 288,* 228-234, 2009.

4054 Sharma, A., G. D. Cody, and R. J. Hemley, *In situ* diamond-anvil cell observations of methanogenesis at high pressures and temperatures, *Energy & Fuels 23,* 5571-5579, 2009.

4115 Shen, G., L. Wang, R. Ferry, H. K. Mao, and R. J. Hemley, A portable laser heating microscope for high pressure research, *J. Phys.: Conf. Ser. 215,* 012191, 2010.

4153 Shen, G., Y. Wang, V. Prakapenka, C. J. Benmore, E. E. Alp, Y. Ding, and W. Yang, High-pressure research at the Advanced Photon Source, *Synchrotron Radiation News 23 (no. 3),* 32-38, 2010.

4112 Shulenburger, L., S. Yu. Savrasov, and R. E. Cohen, Relative importance of crystal field versus bandwidth to the high pressure spin transition in transition metal monoxides, *J. Phys.: Conf. Ser. 215,* 012122, 2010.

4064 Somayazulu, M., P. Dera, A. F. Goncharov, S. A. Gramsch, P. Liermann, W. Yang, Z. Liu, H. K. Mao, and R. J. Hemley, Pressure-induced bonding and compound formation in xenon-hydrogen solids, *Nature Chem. 2,* 50-53, 2010.

4061 Song, Y., C. Murli, and Z. Liu, *In situ* high-pressure study of diborane by infrared spectroscopy, *J. Chem. Phys. 131,* 174506, 2009.

4142 Steele, A., F. M. McCubbin, M. Fries, M. Glamoclija, L. Kater, and H. Nekvasil, Graphite in an Apollo 17 impact melt breccia, *Science 329,* 51, 2010.

4157 Stemshorn, A. K., G. Tsoi, Y. K. Vohra, S. Sinogeikin, P. M. Wu, Y. Huang, S. M. Rao, M.-K. Wu, K. W. Yeh, and S. T. Weir, Low temperature amorphization and superconductivity in FeSe single crystals at high pressures, *J. Mater. Res. 25,* 396-400, 2010.

____ Strobel, T. A., X.-J. Chen, M. Somayazulu, and R. J. Hemley, Vibrational dynamics, intermolecular interactions, and compound formation in GeH_4 - H_2 under pressure, *J. Chem. Phys.,* in press.

4095 Struzhkin, V. V., H. K. Mao, and R. J. Hemley, High-pressure synchrotron x-ray spectroscopy with diamond anvil cells, in *Perspectives in Materials Characterization,* G. Amarendra, B. Raj, and M. H. Manghnani, eds., pp. 151-178, Universities Press (India), Hyderabad, India, 2009.

4114 Subramanian, N., A. F. Goncharov, M. Somayazulu, and R. J. Hemley, Raman spectroscopy of hydrogen confined at extreme conditions, *J. Phys.: Conf. Ser. 215,* 012057, 2010.

4171 Subramanian, N., V. V. Struzhkin, A. F. Goncharov, and R. J. Hemley, A virtual experiment control and data acquisition system for *in situ* laser heated diamond anvil cell Raman spectroscopy, *Rev. Sci. Instrum. 81,* 093906, 2010.

4183 Sun, Y., Y. Ren, D. R. Haeffner, J. D. Almer, L. Wang, W. Yang, and T. T. Truong, Nanophase evolution at semiconductor/electrolyte interface in situ probed by time-resolved high-energy synchrotron X-ray diffraction, *Nano Lett. 10,* 3747-3753, 2010.

4091 Sverjensky, D. A., and N. Lee, The Great Oxidation Event and mineral diversification, *Elements 6,* 31-36, 2010.

4175 Szynkiewicz, A., R. C. Ewing, C. H. Moore, M. Glamoclija, D. Bustos, and L. M. Pratt, Origin of terrestrial gypsum dunes–implications for Martian gypsum-rich dunes of Olympia Undae, *Geomorphology 121,* 69-83, 2010.

4145 Szynkiewicz, A., C. H. Moore, M. Glamoclija, D. Bustos, and L. M. Pratt, Origin of coarsely crystalline gypsum domes in a saline playa environment at the White Sands National Monument, New Mexico, *J. Geophys. Res. 115,* F02021, 10.1029/2009JF001592, 2010.

4040 Szynkiewicz, A., C. H. Moore, M. Glamoclija, and L. M. Pratt, Sulfur isotope signatures in gypsiferous sediments of the Estancia and Tularosa basins as indicators of sulfate sources, hydrological processes, and microbial activity, *Geochim. Cosmochim. Acta 73,* 6162-6186, 2009.

4071 Tang, Y., A. F. Goncharov, V. V. Struzhkin, R. J. Hemley, and M. Ouyang, Spin of semiconductor quantum dots under hydrostatic pressure, *Nano Lett. 10,* 358-362, 2010.

4060 Trefil, J., and R. M. Hazen, *The Sciences: An Integrated Approach,* 6th ed., John Wiley & Sons, Hoboken, N.J., 555 pp., 2010.

____ Trefil, J., and R. M. Hazen, Scientific literacy: a modest proposal, in *Science in the Liberal Arts Curriculum,* J. Hildebrand and J. Meinwald, eds., American Academy of Arts and Sciences, Boston, in press.

4119 Tschauner, O., B. Kiefer, J. McClure, and S. Sinogeikin, Possible formation of crystalline sodium carbene carbonate $Na_2(CO)CO_3$ at high pressure, *J. Phys.: Conf. Ser. 215,* 012129, 2010.

4098 Wang, L., Y. Ding, W. Yang, W. Liu, Z. Cai, J. Kung, J. Shu, R. J. Hemley, W. L. Mao, and H. K. Mao, Nanoprobe measurements of materials at megabar pressures, *Proc. Natl. Acad. Sci. USA 107,* 6140-6145, 2010.

4164 Wang, L., W. Yang, Y. Ding, Y. Ren, S. Xiao, B. Liu, S. V. Sinogeikin, Y. Meng, D. J. Gosztola, G. Shen, R. J. Hemley, W. L. Mao, and H. K. Mao, Size-dependent amorphization of nanoscale Y_2O_3 at high pressure, *Phys. Rev. Lett. 105,* 095701, 2010.

____ Weirich, J. R., A. Wittmann, C. E. Isachsen, D. Rumble, T. D. Swindle, and D. A. Kring, The Ar-Ar age and petrology of Miller Range 05029: evidence for a large impact in the very early solar system, *Meteorit. Planet. Sci.,* in press.

4113 Yamanaka, T., W. L. Mao, H. K. Mao, R. J. Hemley, and G. Shen, New structure and spin state of iron-rich $(Mg,Fe)SiO_3$ post-perovskite, *J. Phys.: Conf. Ser. 215,* 012100, 2010.

4057 Yamanaka, T., T. Mine, S. Asogawa, and Y. Nakamoto, Jahn-Teller transition of Fe_2TiO_4 observed by maximum entropy method at high pressure and low temperature, *Phys. Rev. B 80,* 134120, 2009.

4151 Yoshimura, Y., H. K. Mao, and R. J. Hemley, *In situ* Raman and optical microscopy of the relaxation behavior of amorphous ices under pressure, *J. Raman Spectrosc. 41,* 678-683, 2010.

4051 You, S., Z. Li, L. Yang, C. Dong, L. Chen, C. Jin, J. Hu, G. Shen, and H. K. Mao, High pressure induced coordination evolution in chain compound Li_2CuO_2, *J. Solid State Chem. 182,* 3085-3090, 2009.

4082 Zeng, Q.S., Y. Ding, W. L. Mao, W. Yang, S. V. Sinogeikin, J. Shu, H. K. Mao, and J. Z. Jiang, Origin of pressure-induced polyamorphism in $Ce_{75}Al_{25}$ metallic glass, *Phys. Rev. Lett. 104,* 105702, 2010.

4162 Zeng, Q. S., V. V. Struzhkin, Y. Z. Fang, C. X. Gao, H. B. Luo, X. D. Wang, C. Lathe, W. L. Mao, F. M. Wu, H. K. Mao, and J. Z. Jiang, Properties of polyamorphous $Ce_{75}Al_{25}$ metallic glasses, *Phys. Rev. B 82,* 054111, 2010.

4137 Zhang, C., X.-J. Chen, Y.-L. Li, V. V. Struzhkin, R. J. Hemley, H. K. Mao, R.-Q. Zhang, and H.-Q. Lin, Superconductivity in hydrogen-rich material: GeH_4, *J. Supercond. Novel Magn. 23,* 717-719, 2010.

4155 Zhang, C., X.-J. Chen, Y.-L. Li, V. V. Struzhkin, H. K. Mao, R.-Q. Zhang, and H.-Q. Lin, Structural transitions of solid germane under pressure, *Europhys. Lett. 90,* 66006, 2010.

4177 Zhang, C., X.-J. Chen, R.-Q. Zhang, and H.-Q. Lin, Chemical trend of pressure-induced metallization in alkaline earth hydrides, *J. Phys. Chem. C 114,* 14614-14617, 2010.

4049 Zhang, C., W. Yi, L. Sun, X.-J. Chen, R. J. Hemley, H. K. Mao, W. Lu, X. Dong, L. Bai, J. Liu, A. F. Moreira Dos Santos, J. J. Molaison, C. A. Tulk, G. Chen, N. Wang, and Z. Zhao, Pressure-induced lattice collapse in the tetragonal phase of single-crystalline $Fe_{1.05}Te$, *Phys. Rev. B 80,* 144519, 2009.

4144 Zhang, F. X., M. Lang, Z. Liu, and R. C. Ewing, Pressure-induced disordering and anomalous lattice expansion in $La_2Zr_2O_7$ pyrochlore, *Phys. Rev. Lett. 105,* 015503, 2010.

4161 Zhang, L., P. Mohanty, N. Coombs, Y. Fei, H. K. Mao, and K. Landskron, Catalyst-free synthesis of transparent, mesoporous diamond monoliths from periodic mesoporous carbon CMK-8, *Proc. Natl. Acad. Sci. USA 107,* 13593-13596, 2010.

4065 Zhang, S. J., X. C. Wang, Q. Q. Liu, Y. X. Lv, X. H. Yu, Z. J. Lin, Y. S. Zhao, L. Wang, Y. Ding, H. K. Mao, and C. Q. Jin, Superconductivity at 31 K in "111"-type iron arsenide superconductor $Na_{1-x}FeAs$ induced by pressure, *Eur. Phys. Lett. 88,* 47008, 2009.

4074 Zhao, Q., Y. Fan, G. Wen, Z. Liu, H. Ma, X. Jia, G. Zou, and H. K. Mao, Shape-controlled synthesis of high-purity CrO_2 under HTHP, *Mater. Lett. 64,* 592-595, 2010.

4128 Zhao, Y., J. Zhang, H. Xu, K. A. Lokshin, D. He, J. Qian, C. Pantea, L. L. Daemen, S. C. Vogel, Y. Ding, and J. Xu, High-pressure neutron diffraction studies at LANSCE, *Appl. Phys. A 99,* 585-599, 2010.

4167 Zhuravlev, K. K., K. Traikov, Z. Dong, S. Xie, Y. Song, and Z. Liu, Raman and infrared spectroscopy of pyridine under high pressure, *Phys. Rev. B 82,* 064116, 2010.

____ Zolensky, M., J. Herrin, T. Mikouchi, K. Ohsumi, J. Friedrich, A. Steele, D. Rumble, M. Fries, S. Sandford, S. Milam, K. Hagiya, H. Takeda, W. Satake, T. Kurihara, M. Colbert, R. Hanna, J. Maisano, R. Ketcham, L. Le, G.-A. Robinson, J. Martinez, K. Ross, P. Jenniskens, and M. Shaddad, Mineralogy and petrology of the Almahata Sitta ureilite, *Meteorit. Planet. Sci.,* in press.

4068 Zou, Y., B. Liu, L. Wang, D. Liu, S. Yu, P. Wang, T. Wang, M. Yao, Q. Li, B. Zou, T. Cui, G. Zou, T. Wågberg, B. Sundqvist, and H. K. Mao, Rotational dynamics of confined C_{60} from near-infrared Raman studies under high pressure, *Proc. Natl. Acad. Sci. USA 106,* 22135-22138, 2009.

GLOBAL ECOLOGY

Almeyda Zambrano, A. M., E. N. Broadbent, and W. H. Durham, Social and environmental effects of ecotourism in the Osa Peninsula of Costa Rica: the Lapa Rios case, *J. Ecotourism 9*, 62-83, 2010.

Almeyda Zambrano, A. M., E. N. Broadbent, M. S. Wyman, and W. H. Durham, Ecotourism impacts in the Nicoya Peninsula, Costa Rica, *Int. J. Tourism Res.*, doi:10.1002/jtr.797, 2010.

Anderegg, W. R. L. Good night, sweet trees, *High Country News 42*, 24-25, 2010.

Anderegg, W. R. L., J. W. Prall, J. Harold, and S. H. Schneider, Expert credibility in climate change, *Proc. Natl. Acad. Sci. USA*, doi/10.1073/pnas.1003187107, 2010.

Asner, G. P., Tropical forest carbon assessment: integrating satellite and airborne mapping approaches, *Environ. Res. Lett. 4*, 11, doi:10.1088/1748-9326/4/3/034009, 2009.

Asner, G. P., and A. Alencar, Drought impacts on the Amazon forest: the remote sensing perspective, *New Phytol.,* doi:10.1111/j.1469-8137.2010.03310.x, 2010.

Asner, G. P., and S. Archer, Livestock and the global carbon cycle, in *Livestock in a Changing Landscape: Drivers, Consequences, and Responses*, H. Steinfeld, H. Mooney, F. Schneider, and L. E. Neville, eds., p. 69, Island Press, Washington, D.C., 2010.

Asner, G. P., M. Keller, M. Lentini, F. Merry, and C. Souza, Jr., Selective logging and its relation to deforestation, Amazonia, and global change, *Geophys. Mono. Ser. 186,* 25-42, doi:10.1029/2008GM000723, 2009.

Asner, G. P., S. R. Loarie, and U. Heyder, Combined effects of climate and land-use change on the future of humid tropical forests, *Conserv. Lett. 00*, 1-9, doi:10.1111/j.1755263X,2010, 00133.x, 2010.

Asner, G. P., and R. E. Martin, Airborne spectranomics: mapping canopy chemical and taxonomic diversity in tropical forests, *Front. Ecol. Environ. 7,* doi:10.1890/070152, 2009.

Asner, G. P., R. E. Martin, A. J. Ford, D. J. Metcalfe, and M. J. Liddell, Leaf chemical and spectral diversity in Australian tropical forests, *Ecol. Appl. 19*, 236–253, 2009.

Asner, G. P., G. V. N. Powell, J. Mascaro, D. E. Knapp, J. K. Clark, J. Jacobson, T. Kennedy-Bowdoin, A. Balaji, G. Paez-Acosta, E. Victoria, L. Secada, M. Valqui, and R. F. Hughes, High-resolution forest carbon stocks and emissions in the Amazon, *Proc. Natl. Acad. Sci. USA,* doi:10.1073/pnas.1004875107, 2010.

Asner, G. P., T. K. Rudel, T. M. Aide, R. DeFries, and R. Emerson, A contemporary assessment of change in humid tropical forests, *Conserv. Biol. 23*, 1386-1395, doi:10.1111/j.1523-1739.2009.01333.x, 2009.

Bala, G., K. Caldeira, R. Nemani, L. Cao, G. Ban-Weiss, and H. J. Shin, Albedo enhancement of marine clouds to counteract global warming: impacts on the hydrological cycle, *Clim. Dynam.,* doi:10.1007/s00382-010-0868-1, 2010.

Ban-Weiss., G. A., and K. Caldeira, Geoengineering as an optimization problem, *Environ. Res. Lett. 5,* 034009, doi:10.1088/1748-9326/5/3/034009, 2010.

Barger, N. N., H. A. Adams, C. Woodhouse, J. C. Neff, and G. P. Asner, Influence of livestock grazing and climate on Pinyon Pine (*Pinus edulis*) dynamics, *Rangeland Ecol. Manag. 62*, 531-539, 2009.

Bendick, R., K. M. Dahlin, B. V. Smoliak, L. Kumler, S. J. Jones, A. Aktipis, E. Fugate, R. Hertog, C. Moberg, and D. Scott, Choosing carbon mitigation strategies using ethical deliberation, *Wea. Climate Soc. 2,* 140-147, doi:10.1175/2010WCAS1036.1, 2010.

Berry, J. A., D. J. Beerling, and P. J. Franks, Stomata: key players in the earth system, past and present. *Curr. Opin. Plant Biol. 13,* 223-240, 2010.

Cao, L., G. Bala, G., K. Caldeira, R. Nemani, and G. Ban-Weiss, Importance of carbon dioxide physiological forcing to future climate change, *Proc. Natl. Acad. Sci. USA 107*, 9513-9518, doi:10.1073/pnas.0913000107, 2010.

Cao, L., and K. Caldeira, Atmospheric carbon dioxide removal: long-term consequences and commitment, *Environ. Res. Lett.,* doi:10.1088/1748-9326/5/2/024011, 2010.

Chapin, F. S. I., J. T. Randerson, A. D. McGuire, J. A. Foley, and C. B. Field, Changing feedbacks in the climate-biosphere system, *Front. Ecol. Environ. 6,* 313-320, 2009.

Davis, S. J., K. Caldeira, and H. D. Matthews, Future CO_2 emissions and climate change from existing energy infrastructure, *Science 329*, 1330–1333, doi:10.1126/science.1188566, 2010.

De Santis, A., G. P. Asner, P. J. Vaughan, and D. E. Knapp, Mapping burn severity and burning efficiency in California using simulation models and Landsat imagery, *Remote Sens. Environ. 114,* 1535-1545, 2010.

Flaspohler, D. J., C. P. Giardina, G. P. Asner, P. Hart, J. Price, C. K. Lyons, and X. Castaneda, Long-term effects of fragmentation and fragment properties on bird species richness in Hawaiian forests, *Biol. Conserv. 143*, 280-288, 2010.

Gonzalez, P., G. P. Asner, J. J. Battles, M. A. Lefsky, K. M. Waring, and M. Palace, Forest carbon densities and uncertainties from Lidar, QuickBird, and field measurements in California, *Remote Sens. Environ. 114*, 1561-1575, 2010.

Huang, C., G. P. Asner, N. N. Barger, J. C. Neff, and M. L. Floyd, Regional aboveground live carbon losses due to drought-induced tree dieback in piñon-juniper ecosystems, *Remote Sens. Environ. 114,*1471-1479, 2010.

Koltunov, A., S. L. Ustin, G. P. Asner, and I. Fung, Selective logging changes forest phenology in the Brazilian Amazon: evidence from MODIS image time series analysis, *Remote Sens. Environ. 113*, 2431-2440, 2009.

Levick, S. R., G. P. Asner, O. A. Chadwick, L. M. Khomo, K. H. Rogers, A. S. Hartshorn, T. Kennedy-Bowdoin, and D. E. Knapp, Regional insight into savanna hydrogeomorphology from termite mounds, *Nat. Commun. 1*, 65, doi:10.1038/ncomms1066, 2010.

Loarie, S. R., P. B. Duffy, H. Hamilton, G. P. Asner, C. B. Field, and D. D. Ackerly, The velocity of climate change, *Nature 46,* 1052-1055, 2009.

Pieruschkaa, R., Hubera, G., and J. A. Berry, Control of transpiration by radiation, *Proc. Natl. Acad. Sci. USA*, doi:10.1073/pnas.0913177107, 2010.

Pongratz, J., C. H. Reick, T. Raddatz, and M. Claussen, Biogeophysical versus biogeochemical climate response to historical anthropogenic land cover change, *Geophys. Res. Lett. 37*, L08702, doi:10.1029/2010GL043010, 2010.

Pringle, E. G., R. I. Adams, E. N. Broadbent, P. I. Busby, C. I. Donatti, E. L. Kurten, K. Renton, and R. Dirzo, Distinct leaf-trait syndromes of evergreen and deciduous trees in a seasonally dry tropical forest, *Biotropica*, doi:10.1111/j.1744-7429.2010.00697.x, 2010.

Rudel, T. K., R. DeFries, G. P. Asner, and W. Laurence, Changing drivers of deforestation and new opportunities for conservation, *Conserv. Biol. 23,* 1396-1405, doi:10.1111/j.1523-1739.2009.01332.x, 2009.

Vitousek, P., G. P. Asner, O. A. Chadwick, and S. Hotchkiss, Landscape-level variation in forest structure and biogeochemistry across a substrate age gradient in Hawaii, *Ecology 90,* 3074-3086, 2009.

Vuichard, N., P. Ciais, and A. Wolf, Soil carbon sequestration or biofuel production: new land-use opportunities for mitigating climate over abandoned Soviet farmlands, *Envir. Sci. Tech.*, doi:10.102/es901652t, 2009.

Wolf, A., J. A. Berry, and G. P. Asner, Allometric constraints on sources of variability in multi-angle reflectance measurements, *Remote Sens. Environ. 114,* 1205-1219, 2010.

OBSERVATORIES

Adams, E. R., M. López-Morales, J. L. Elliot, S. Seager, and D. J. Osip, Lack of transit timing variations of OGLE-TR-111b: a re-analysis with six new epochs, *Astrophys. J. 714*, 13, 2010.

Amanullah, R., C. Lidman, D. Rubin, G. Aldering, . . . G. Folatelli, et al., Spectra and Hubble Space Telescope light curves of six type Ia supernova at 0.511 < z < 1.12 and the Union2 compilation, *Astrophys. J. 716*, 712, 2010.

An, D., M. H. Pinsonneault, T. Masseron, F. Delahaye, J. A. Johnson, D. M. Terndrup, T. C. Beers, I. I. Ivans, and Z. Ivezić, Galactic globular and open clusters in the Sloan Digital Sky Survey. II. Test of theoretical stellar isochrones, *Astrophys. J. 700*, 523, 2009.

Anglada-Escudé, G., E. L. Shkolnik, A. J. Weinberger, I. B. Thompson, D. J. Osip, and J. H. Debes, Strong constraints to the putative planet candidate around VB 10 using Doppler spectroscopy, *Astrophys. J. (Lett.) 711*, L24, 2010.

Arias, J. I., R. H. Barbá, R. C. Gamen, N. I. Morrell, et al., On the multiplicity of the zero-age main-sequence O star Herschel 36, *Astrophys. J. (Lett.) 710*, L30, 2010.

Arnold, T. J., P. Martini, J. S. Mulchaey, et al., Active galactic nuclei in groups and clusters of galaxies: detection and host morphology, *Astrophys. J. 707*, 1691, 2009.

Arriagada, P., R. P. Butler, D. Minniti, M. López-Morales, S. A. Shectman, et al., Five long-period extrasolar planets in eccentric orbits from the Magellan Planet Search Program, *Astrophys. J. 711*, 1229, 2010.

Aviles, A., S. Zharikov, G. Tovmassian, R. Michael, M. Tapia, M. Roth, et al., SDSS J123813.73 – 033933.0: a cataclysmic variable evolved beyond the period minimum, *Astrophys. J. 711*, 389, 2010.

Bai, L., J. Rasmussen, J. S. Mulchaey, et al., The first mid-infrared view of the star-forming properties of nearby galaxy groups, *Astrophys. J. 713*, 637, 2010.

Balogh, M. L., S. L. McGee, D. Wilman, R. G. Bower, G. Hau, S. L. Morris, J. S. Mulchaey, A. Oemler, Jr., et al., The colour of galaxies in distant groups, *Mon. Not. Roy. Astron. Soc. 398*, 754, 2009.

Barbá, R. H., R. Gamen, J. I. Arias, N. I. Morrell, et al., Spectroscopic survey of galactic O and WN stars. OWN Survey: new binaries and trapezium-like systems, in *The Interferometric View on Hot Stars*, Rev. Mex. Astron. Astrof. Serie Conf. 38, Th. Rivinius and M. Curé, eds., p. 30, Instituto de Astronomía, Universidad Nacional Autónoma de México, México, D. F., 2010.

Basu-Zych, A. R., D. Schiminovich, S. Heinis, R. Overzier, . . . B. F. Madore, . . . M. Seibert, et al., Studying large- and small-scale environments of ultraviolet luminous galaxies, *Astrophys. J. 699*, 1307, 2009.

Berger, E., A. M. Soderberg, R. A. Chevalier, C. Fransson, . . . I. I. Ivans, J. Simmerer, I. B. Thompson, et al., An intermediate luminosity transient in NGC 300: the eruption of a dust-enshrouded massive star, *Astrophys. J. 699*, 1850, 2009.

Bernstein, R., and A. McWilliam, Detailed chemical abundances of extragalactic globular clusters, in *Globular Clusters – Guides to Galaxies*, T. Richtler and S. Larsen, eds., p. 11, Springer, Heidelberg, Germany, 2009.

Boquien, M., G. Bendo, D. Calzetti, D. Dale, C. Engelbracht, R. Kennicutt, J. C. Lee, et al., Total infrared luminosity estimation of resolved and unresolved galaxies, *Astrophys. J. 713*, 626, 2010.

Boquien, M., D. Calzetti, R. Kennicutt, D. Dale, C. Engelbracht, K. D. Gordon, S. Hong, J. C. Lee, and J. Portouw, Star-forming or starbursting? The ultraviolet conundrum, *Astrophys. J. 706*, 553, 2009.

Boss, A. P., A. J. Weinberger, G. Anglada-Escudé, I. B. Thompson, G. Burley, C. Birk, et al., The Carnegie Astrometric Planet Search Program, *Publ. Astron. Soc. Pac. 121*, 1218, 2009.

Bothwell, M. S., R. C. Kennicutt, Jr., and J. C. Lee, On the interstellar medium and star formation demographics of galaxies in the local universe, *Mon. Not. Roy. Astron. Soc. 400*, 154, 2009.

Bouwens, R. J., G. D. Illingworth, P. A. Oesch, M. Stiavelli, P. van Dokkum, M. Trenti, D. Magee, I. Labbé, et al., Discovery of z ~ 8 galaxies in the Hubble Ultra Deep Field from ultra-deep WFC3/IR observations, *Astrophys. J. (Lett.) 709*, L133, 2010.

Bouwens, R. J., G. D. Illingworth, P. A. Oesch, M. Trenti, M. Stiavelli, C. M. Carollo, M. Franx, P. G. van Dokkum, I. Labbé, and D. Magee, Very blue UV-continuum slope β of low luminosity z ~ 7 galaxies from WFC3/IR: evidence for extremely low metallicities? *Astrophys. J. (Lett.) 708*, L69, 2010.

Brammer, G. B., K. E. Whitaker, P. G. van Dokkum, D. Marchesini, I. Labbé, et al., The dead sequence: a clear bimodality in galaxy colors from z = 0 to z = 2.5, *Astrophys. J. (Lett.) 706*, L173, 2009.

Bresolin, F., G. Stasińska, J. M. Vílchez, J. D. Simon, and E. Rosolowsky, Planetary nebulae in M33: probes of asymptotic giant branch nucleosynthesis and interstellar medium abundances, *Mon. Not. Roy. Aston. Soc. 404*, 1679, 2010.

Bush, S. J., T. J. Cox, et al., Spiral-induced star formation in the outer disks of galaxies, *Astrophys. J. 713*, 780, 2010.

Calzetti, D., S.-Y. Wu, S. Hong, R. C. Kennicutt, J. C. Lee, et al., The calibration of monochromatic far-infrared star formation rate indicators, *Astrophys. J. 714*, 1256, 2010.

Catinella, B., D. Schiminovich, G. Kauffmann, S. Fabello, . . . B. F. Madore, et al., The GALEX Arecibo SDSS Survey–I. Gas fraction scaling relations of massive galaxies and first data release, *Mon. Not. Roy. Astron. Soc. 403*, 683, 2010.

Cescutti, G., F. Matteucci, A. McWilliam, and C. Chiappini, The evolution of carbon and oxygen in the bulge and disk of the Milky Way, *Astron. Astrophys. 505*, 605, 2009.

Chen, H.-W., J. E. Helsby, J.-R. Gauthier, S. A. Shectman, I. B. Thompson, and J. L. Tinker, An empirical characterization of extended cool gas around galaxies using Mg II absorption features, *Astrophys. J. 714*, 1521, 2010.

Chen, H.-W., and J. S. Mulchaey, Probing the intergalactic medium-galaxy connection at z < 0.5. I. A galaxy survey in Qso fields and a galaxy-absorber cross-correlation study, *Astrophys. J. 701*, 1219, 2009.

Cluver, M. E., P. N. Appleton, F. Boulanger, P. Guillard, P. Ogle, P.-A. Duc, N. Lu, J. Rasmussen, et al., Powerful H_2 line cooling in Stephan's Quintet. I. Mapping the significant cooling pathways in group-wide shocks, *Astrophys. J. 710*, 248, 2010.

Cohen, J. G., A. Gould, I. B. Thompson, et al., A puzzle involving Galactic bulge microlensing events, *Astrophys. J. (Lett.) 711*, L48, 2010.

Cohen, J. G., I. B. Thompson, T. Sumi, I. Bond, A. Gould, J. A. Johnson, W. Huang, and G. Burley, Clues to the metallicity distribution in the Galactic bulge: abundances in MOA-2008-BLG-310S and MOA-2008-BLG-311S, *Astrophys. J. 699*, 66, 2009.

Colucci, J. E., R. A. Bernstein, S. Cameron, A. McWilliam, and J. G. Cohen, M31 globular cluster abundances from high-resolution, integrated-light spectroscopy, *Astrophys. J. 704*, 385, 2009.

Contreras, C., M. Hamuy, M. M. Phillips, G. Folatelli, N. B. Suntzeff, S. E. Persson, M. Stritzinger, L. Boldt, S. Gonzalez, W. Krzeminski, N. Morrell, M. Roth, F. Salgado, M. J. Maureira, C. R. Burns, W. L. Freedman, B. F. Madore, D. Murphy, et al., The Carnegie Supernova Project: first photometry data release of low-redshift type Ia supernovae, *Astron. J. 139*, 519, 2010.

Coppin, K., A. Pope, K. Menéndez-Delmestre, et al., Mid-infrared spectroscopy of candidate active galactic nuclei-dominated submillimeter galaxies, *Astrophys. J. 713*, 503, 2010.

Coppin, K., A. Pope, K. Menéndez-Delmestre, et al., Starburst or AGN dominance in submillimetre-luminous candidate AGN? in *Hunting for the Dark: The Hidden Side of Galaxy Formation*, AIP Conf. Proceedings 1240, V. P. Debattista and C. C. Popescu, eds., p. 80, American Institute of Physics, Melville, N.Y., 2010.

Croxall, K. V., L. van Zee, H. Lee, E. D. Skillman, J. C. Lee, et al., Chemical abundances of seven irregular and three tidal dwarf galaxies in the M81 Group, *Astrophys. J. 705*, 723, 2009.

Dale, D. A., S. A. Cohen, L. C. Johnson, M. D. Schuster, . . . J. C. Lee, et al., The Spitzer Local Volume Legacy: survey description and infrared photometry, *Astrophys. J. 703*, 517, 2009.

Damen, M., N. M. Förster Schreiber, M. Franx, I. Labbé, et al., Star formation in the Chandra Deep Field South: observations confront simulations, *Astrophys. J. 705*, 617, 2009.

D'Andrea, C. B., M. Sako, B. Dilday, J. A. Frieman, . . . J. L. Prieto, R. Quimby, A. G. Reiss, M. Stritzinger, et al., Type II-P supernovae from the SDSS-II Supernova Survey and the Standardized Candle Method, *Astrophys. J. 708*, 661, 2010.

Dasyra, K. M., B. M. Peterson, L. J. Tacconi, H. Netzer, L. C. Ho, et al., On the relation between black hole mass and velocity disperson in type 1 and type 2 AGN, in *Co-Evolution of Central Black Holes and Galaxies*, IAU Symp. 267, B. M. Peterson, R. S. Somerville, and T. Storchi-Bergmann, eds., p. 172, Cambridge University Press, Cambridge, 2010.

Dong, R., J. Rasmussen, and J. S. Mulchaey, A systematic search for x-ray cavities in the hot gas of galaxy groups, *Astrophys. J. 712*, 883, 2010.

Dopita, M. A., W. P. Blair, K. S. Long, M. Mutchler, . . . P. McCarthy, et al., Supernova remnants and the interstellar medium of M83: imaging and photometry with the Wide Field Camera 3 on the Hubble Space Telescope, *Astrophys. J. 710*, 964, 2010.

Dopita, M. A., D. Calzetti, J. Maíz Apellániz, W. P. Blair, . . . P. McCarthy, et al., Supernova remnants, planetary nebulae, and the distance to NGC 4214, *Astrophys. Space Sci.,* doi:10.1007/s10509-010-0376-0, 2010.

Dressler, A., A. Oemler, M. G. Gladders, L. Bai, J. R. Rigby, and B. M. Poggianti, Evolution of the rate and mode of star formation in galaxies since $z = 0.7$, *Astrophys. J. (Lett.) 699*, L130, 2009.

Drinkwater, M. J., R. J. Jurek, C. Blake, D. Woods, . . . B. F. Madore, et al., The WiggleZ Dark Energy Survey: survey design and first data release, *Mon. Not. Roy. Astron. Soc. 401*, 1429, 2010.

Driver, S. P., P. Norberg, I. K. Baldry, S. P. Bamford, . . . B. F. Madore, M. Seibert, et al., GAMA: towards a physical understanding of galaxy formation, *Astron. Geophys. 50*, 12, 2009.

Elias-Rosa, N., S. D. Van Dyk, W. Li, N. Morrell, S. González, et al., On the progenitor of the type-II-plateau SN 2008cn in NGC 4603, *Astrophys. J. 706*, 1174, 2009.

Elitzur, M., and L. C. Ho, On the disappearance of the broad-line region in low-luminosity active galactic nuclei, *Astrophys. J. (Lett.) 701*, L91, 2009.

Epstein, C. R., J. A. Johnson, S. Dong, A. Udalski, A. Gould, and G. Becker, Chemical composition of faint (I ~ 21 mag) microlensed bulge dwarf OGLE-2007-BLG-514S, *Astrophys. J. 709*, 447, 2010.

Fariña, C., G. L. Bosch, N. I. Morrell, et al., Spectroscopic study of the N159/N160 complex in the Large Magellanic Cloud, *Astron. J. 138*, 510, 2009.

Fasano, G., D. Bettoni, B. Ascaso, G. Tormen, . . . A. Dressler, et al., The shapes of BCGs and normal ellipticals in nearby clusters, *Mon. Not. Roy. Astron. Soc. 404*, 1490, 2010.

Finkelstein, S. L., C. Papovich, G. Rudnik, E. Egami, E. Le Floc'h, M. J. Rieke, J. R. Rigby, and C. N. A. Willmer, Turning back the clock: inferring the history of the Eight O'clock Arc, *Astrophys. J. 700*, 376, 2009.

Finoguenov, A., J. L. Connelly, L. C. Parker, D. J. Wilman, J. S. Mulchaey, et al., The roadmap for unification in galaxy group selection. I. A search for extended x-ray emission in the CNOC2 Survey, *Astrophys. J. 704*, 564, 2009.

Fiorentino, G., A. Monachesi, S. C. Trager, T. R. Lauer, A. Saha, K. J. Mighell, W. Freedman, A. Dressler, et al., M32: Is there an ancient and metal-poor stellar population? in *Stellar Populations: Planning for the Next Decade*, IAU Symp. 262, G. Bruzual and S. Charlot, eds., p. 333, Cambridge University Press, Cambridge, 2010.

Fiorentino, G., A. Monachesi, S. Trager, T. Lauer, A. Saha, K. Mighell, W. L. Freedman, A. Dressler, et al., M32: Is there an ancient, metal-poor population? in *Stellar Pulsation: Challenges for Theory and Observation*, AIP Conf. Proceedings 1170, J. A. Guzik and P. A. Bradley, eds., p. 216, American Institute of Physics, Melville, N.Y., 2009.

Fiorentino, G., A. Monachesi, S. C. Trager, T. R. Lauer, A. Saha, K. J. Mighell, W. Freedman, A. Dressler, et al., RR Lyrae variables in M32 and the disk of M31, *Astrophys. J. 708*, 817, 2010.

Firpo, V., G. Bosch, G. Hägele, Á. I. Díaz, and N. Morrell, Haro 15: Is it actually a low metallicity galaxy? in *Chemical Abundances in the Universe: Connecting First Stars to Planets*, IAU Symp. 265, K. Cunha, M. Spite, and B. Barbuy, eds., p. 243, Cambridge University Press, Cambridge, 2010.

Floyd, D. J. E., et al., The accretion disc in the quasar SDSS J0924+0219, *Mon. Not. Roy. Astron. Soc. 398*, 233, 2009.

Floyd, D. J. E., J. Thomas-Osip, and G. Prieto, Seeing, wind, and other scale effects on image quality at the Magellan Telescopes, *Publ. Astron. Soc. Pac. 122*, 731, 2010.

Folatelli, G., M. M. Phillips, C. R. Burns, C. Contreras, M. Hamuy, W. L. Freedman, S. E. Persson, M. Stritzinger, N. B. Suntzeff, K. Krisciunas, L. Boldt, S. Gonzalez, W. Krzeminski, N. Morrell, M. Roth, F. Salgado, B. F. Madore, D. Murphy, et al., The Carnegie Supernova Project: analysis of the first sample of low-redshift type Ia supernovae, *Astron. J. 139*, 120, 2010.

Frebel, A., E. N. Kirby, and J. D. Simon, Linking dwarf galaxies to halo building blocks with the most metal-poor star in Sculptor, *Nature 464*, 72, 2010.

Frebel, A., J. D. Simon, et al., Extremely metal-poor Cambridge University Press, Cambridge, 2010.

Frebel, A., J. D. Simon, et al., High-resolution spectroscopy of extremely metal-poor stars in the least evolved galaxies: Ursa Major II and Coma Berenices, *Astrophys. J. 708*, 560, 2010.

Freedman, W. L., C. R. Burns, M. M. Phillips, P. Wyatt, S. E. Persson, B. F. Madore, C. Contreras, G. Folatelli, E. S. Gonzalez, M. Hamuy, E. Hsiao, D. D. Kelson, N. Morrell, D. C. Murphy, M. Roth, M. Stritzinger, L. Sturch, N. B. Suntzeff, P. Astier, C. Balland, B. Bassett, L. Boldt, et al., The Carnegie Supernova Project: first near-infrared Hubble diagram to z ~ 0.7, *Astrophys. J. 704*, 1036, 2009.

González, V., I. Labbé, et al., The stellar mass density and specific star formation rate of the universe at z ~ 7, *Astrophys. J. 713*, 115, 2010.

Green, P. J., A. D. Myers, W. A. Barkhouse, J. S. Mulchaey, V. N. Bennert, T. J. Cox, and T. L. Aldcroft, SDSS J1254+0846: a binary quasar caught in the act of merging, *Astrophys. J. 710*, 1578, 2010.

Greene, J. E., and L. C. Ho, Active galaxies and the study of black hole demographics, *Publ. Astron. Soc. Pac. 121*, 1167, 2009.

Greene, J. E., N. L. Zakamska, X. Liu, A. J. Barth, and L. C. Ho, The growth of black holes: insights from obscured active galaxies, *Astrophys. J. 702*, 441, 2009.

Haehnelt, M. G., M. Rauch, A. Bunker, G. Becker, et al., Pushing FORS to the limit – A new population of faint extended Lyα emitters at z ~ 3, in *Science with the VLT in the ELT Era*, A. Moorwood, ed., p. 23, Springer, Dordrecht, 2009.

Hamuy, M., J. Deng, P. A. Mazzali, N. I. Morrell, M. M. Phillips, M. Roth, S. González, J. Thomas-Osip, W. Krzeminski, C. Contreras, J. Maza, L. González, L. Huerta, G. Folatelli, R. Chornock, A. V. Filippenko, S. E. Persson, W. L. Freedman, K. Koviak, et al., Supernova 2003bg: the first type IIb hypernova, *Astrophys. J. 703*, 1612, 2009.

Hayward, C. C., P. Jonsson, K. Noeske, S. Wuyts, T. J. Cox, et al., Testing star formation rate indicators using galaxy merger simulations and radiative transfer, in *Stellar Populations: Planning for the Next Decade*, IAU Symp. 262, G. Bruzual and S. Charlot, eds., p. 257, Cambridge University Press, Cambridge, 2010.

Hester, J. A., M. Seibert, J. D. Neill, T. K. Wyder, A. Gil de Paz, B. F. Madore, et al., IC 3418: star formation in a turbulent wake, *Astrophys. J. (Lett.) 716*, L14, 2010.

Ho, L. C., Origin and dynamical support of ionized gas in galaxy bulges, *Astrophys. J. 699*, 638, 2009.

Ho, L. C., Radiatively inefficient accretion in nearby galaxies, *Astrophys. J. 699*, 626, 2009.

Ho, L. C., et al., A search for "dwarf" Seyfert nuclei. VII. A catalog of central stellar velocity dispersions of nearby galaxies, *Astrophys. J. Suppl. Ser. 183*, 1, 2009.

Ho, L. C., and M. Kim, Magellan spectroscopy of low-redshift active galactic nuclei, *Astrophys. J. Suppl. Ser. 184*, 398, 2009.

Höflich, P., K. Krisciunas, A. M. Khokhlov, E. Baron, G. Folatelli, M. Hamuy, M. M. Phillips, et al., Secondary parameters of type Ia supernova light curves, *Astrophys. J. 710*, 444, 2010.

Howell, J. H., L. Armus, J. M. Mazzarella, A. S. Evans, . . . B. F. Madore, et al., The Great Observatories All-sky LIRG Survey: comparison of ultraviolet and far-infrared properties, *Astrophys. J. 715*, 572, 2010.

Kajisawa, M., T. Ichikawa, I. Tanaka, M. Konishi, . . . M. Ouchi, et al., MOIRCS Deep Survey. IV. Evolution of galaxy stellar mass function back to $z \sim 3$, *Astrophys. J. 702*, 1393, 2009.

Kaluzny, J., M. Rozyczka, I. B. Thompson, and K. Zloczewski, An unusual eclipsing blue straggler V8-NGC 6752, *Acta Astron. 59*, 371, 2009.

Kaluzny, J., and I. B. Thompson, Variable stars in the globular cluster NGC 6752, *Acta Astron. 59*, 273, 2009.

Kelson, D. D., and B. P. Holden, The mid-infrared luminosities of normal galaxies over cosmic time, *Astrophys. J. (Lett.) 713*, L28, 2010.

Kennicutt, Jr., R. C., C.-N. Hao, D. Calzetti, J. Moustakas, D. A. Dale, G. Bendo, C. W. Engelbracht, B. D. Johnson, and J. C. Lee, Dust-corrected star formation rates of galaxies. I. Combinations of Hα and infrared tracers, *Astrophys. J. 703*, 1672, 2009.

Kerber, F., M. Roth, et al., On the distribution of dust in the "born-again" planetary nebula A 30, in *The Biggest, Baddest, Coolest Stars*, ASP Conf. Series 412, D. G. Luttermoser, B. J. Smith, and R. E. Stencel, eds., p. 235, Astronomical Society of the Pacific, San Francisco, 2009.

Khan, R., K. Z. Stanek, J. L. Prieto, et al., Census of self-obscured massive stars in nearby galaxies with Spitzer: implications for understanding the progenitors of SN 2008S-like transients, *Astrophys. J. 715*, 1094, 2010.

Kinemuchi, K., G. Wallerstein, G. Preston, et al., Spectroscopic study of NSVS RR Lyrae stars: preliminary metallicity results, in *Stellar Pulsation: Challenges for Theory and Observation*, AIP Conf. Proceedings 1170, J. A. Guzik and P. A. Bradley, eds., p. 191, American Institute of Physics, Melville, N.Y., 2009.

Koch, A., P. Côté, and A. McWilliam, All quiet in the outer halo: chemical abundances in the globular cluster Pal 3, *Astron. Astrophys. 506*, 729, 2009.

Koch, A., and A. McWilliam, A differential chemical abundance scale for the globular cluster M5, *Astron. J. 139*, 2289, 2010.

Koenigsberger, G., L. Georgiev, D. J. Hillier, N. Morrell, et al., A ~ 40 year variability cycle in the luminous blue variable/Wolf-Rayet binary system HD 5980? *Astron. J. 139*, 2600, 2010.

Kollmeier, J. A., et al., Lyα emission from cosmic structure. I. Fluorescence, *Astrophys. J. 708*, 1048, 2010.

Kollmeier, J. A., A. Gould, S. Shectman, I. B. Thompson, G. W. Preston, J. D. Simon, J. D. Crane, et al., Spectroscopic confirmation of the Pisces overdensity, *Astrophys. J. (Lett.) 705*, L158, 2009.

Kriek, M., P. G. van Dokkum, I. Labbé, et al., An ultra-deep near-infrared spectrum of a compact quiescent galaxy at $z = 2.2$, *Astrophys. J. 700*, 221, 2009.

Krisciunas, K., G. H. Marion, N. B. Suntzeff, G. Blanc, . . . L. Gonzalez, S. Gonzalez, . . . N. Morrell, M. M. Phillips, M. Stritzinger, and J. Thomas-Osip, The fast declining type Ia supernova 2003gs, and evidence for a significant dispersion in near-infrared absolute magnitudes of fast decliners at maximum light, *Astron. J. 138*, 1584, 2009.

Labbé, I., Dissecting the formation histories of galaxies with stellar populations models, in *Stellar Populations: Planning for the Next Decade*, IAU Symp. 262, G. Bruzual and S. Charlot, eds., p. 153, Cambridge University Press, Cambridge, 2010.

Labbé, I., et al., Star formation rates and stellar masses of $z = 7$-8 galaxies from IRAC observations of the WFC3/IR early release science and the HUDF fields, *Astrophys. J. (Lett.) 716*, L103, 2010.

Labbé, I., et al., Ultradeep Infrared Array Camera observations of sub-L^* $z \sim 7$ and $z \sim 8$ galaxies in the Hubble Ultra Deep Field: the contribution of low-luminosity galaxies to the stellar mass density and reionization, *Astrophys. J. (Lett.) 708*, L26, 2010.

Lal, D. V., and L. C. Ho, The radio properties of type 2 quasars, *Astron. J. 139*, 1089, 2010.

Lampeitl, H., R. C. Nichol, H.-J. Seo, T. Giannantonio, . . . M. Stritzinger, et al., Five-year Sloan Digital Sky Survey-II supernova results: consistency and constraints with other intermediate-redshift data sets, *Mon. Not. Roy. Astron. Soc. 401*, 2331, 2010.

Lee, J. C., et al., Comparison of Hα and UV star formation rates in the local volume: systematic discrepancies for dwarf galaxies, *Astrophys. J. 706*, 599, 2009.

Leloudas, G., M. D. Stritzinger, J. Sollerman, C. R. Burns, . . . M. M. Phillips, . . . J. Thomas-Osip, et al., The normal type Ia SN 2003hv out to very late phases, *Astron. Astrophys. 505*, 265, 2009.

Levesque, E. M., A. M. Soderberg, R. J. Foley, E. Berger, . . . M. D. Stritzinger, et al., The high-metallicity explosion environment of the relativistic supernova 2009bb, *Astrophys. J. (Lett.) 709*, L26, 2010.

Linnell, A. P., P. Szkody, R. M. Plotkin, J. Holtzman, M. Seibert, et al., GALEX and optical light curves of WX LMi, SDSSJ103100.5+202832.2, and SDSSJ121209.31+013627.7, *Astrophys. J. 713*, 1183, 2010.

Lotz, J. M., P. Jonsson, T. J. Cox, and J. R. Primack, The effect of gas fraction on the morphology and time-scales of disc galaxy mergers, *Mon. Not. Roy. Astron. Soc. 404*, 590, 2010.

Lotz, J. M., P. Jonsson, T. J. Cox, and J. R. Primack, The effect of mass ratio on the morphology and time-scales of disc galaxy mergers, *Mon. Not. Roy. Astron. Soc. 404*, 575, 2010.

Madore, B. F., Sigma One, *Astron. J. 139*, 2052, 2010.

Madore, B. F., Star formation timescales and the Schmidt Law, *Astrophys. J. (Lett.) 716*, L131, 2010.

Marble, A. R., C. W. Engelbracht, L. van Zee, D. A. Dale, J. D. T. Smith, K. D. Gordon, Y. Wu, J. C. Lee, et al., An aromatic inventory of the local volume, *Astrophys. J. 715*, 506, 2010.

Marchesini, D., P. G. van Dokkum, N. M. Förster Schreiber, M. Franx, I. Labbé, and S. Wuyts, The evolution of the stellar mass function of galaxies from $z = 4.0$ and the first comprehensive analysis of its uncertainties: evidence for mass-dependent evolution, *Astrophys. J. 701*, 1765, 2009.

Martini, P., G. R. Sivakoff, and J. S. Mulchaey, The evolution of active galactic nuclei in clusters of galaxies to redshift 1.3, *Astrophys. J. 701*, 66, 2009.

Mason, E., M. Diaz, R. E. Williams, G. Preston, and T. Bensby, The peculiar nova V1309 Scorpii/nova Scorpii 2008: a candidate twin of V838 Monocerotis, *Astron. Astrophys. 516,* 108, 2010.

Maurer, J. I., P. A. Mazzali, J. Deng, A. V. Filippenko, . . . M. Stritzinger, et al., Characteristic velocities of stripped-envelope core-collapsed supernova cores, *Mon. Not. Roy. Astron. Soc. 402*, 161, 2010.

McWilliam, A., et al., Chemical composition of the galactic bulge in Baade's Window, in *Chemical Abundances in the Universe: Connecting First Stars to Planets*, IAU Symp. 265, K. Cunha, M. Spite, and B. Barbuy, eds., p. 279, Cambridge University Press, Cambridge, 2010.

Mendel, J. T., R. N. Proctor, J. Rasmussen, et al., The anatomy of the NGC 5044 group–II. Stellar populations and star formation histories, *Mon. Not. Roy. Astron. Soc. 396*, 2103, 2009.

Menéndez-Delmestre, K., et al., Mid-infrared spectroscopy of submillimeter galaxies: extended star formation in massive high-redshift galaxies, *Astrophys. J. 699*, 667, 2009.

Menéndez-Delmestre, K., et al., OSIRIS view of submillimeter galaxies: a 2-D spectroscopic insight to starburst galaxies in the high-redshift universe, in *Co-Evolution of Central Black Holes and Galaxies*, IAU Symp. 267, B. M. Peterson, R. S. Somerville, and T. Storchi-Bergmann, eds., p. 46, Cambridge University Press, Cambridge, 2010.

Mentuch, E., R. G. Abraham, K. Glazebrook, P. J. McCarthy, et al., A near-infrared excess in the continuum of high-redshift galaxies: a tracer of star formation and circumstellar disks? *Astrophys. J. 706*, 1020, 2009.

Monachesi, A., S. C. Trager, T. R. Lauer, W. Freedman, A. Dressler, et al., The stellar populations of M32: resolving the nearest elliptical with HST ACS/HRC, in *Stellar Populations: Planning for the Next Decade*, IAU Symp. 262, G. Bruzual and S. Charlot, eds., p. 135, Cambridge University Press, Cambridge, 2010.

Mulchaey, J. S., and T. E. Jeltema, Hot gas halos in early-type field galaxies, *Astrophys. J. (Lett.) 715*, L1, 2010.

Mulchaey, J. S., and T. E. Jeltema, Hot gas halos in galaxies, in *Hunting for the Dark: The Hidden Side of Galaxy Formation*, AIP Conf. Proceedings 1240, V. P. Debattista and C. C. Popescu, eds., p. 146, American Institute of Physics, Melville, N.Y., 2010.

Muñoz-Mateos, J. C., A. Gil de Paz, S. Boissier, J. Zamorano, D. A. Dale, P. G. Pérez-González, J. Gallego, B. F. Madore, et al., Radial distribution of stars, gas, and dust in SINGS galaxies. II. Derived dust properties, *Astrophys. J. 701*, 1965, 2009.

Muñoz-Mateos, J. C., A. Gil de Paz, S. Boissier, J. Zamorano, . . . B. F. Madore, et al., Radial distribution of dust properties in nearby galaxies, in *Highlights of Spanish Astrophysics V*, J. M Diego et al., eds., p. 323, Springer, Heidelberg, 2010.

Muñoz-Mateos, J. C., A. Gil de Paz, J. Zamorano, S. Boissier, . . . B. F. Madore, et al., Radial distribution of stars, gas, and dust in SINGS galaxies. I. Surface photometry and morphology, *Astrophys. J. 703*, 1569, 2009.

Muzzin, A., D. Marchesini, P. G. van Dokkum, I. Labbé, et al., A near-infrared spectroscopic survey of K-selected galaxies at $z \sim 2.3$: comparison of stellar population synthesis codes and constraints from the rest-frame NIR, *Astrophys. J. 701*, 1839, 2009.

Muzzin, A., P. van Dokkum, M. Franx, D. Marchesini, M. Kriek, and I. Labbé, How massive are massive compact galaxies? *Astrophys. J. (Lett.) 706*, L188, 2009.

Neill, J. D., M. Sullivan, D. A. Howell, A. Conley, M. Seibert, . . . B. F. Madore, et al., The local hosts of type Ia supernovae, *Astrophys. J. 707*, 1449, 2009.

O'Dowd, M. J., D. Schiminovich, B. D. Johnson, M. A. Treyer, . . . M. Seibert, et al., Polycyclic aromatic hydrocarbons in galaxies at $z \sim 0.1$: the effect of star formation and active galactic nuclei, *Astrophys. J. 705*, 885, 2009.

Oesch, P. A., R. J. Bouwens, C. M. Carollo, G. D. Illingworth, M. Trenti, M. Stiavelli, D. Magee, I. Labbé, and M. Franx, Structure and morphologies of $z \sim 7$-8 galaxies from ultra-deep WFC3/IR imaging of the Hubble Ultra-deep Field, *Astrophys. J. (Lett.) 709*, L21, 2010.

Oesch, P. A., R. J. Bouwens, G. D. Illingworth, C. M. Carollo, M. Franx, I. Labbé, et al., $z \sim 7$ galaxies in the HUDF: first epoch WFC3/IR results, *Astrophys. J. (Lett.) 709*, L16, 2010.

Olivares E., F., M. Hamuy, G. Pignata, J. Maza, M. Bersten, M. M. Phillips, N. B. Suntzeff, A. V. Filippenko, N. I. Morrell, et al., The standardized candle method for type II plateau supernovae, *Astrophys. J. 715*, 833, 2010.

Ono, Y., M. Ouchi, K. Shimasaku, M. Akiyama, J. Dunlop, D. Farrah, J. C. Lee, et al., Stellar populations of Lyα emitters at $z = 3$-4 based on deep large area surveys in the Subaru-SXDS/UKIDSS-UDS Field, *Mon. Not. Roy. Astron. Soc. 402*, 1580, 2010.

Ouchi, M., et al., Large area survey for $z = 7$ galaxies in SDF and GOODS-N: implications for galaxy formation and cosmic reionization, *Astrophys. J. 706*, 1136, 2009.

Overzier, R. A., T. M. Heckman, C. Tremonti, L. Armus, . . . B. Madore, M. Seibert, et al., Local Lyman break galaxy analogs: the impact of massive star-forming clumps on the interstellar medium and the global structure of young, forming galaxies, *Astrophys. J. 706*, 203, 2009.

Papovich, C., I. Momcheva, C. N. A. Willmer, K. D. Finkelstein, . . . P. McCarthy, et al., A Spitzer-selected galaxy cluster at $z = 1.62$, *Astrophys. J. 716*, 1503, 2010.

Papovich, C., G. Rudnik, J. R. Rigby, et al., Paschen-α emission in the gravitationally lensed galaxy SMM J163554.2+661225, *Astrophys. J. 704*, 1506, 2009.

Patel, S. G., B. P. Holden, D. D. Kelson, et al., The dependence of star formation rates on stellar mass and environment at $z \sim 0.8$, *Astrophys. J. (Lett.) 705*, L67, 2009.

Peng, C. Y., L. C. Ho, et al., Detailed decomposition of galaxy images. II. Beyond axisymmetric models, *Astron. J. 139*, 2097, 2010.

Preston, G. W., A few binary star puzzles for Roberto on the occasion of his birthday, *Publ. Astron. Soc. Aust. 26*, 372, 2009.

Preston, G. W., Helium lines in RR Lyrae spectra, *Astron. Astrophys. 507*, 1621, 2009.

Rasmussen, J., and T. J. Ponman, Temperature and abundance profiles of hot gas in galaxy groups–II. Implications for feedback and ICM enrichment, *Mon. Not. Roy. Astron. Soc. 399*, 239, 2009.

Rasmussen, J., and T. Ponman, The environmental impact of galaxy evolution, in *Galaxy Evolution: Emerging Insights and Future Challenges*, ASP Conf. Series 419, S. Jogee et al., eds., p. 415, Astronomical Society of the Pacific, San Francisco, 2009.

Rey, S.-C., S. T. Sohn, M. A. Beasley, Y.-W. Lee, . . . M. Seibert, . . . B. F. Madore, et al., Probing the intermediate-age globular clusters in NGC 5128 from ultraviolet observations, *Astrophys. J. (Lett.) 700*, L11, 2009.

Rigby, J. R., et al., Calibration of [O IV] 26 μm as a measure of intrinsic active galactic nucleus luminosity, *Astrophys. J. 700*, 1878, 2009.

Roederer, I. U., C. Sneden, I. B. Thompson, G. W. Preston, and S. A. Shectman, Characterizing the chemistry of the Milky Way stellar halo: detailed chemical analysis of a metal-poor stellar stream, *Astrophys. J. 711*, 573, 2010.

Roederer, I. U., C. Sneden, I. B. Thompson, G. W. Preston, and S. A. Shectman, Detailed chemical abundances in a metal-poor stellar stream, in *Chemical Abundances in the Universe: Connecting First Stars to Planets*, IAU Symp. 265, K. Cunha, M. Spite, and B. Barbuy, eds., p. 368, Cambridge University Press, Cambridge, 2010.

Rozyczka, M., J. Kaluzny, P. Pietrukowicz, W. Pych, B. Mazur, M. Catelan, and I. B. Thompson, A new lower main sequence eclipsing binary with detached components, *Acta Astron. 59*, 385, 2009.

Salim, S., M. Dickinson, R. M. Rich, S. Charlot, J. C. Lee, et al., Mid-IR luminosities and UV/optical star formation rates at $z < 1.4$, *Astrophys. J. 700*, 161, 2009.

Sandage, A., The Tolman Surface Brightness Test for the reality of the expansion. V. Provenance of the test and a new representation of the data for three remote Hubble Space Telescope galaxy clusters, *Astron. J. 139*, 728, 2010.

Sandage, A., B. Reindl, and G. A. Tammann, The linearity of the cosmic expansion field from 300 to 30,000 km s^{-1} and the bulk motion of the local supercluster with respect to the cosmic microwave background, *Astrophys. J. 714*, 1441, 2010.

Sarajedini, A., C. L. Mancone, T. R. Lauer, A. Dressler, W. Freedman, et al., RR Lyrae variables in two fields in the spheroid of M31, *Astron. J. 138*, 184, 2009.

Scarlata, C., J. Colbert, H. I. Teplitz, C. Bridge, P. Francis, P. Palunas, et al., He II emission in Lyα nebulae: active galactic nucleus or cooling radiation? *Astrophys. J. 706*, 1241, 2009.

Schörck, T., N. Christlieb, J. G. Cohen, T. C. Beers, S. Shectman, I. Thompson, A. McWilliam, et al., The stellar content of the Hamburg/ESO Survey. V. The metallicity distribution function of the galactic halo, *Astron. Astrophys. 507*, 817, 2009.

Sheen, Y.-K., H. Jeong, S. K. Yi, I. Ferreras, . . . B. F. Madore, . . . M. Seibert, et al., Tidal dwarf galaxies around a post-merger galaxy, NGC 4922, *Astron. J. 138*, 1911, 2009.

Shi, Y., G. H. Rieke, P. Smith, J. Rigby, et al., Unobscured type 2 active galactic nuclei, *Astrophys. J. 714*, 115, 2010.

Silverman, J. M., P. Mazzali, R. Chornock, A. V. Filippenko, A. Clocchiatti, M. M. Phillips, et al., Optical spectroscopy of the somewhat peculiar type IIb supernova 2001ig, *Publ. Astron. Soc. Pac. 121*, 689, 2009.

Simon, J. D., et al., Variable sodium absorption in a low-extinction type Ia supernova, *Astrophys. J. 702*, 1157, 2009.

Simon, J. D., A. Frebel, A. McWilliam, E. N. Kirby, and I. B. Thompson, High-resolution spectroscopy of extremely metal-poor stars in the least evolved galaxies: Leo IV, *Astrophys. J. 716*, 446, 2010.

Soderberg, A. M., S. Chakraborti, G. Pignata, R. A. Chevalier, . . . M. D. Stritzinger, et al., A relativistic type Ibc supernova without a detected γ-ray burst, *Nature 463*, 513, 2010.

Szomoru, D., M. Franx, P. G. van Dokkum, M. Trenti, G. D. Illingworth, I. Labbé, et al., Confirmation of the compactness of a $z = 1.91$ quiescent galaxy with Hubble Space Telescope's Wide Field Camera 3, *Astrophys. J. (Lett.) 714*, L244, 2010.

Tammann, G. A., and A. Sandage, The Hubble Constant and HST, in *The Impact of HST on European Astronomy*, F. D. Macchetto, ed., p. 289, Springer, Dordrecht, 2010.

Taylor, E. N., M. Franx, P. G. van Dokkum, R. F. Quadri, . . . I. Labbé, et al., A public, K-selected, optical-to-near-infrared catalog of the Extended Chandra Deep Field South (ECDFS) from the Multiwavelength Survey by Yale-Chile (MUSYC), *Astrophys. J. Suppl. Ser. 183*, 295, 2009.

Thilker, D. A., L. Bianchi, D. Schiminovich, A. Gil de Paz, M. Seibert, B. F. Madore, et al., NGC 404: a rejuvenated lenticular galaxy on a merger-induced, blueward excursion into the green valley, *Astrophys. J. (Lett.) 714*, L171, 2010.

Thomas-Osip, J. E., and G. E. Prieto, Giant Magellan Telescope site testing and characterization at Las Campanas Observatory, in *Optical Turbulence: Astronomy Meets Meteorology*, E. Masciadri and M. Sarazin, eds., p. 379, Imperial College Press, London, 2009.

Thompson, I. B., J. Kaluzny, S. M. Rucinski, W. Krzeminski, W. Pych, A. Dotter, and G. S. Burley, The Cluster AgeS Experiment (CASE). IV. Analysis of the eclipsing binary V69 in the globular cluster 47 Tuc, *Astron. J. 139*, 329, 2010.

Thornton, C. E., A. J. Barth, L. C. Ho, and J. E. Greene, Emission and absorption properties of low-mass type 2 active galaxies with XMM-Newton, *Astrophys. J. 705*, 1196, 2009.

Thornton, C. E., A. J. Barth, L. C. Ho, and J. E. Greene, Spitzer IRS observations of low-mass Seyfert galaxies, in *Co-Evolution of Central Black Holes and Galaxies*, IAU Symp. 267, B. M. Peterson, R. S. Somerville, and T. Storchi-Bergmann, eds., p. 268, Cambridge University Press, Cambridge, 2010.

Toft, S., M. Franx, P. van Dokkum, N. M. Förster Schreiber, I. Labbé, et al., The size-star formation relation of massive galaxies at $1.5 < z < 2.5$, *Astrophys. J. 705*, 255, 2009.

Tran, K.-V. H., A. Saintonge, J. Moustakas, L. Bai, et al., A spectroscopically confirmed excess of 24 μm sources in a super galaxy group at $z = 0.37$: enhanced dusty star formation relative to the cluster and field environment, *Astrophys. J. 705*, 809, 2009.

Tremblay, G. R., M. Chiaberge, W. B. Sparks, S. A. Baum, . . . D. J. E. Floyd, F. D. Macchetto, G. K. Miley, et al., HST/ACS emission line imaging of low-redshift 3CR radio galaxies. I. The data, *Astrophys. J. Suppl. Ser. 183*, 278, 2009.

Trump, J. R., C. D. Impey, B. C. Kelly, M. Elvis, . . . P. J. McCarthy, et al., Observational limits on type 1 active galactic nucleus accretion rate in COSMOS, *Astrophys. J. 700*, 49, 2009.

Trump, J. R., C. D. Impey, Y. Taniguchi, M. Brusa, . . . P. J. McCarthy, et al., The nature of optically dull active galactic nuclei in COSMOS, *Astrophys. J. 706*, 797, 2009.

Valentinuzzi, T., J. Fritz, B. M. Poggianti, A. Cava, . . . A. Dressler, et al., Superdense massive galaxies in WINGS local clusters, *Astrophys. J. 712*, 226, 2010.

Valentinuzzi, T., D. Woods, G. Fasano, M. Riello, . . . A. Dressler, et al., WINGS: a WIde-field Nearby Galaxy-cluster Survey. III. Deep near-infrared photometry of 28 nearby clusters, *Astron. Astrophys. 501*, 851, 2009.

van Dokkum, P. G., K. E. Whitaker, G. Brammer, M. Franx, M. Kriek, I. Labbé, et al., The growth of massive galaxies since $z = 2$, *Astrophys. J. 709*, 1018, 2010.

Veilleux, S., D.-C. Kim, D. S. N. Rupke, C. Y. Peng, . . . L. C. Ho, et al., A deep Hubble Space Telescope H-band imaging survey of massive gas-rich mergers. II. The QUEST QSOs, *Astrophys. J. 701*, 587, 2009.

Veilleux, S., B. J. Weiner, D. S. N. Rupke, M. McDonald, C. Birk, J. Bland-Hawthorn, A. Dressler, T. Hare, D. Osip, et al., MMTF: the Maryland-Magellan Tunable Filter, *Astron. J. 139*, 145, 2010.

Walborn, N. R., I. D. Howarth, C. J. Evans, P. A. Crowther, . . . N. I. Morrell, et al., The Onfp class in the Magellanic Clouds, *Astron. J. 139*, 1283, 2010.

Walborn, N. R., A. Sota, J. Maíz Apellániz, E. J. Alfaro, N. Morrell, et al., Early results from the Galactic O-star Spectroscopic Survey: C III emission lines in Of spectra, *Astrophys. J. (Lett.) 711*, L143, 2010.

Wang, J.-G., X.-B. Dong, T.-G. Wang, L. C. Ho, et al., Estimating black hole masses in active galactic nuclei using the Mg II λ2800 emission line, *Astrophys. J. 707*, 1334, 2009.

Weisz, D. R., E. D. Skillman, J. M. Cannon, A. E. Dolphin, R. C. Kennicutt, Jr., J. Lee, and F. Walter, Does stellar feedback create HI holes? A Hubble Space Telescope/Very Large Array study of Holmberg II, *Astrophys. J. 704*, 1538, 2009.

Williams, R. J., R. F. Quadri, M. Franx, P. G. van Dokkum, S. Toft, M. Kriek, and I. Labbé, The evolving relations between size, mass, surface density, and star formation in 3×10^4 galaxies since $z = 2$, *Astrophys. J. 713,* 738, 2010.

Wuyts, S., M. Franx, T. J. Cox, N. M. Förster Schreiber, C. C. Hayward, L. Hernquist, P. F. Hopkins, I. Labbé, et al., Color distributions, number, and mass densities of massive galaxies at $1.5 < z < 3$: comparing observations with merger simulations, *Astrophys. J. 700*, 799, 2009.

Wuyts, S., P. G. van Dokkum, M. Franx, N. M. Förster Schreiber, G. D. Illingworth, I. Labbé, and G. Rudnick, Optical spectroscopy of distant red galaxies, *Astrophys. J. 706*, 885, 2009.

Yuan, F., Z. Yu, and L. C. Ho, Revisiting the "fundamental plane" of black hole activity at extremely low luminosities, *Astrophys. J. 703*, 1034, 2009.

PLANT BIOLOGY

Bais, P., S. Moon, K. He, R. Leitao, K. Dreher, T. Walk, Y. Sucaet, L. Barkan, G. Wohlgemuth, E. S. Wurtele, P. Dixon, O. Fiehn, B. M. Lange, V. Shulaev, L. W. Sumner, R. Welti, B. Nikolau, S. Y. Rhee, and J. A. Dickerson, PlantMetabolomics.org: a web portal for plant metabolomics experiments, *Plant Physiol. 152*, 1807-1816, 2010.

Barton, M. K., Twenty years on: the inner workings of the shoot apical meristem, a developmental dynamo, *Dev. Biol. 341*, 95-113, 2010.

Bittner, C. X., A. Loaiza, I. Ruminot, V. Larenas, T. Sotelo-Hitschfeld, R. Gutierrez, A. Cordova, A. Valdebenito, W. B. Frommer, and L. F. Barros, Real-time metabolic rate analysis in single astrocytes, *Front. Neuroenerget. 2*, 1-11, 2010.

Briggs, W. R., A wandering pathway from Minnesota wildflowers to phototropins to bacterial virulence, *Annu. Rev. Plant Biol. 61*, 1-20, 2010.

Chen, J., L. Ji, W. Hsu, K.-L. Tan, and S. Y. Rhee, Exploiting domain knowledge to improve biological significance of biclusters with key missing genes, *IEEE Technical Committee on Data Engineering Conference*, ICDE.2009, 205, pp. 1219-1222, 2009.

Frommer, W. B., CO2mmon sense, *Science 327*, 275-276, 2010.

Frommer, W. B., Grand opportunities in physiology to address the grand challenges facing the planet, *Front. Plant Physiol. 1*, 1-3, 2010.

Frommer, W. B., and U. Sonnewald, Progress in physiological research and its relevance for agriculture and ecology, *Curr. Opin. Plant Biol. 13*, 227-232, 2010.

Gene Ontology Consortium, The Gene Ontology in 2010: extensions and refinements, *Nucl. Acids Res. 38*, D331-D335, 2010.

Gómez-Garcia, M. R., M. Davison, M. Blain-Hartnung, A. R. Grossman, and D. Bhaya, Alternative pathways for phosphonate metabolism in thermophilic cyanobacteria from microbial mats, *ISME J.,* ePub July 15, 2010.

Gómez-Garcia, M. R., M. Davison, M. Blain-Hartnung, A. R. Grossman, and D. Bhaya, Metabolism of phosphonates by thermophilic *Synechococcus* spp from microbial mats, *ISME J*., doi:10.1038/ismej.2010.96, 2010.

Gonzalez-Ballester, D., D. Casero, S. Cokus, M. Pellegrini, S. S. Merchant, and A. R. Grossman, RNA-Seq analysis of sulfur-deprived *Chlamydomonas* cells reveals aspects of acclimation critical for cell survival, *Plant Cell 22*, 1-27, 2010.

Gonzalez-Ballester, D., and A. R. Grossman, Sulfur limitation from the physiological to the genomic, chap. 5 of *The Chlamydomonas Sourcebook,* E. Harris, D. Stern, and G. Witman, eds., pp. 159-188, Elsevier, Oxford, U.K, 2009.

Graham Peers, G., T. B. Truong, D. Elrad, E. Ostendorf, A. R. Grossman, M. Hippler, and K. K. Niyogi, A *Chlamydomonas* mutant reveals a role of LI818/LHCSR proteins in regulation of photosynthesis, *Nature 462*, 518-521, 2009.

Grossman, A., S. J. Karpowicz, M. Heinnickel, D. Dewez, B. Hamel, R. Dent, K. K. Niyogi, X. Johnson, J. Alric, F. A. Wollman, H. Li, and S. S. Merchant, Comparative genomics in the identification of genes in the green lineage and that impact photosynthesis, *Photosyn. Res. 106*, 3-17, 2010.

Grossman, A. R., K. R. M. Mackey, and S. Bailey, A perspective on photosynthesis in the oligotrophic oceans: hypotheses concerning alternative routes of electron flow, *J. Phycol.*, doi:10.1111/j.1529-8817.2010.00852.x, 2010.

Gutierrez, R., G. Grossmann, W. B. Frommer, and D. W. Ehrhardt, Opportunities to explore plant membrane organization with super-resolution microscopy, *Plant Physiol. 154*, 463-466, 2010.

Jensen, S., A.-S. Steunou, D. Bhaya, M. Kühl, and A. R. Grossman, In situ dynamics of O_2, pH, and cyanobacterial transcripts associated with inorganic carbon concentration, photosynthesis, and detoxification of reactive oxygen species in hot spring microbial mats, *ISME J*., ePub August 26, 2010.

Jurkuta, R. J., N. J. Kaplinsky, J. E. Spindel, and M. K. Barton, Partitioning the apical domain of the *Arabidopsis* embryo requires the BOBBER1 NudC domain protein, *Plant Cell 21*, 1957-1971, 2009.

Kim, T.-W., S. Guan, Y. Sun, Z. Deng, J.-X. Shang, Y. Sun, A. L. Burlingame, and Z.-Y. Wang, Brassinosteroid signal transduction from cell-surface receptor kinases to nuclear transcription factors, *Nat. Cell Biol. 11*, 1254-1262, 2009.

Kim, T.-W., and Z.-Y. Wang, Brassinosteroid signal transduction from receptor kinases to transcription factors, *Annu. Rev. Plant Biol. 61*, 681-704, 2010.

Kutschera, U., and W. R. Briggs, From Charles Darwin's botanical country-house studies to modern plant biology, *Plant Biol. 11*, 785-795, 2009.

Kutschera, U., Z. Deng, J. A. Oses-Prieto, A. L. Burlingame, and Z.-Y. Wang, Cessation of coleoptile elongation and loss of auxin sensitivity in developing rye seedlings: a quantitative proteomic analysis, *Plant Signal Behav. 5*, 509-517, 2010.

Lalonde, S., A. Sero, R. Pratelli, G. Pilot, J. Chen, M. A. Sardi, S. A. Parsa, D.-Y. Kim, B. R. Acharya, E. V. Stein, H.-C. Hu, F. Villiers, K. Takeda, Y. Yang, Y. S. Han, R. Schwacke, W. Chiang, N. Kato, D. Loqué, S. M. Assmann, J. M. Kwak, J. Schroeder, S. Y. Rhee, and W. B. Frommer, A membrane protein/signaling protein interaction network for *Arabidopsis* version AMPv2, *Front. Plant Physiol. 1*, 1-14, 2010.

Lamesch, P., K. Dreher, D. Swarbreck, R. Sasidharan, L. Reiser, and E. Huala, Using the *Arabidopsis* information resource (TAIR) to find information about *Arabidopsis* genes, chap. 1, unit1:11 of *Current Protocols in Bioinformatics*, doi:10.1002/0471250953.bi0111s30, 2010.

Lanquar, V., D. Loqué, and W. B. Frommer, Ammonium transporters: regulation in oligomeric complexes, *Plant Signal. Behav. 3*, 5(6), 2010.

Lanquar, V., D. Loqué, F. Hörmann, S. Lalonde, N. von Wirén, and W. B. Frommer, Ammonium-dependent phosphorylation of the ammonium transporter AMT1;1, *Plant Cell 21*, 3610-3622, 2009.

Lee I., B. Ambaru, P. Thakkar, E. Marcotte, and S. Y. Rhee**,** Rational association of genes with traits using a genome-scale gene network for *Arabidopsis thaliana*, *Nat. Biotechnol. 2*, 149-156, 2010.

Mackey, K. R. M., T. Rivlin, A. R. Grossman, A. F. Post, and A. Paytan, Picophytoplankton responses to changing nutrient and light regimes during a bloom, *Mar. Biol. 156*, 1531-1546, 2009.

Moseley, J., D. Gonzalez-Ballester, and A. R. Grossman, Intersection between sulfur and phosphorus deprivation responses in *Chlamydomonas*, *Genetics 181*, 889-905, 2009.

Moseley, J., and A. R. Grossman, Phosphorus limitation from the physiological to the genomic, in *The Chlamydomonas Sourcebook*, E. Harris, D. Stern, and G. Witman, eds., pp. 189-216, Elsevier, Oxford, U.K., 2009.

Murphy, A., B. Schulz, and W. B. Frommer, Evaluating the function of putative hormone transporters, *Plant Signal. Behav. 4*, 147-148, 2009.

Pootakham, W., D. Gonzalez-Ballester, A. R. Grossman, Function, localization, and regulation of sulfate transporters of *Chlamydononas reinhardtii*, *Plant Physiol. 153*, 1653-1658, 2010.

Pratelli, R., L. Voll, A. Weber, W. B. Frommer, and G. Pilot, Stimulation of non-selective amino acid efflux by a family of glutamine dumper proteins, *Plant Physiol. 152*, 762-773, 2009.

Ryu, W.-H, S.-J. Bai, J. S. Park, Z. Huang, J. Moseley, T. Fabian, R. Fasching, A. R. Grossman, and F. B. Prinz, Direct extraction of photosynthetic electrons from single algal cells using a nano-probing system, *Nano Lett. 10*, 1137-1143, 2010.

Salwinski, L., L. Licata, A. Winter, D. Thorneycroft, J. Khadake, A. Ceol, A. C. Aryamontri, R. Oughtred, M. Livstone, L. Boucher, D. Botstein, K. Dolinski, T. Berardini, E. Huala, M. Tyers, D. Eisenberg, G. Cesareni, and H. Hermjakob, Recurated protein interaction datasets, *Nat. Meth. 6*, 860-861, 2009.

Shibagaki, N., and A. R. Grossman, Binding of cysteine synthase to the STAS domain of sulfate transporter and its regulatory consequences, *J. Biol. Chem. 285*, 25094-25102, 2010.

Takanaga, H., and W. B. Frommer, Plasma membrane GLUT facilitators mediate glucose transport during ER transit, *FASEB J. 24*, 2849-2858, 2010.

Tang,W., Z. Deng, and Z.-Y. Wang, Proteomics shed light on the brassinosteroid signaling mechanisms, *Curr. Opin. Plant Biol. 13*, 27-33, 2010.

Tseng, T.-S., and W. R. Briggs, The *Arabidopsis* rcn1 mutation confers impaired dephosphorylation of Phot2 resulting in enhanced blue-light responses, *Plant Cell 22*, 125-134, 2010.

Zhang, P., K. Dreher, A. Karthikeyan, A. Chi, A. Pujar, R. Caspi, P. Karp, V. Kirkup, M. Latendresse, C. Lee, L. A. Mueller, R. Muller, and S. Y. Rhee, Creation of a genome-wide metabolic pathway database for *Populus trichocarpa* using a new approach for reconstruction and curation of metabolic pathways for plants, *Plant Physiol. 153*, 1479-1491, 2010.

Zhang, L.-Y., M. Bai, J. Wu, J.-Y. Zhu, H. Wang, W. Wang, Z. Zhang, Y. Sun, J. Zhao, X. Sun, H. Yang, Y. Xu, S.-H. Kim, S. Fujioka, W. Lin, K. Chong, T.-G. Lu, and Z.-Y. Wang, Antagonistic HLH/bHLH transcription factors mediate BR regulation of cell elongation and plant development in rice and *Arabidopsis*, *Plant Cell 21*, 3767–3780, 2009.

DEPARTMENT OF TERRESTRIAL MAGNETISM

Here updated through September 30, 2010. The list is regularly updated on the DTM web site (http://www.dtm.ciw.edu).

6762 Adams, E. R., M. López-Morales, J. L. Elliot, S. Seager, and D. J. Osip, Lack of transit timing variations of OGLE-TR-111b: a re-analysis with six new epochs, *Astrophys. J. 714,* 13-24, 2010.

____ Adams, E. R., M. López-Morales, J. L. Elliot, S. Seager, and D. J. Osip, Six high-precision transits of OGLE-TR-113b, *Astrophys. J.,* in press.

____ Alexander, C. M. O'D., Modeling diffusive dissolution in silicate melts, *Geochim. Cosmochim. Acta,* in press.

6793 Alexander, C. M. O'D., S. D. Newsome, M. L. Fogel, L. R. Nittler, H. Busemann, and G. D. Cody, Deuterium enrichments in chondritic macromolecular material—Implications for the origin and evolution of organics, water and asteroids, *Geochim. Cosmochim. Acta 74,* 4417-4437, 2010.

6815 Alexeev, I. I., E. S. Belenkaya, J. A. Slavin, H. Korth, B. J. Anderson, D. N. Baker, S. A. Boardsen, C. L. Johnson, M. E. Purucker, M. Sarantos, and S. C. Solomon, Mercury's magnetospheric magnetic field after the first two MESSENGER flybys, *Icarus 209,* 23-39, 2010.

6791 Anderson, B. J., M. H. Acuña, H. Korth, J. A. Slavin, H. Uno, C. L. Johnson, M. E. Purucker, S. C. Solomon, J. M. Raines, T. H. Zurbuchen, G. Gloeckler, and R. L. McNutt, Jr., The magnetic field of Mercury, *Space Sci. Rev. 152,* 307-339, 2010.

6787 Anglada-Escudé, G., and J. Debes, Perspective acceleration and gravitational redshift. Measuring masses of individual white dwarfs using Gaia + SIM astrometry, in *Relativity in Fundamental Astronomy,* S. A. Klioner, P. K. Seidelman, and M. H. Soffel, eds., pp. 342-344, International Astronomical Union Symposium 261, Cambridge University Press, New York, 2010.

6742 Anglada-Escudé, G., M. López-Morales, and J. E. Chambers, How eccentric orbital solutions can hide planetary systems in 2:1 resonant orbits, *Astrophys. J. 709,* 168-178, 2010.

6758 Anglada-Escudé, G., E. L. Shkolnik, A. J. Weinberger, I. B. Thompson, D. J. Osip, and J. H. Debes, Strong constraints to the putative planet candidate around VB 10 using Doppler spectroscopy, *Astrophys. J. (Lett.) 711,* L24-L29, 2010.

6754 Arriagada, P., R. P. Butler, D. Minniti, M. López-Morales, S. A. Shectman, F. C. Adams, A. P. Boss, and J. E. Chambers, Five long-period extrasolar planets in eccentric orbits from the Magellan Planet Search Program, *Astrophys. J. 711,* 1229-1235, 2010.

6720 Aulbach, S., T. Stachel, R. A. Creaser, L. M. Heaman, S. B. Shirey, K. Muehlenbachs, D. Eichenberg, and J. W. Harris, Sulphide survival and diamond genesis during formation and evolution of Archaean subcontinental lithosphere: a comparison between the Slave and Kaapvaal cratons, *Lithos 112, Suppl. 2,* 747-757, 2009.

6712 Baker, D. N., D. Odstrcil, B. J. Anderson, C. N. Arge, M. Benna, G. Gloeckler, J. M. Raines, D. Schriver, J. A. Slavin, S. C. Solomon, R. M. Killen, and T. H. Zurbuchen, Space environment of Mercury at the time of the first MESSENGER flyby: solar wind and interplanetary magnetic field modeling of upstream conditions, *J. Geophys. Res. 114,* A10101, 10.1029/2009JA014287, 2009.

6750 Bakos, G. Á., G. Torres, A. Pál, J. Hartman, G. Kovács, R. W. Noyes, D. W. Latham, D. D. Sasselov, B. Sipőcz, G. A. Esquerdo, D. A. Fischer, J. A. Johnson, G. W. Marcy, R. P. Butler, H. Isaacson, A. Howard, S. S. Vogt, G. Kovács, J. Fernandez, A. Moór, R. P. Stefanik, J. Lázár, I. Papp, and P. Sári, HAT-P-11b: a super-Neptune planet transiting a bright K star in the *Kepler* field, *Astrophys. J. 710,* 1724-1745, 2010.

6733 Barsanti, M., P. Papale, D. Barbato, R. Moretti, E. Boschi, E. Hauri, and A. Longo, Heterogeneous large total CO_2 abundance in the shallow magmatic system of Kilauea volcano, Hawaii, *J. Geophys. Res. 114,* B12201, 10.1029/2008JB006187, 2009.

6759 Bedding, T. R., H. Kjeldsen, T. L. Campante, T. Appourchaux, A. Bonanno, W. J. Chaplin, R. A. Garcia, M. Martić, B. Mosser, R. P. Butler, H. Bruntt, L. L. Kiss, S. J. O'Toole, E. Kambe, H. Ando, H. Izumiura, B. Sato, M. Hartmann, A. Hatzes, C. Barban, G. Berthomieu, E. Michel, J. Provost, S. Turck-Chièze, J.-C. Lebrun, J. Schmitt, J.-L. Bertaux, S. Benatti, R. U. Claudi, R. Cosentino, S. Leccia, S. Frandsen, K. Brogaard, L. Glowienka, F. Grundahl, E. Stempels, T. Arentoft, M. Bazot, J. Christensen-Dalsgaard, T. H. Dall, C. Karoff, J. Lundgreen-Nielsen, F. Carrier, P. Eggenberger, D. Sosnowska, R. A. Wittenmyer, M. Endl, T. S. Metcalfe, S. Hekker, and S. Reffert, A multi-site campaign to measure solar-like oscillations in Procyon. II. Mode frequencies, *Astrophys. J. 713,* 935-949, 2010.

6814 Benna, M., B. J. Anderson, D. N. Baker, S. A. Boardsen, G. Gloeckler, R. E. Gold, G. C. Ho, R. M. Killen, H. Korth, S. M. Krimigis, M. E. Purucker, R. L. McNutt, Jr., J. M. Raines, W. E. McClintock, M. Sarantos, J. A. Slavin, S. C. Solomon, and T. H. Zurbuchen, Modeling of the magnetosphere of Mercury at the time of the first MESSENGER flyby, *Icarus 209,* 3-10, 2010.

6812 Biller, B. A., M. C. Liu, Z. Wahhaj, E. L. Nielsen, L. M. Close, T. J. Dupuy, T. L. Hayward, A. Burrows, M. Chun, C. Ftaclas, F. Clarke, M. Hartung, J. Males, I. N. Reid, E. L. Shkolnik, A. Skemer, M. Tecza, N. Thatte, S. H. P. Alencar, P. Artymowicz, A. Boss, E. de Gouveia Dal Pino, J. Gregorio-Hetem, S. Ida, M. J. Kuchner, D. Lin, and D. Toomey, The Gemini NICI Planet-Finding Campaign: discovery of a close substellar companion to the young debris disk star PZ Tel, *Astrophys. J. (Lett.) 720,* L82-L87, 2010.

6763 Bitner, M. A., C. H. Chen, J. Muzerolle, A. J. Weinberger, M. Pecaut, E. E. Mamajek, and M. K. McLure, HD 101088, an accreting 14 AU binary in Lower Centaurus Crux with very little circumstellar dust, *Astrophys. J. 714,* 1542-1546, 2010.

6821 Blewett, D. T., B. W. Denevi, M. S. Robinson, C. M. Ernst, M. E. Purucker, and S. C. Solomon, The apparent lack of lunar-like swirls on Mercury: implications for the formation of lunar swirls and for the agent of space weathering, *Icarus 209,* 239-246, 2010.

6780 Boardsen, S. A., T. Sundberg, J. A. Slavin, B. J. Anderson, H. Korth, S. C. Solomon, and L. G. Blomberg, Observations of Kelvin-Helmholtz waves along the dusk-side boundary of Mercury's magnetosphere during MESSENGER's third flyby, *Geophys. Res. Lett. 37,* L12101, 0.1029/2010GL043606, 2010.

6752 Borucki, W. J., D. Koch, G. Basri, N. Batalha, T. Brown, D. Caldwell, J. Caldwell, J. Christensen-Dalsgaard, W. D. Cochran, E. DeVore, E. W. Dunham, A. K. Dupree, T. N. Gautier, III, J. C. Geary, R. Gilliland, A. Gould, S. B. Howell, J. M. Jenkins, Y. Kondo, D. W. Latham, G. W. Marcy, S. Meibom, H. Kjeldsen, J. J. Lissauer, D. G. Monet, D. Morrison, D. Sasselov, J. Tarter, A. Boss, D. Brownlee, T. Owen, D. Buzasi, D. Charbonneau, L. Doyle, J. Fortney, E. B. Ford, M. J. Holman, S. Seager, J. H. Steffen, W. F. Welsh, J. Rowe, H. Anderson, L. Buchhave, D. Ciardi, L. Walkowicz, W. Sherry, E. Horch, H. Isaacson, M. E. Everett, D. Fischer, G. Torres, J. A. Johnson, M. Endl, P. MacQueen, S. T. Bryson, J. Dotson, M. Haas, J. Kolodziejczak, J. Van Cleve, H. Chandrasekaran, J. D. Twicken, E. V. Quintana, B. D. Clarke, C. Allen, J. Li, H. Wu, P. Tenenbaum, E. Verner, F. Bruhweiler, J. Barnes, and A. Prsa, Kepler planet-detection mission: introduction and first results, *Science 327,* 977-980, 2010.

6784 Boss, A. P., Metallicity and planet formation: models, in *Chemical Abundances in the Universe,* K. Cunha, M. Spite, and B. Barbuy, eds., pp. 391-398, International Astronomical Union Symposium 265, Cambridge University Press, New York, 2010.

6835 Boss, A., *L'Universo affollato: Alla ricerca di pianeti abitati [The Crowded Universe: the Search for Living Planets]* (in Italian), Le Scienze, Rome, 190 pp., 2010.

6795 Boss, A. P., and S. A. Keiser, Who pulled the trigger: a supernova or an asymptotic giant branch star? *Astrophys. J. (Lett.) 717,* L1-L5, 2010.

6738 Boss, A. P., S. A. Keiser, S. I. Ipatov, E. A. Myhill, and H. A. T. Vanhala, Triggering collapse of the presolar dense cloud core and injecting short-lived radioisotopes with a shock wave. I. Varied shock speeds, *Astrophys. J. 708,* 1268-1280, 2010.

6714 Boss, A. P., A. J. Weinberger, G. Anglada-Escudé, I. B. Thompson, G. Burley, C. Birk, S. H. Pravdo, S. B. Shaklan, G. D. Gatewood, S. R. Majewski, and R. J. Patterson, The Carnegie Astrometric Planet Search program, *Publ. Astron. Soc. Pacific 121,* 1218-1231, 2009.

6756 Boyet, M., R. W. Carlson, and M. Horan, Old Sm-Nd ages for cumulate eucrites and redetermination of the solar system initial ^{146}Sm/^{144}Sm ratio, *Earth Planet. Sci. Lett. 291,* 172-181, 2010.

6790 Bruntt, H., T. R. Bedding, P. O. Quirion, G. Lo Curto, F. Carrier, B. Smalley, T. H. Dall, T. Arentoft, M. Bazot, and R. P. Butler, Accurate fundamental parameters for 23 bright solar-type stars, *Mon. Not. Roy. Astron. Soc. 405,* 1907-1923, 2010.

6717 Busemann, H., A. N. Nguyen, G. D. Cody, P. Hoppe, A. L. D. Kilcoyne, R. M. Stroud, T. J. Zega, and L. R. Nittler, Ultra-primitive interplanetary dust particles from the comet 26P/Grigg-Skjellerup dust stream collection, *Earth Planet. Sci. Lett. 288,* 44-57, 2009.

6715 Chambers, J. E., An analytical model for the evolution of a viscous, irradiated disk, *Astrophys. J. 705,* 1206-1214, 2009.

6799 Chambers, J. E., Planetesimal formation by turbulent concentration, *Icarus 208,* 505-517, 2010.

6827 Chambers, J. E., More giants in focus, *Nature 467,* 405-406, 2010.

6832 Chambers, J. E., N-body integrators for planets in binary star systems, in *Planets in Binary Star Systems,* N. Haghighipour, ed., pp. 239-263, Springer, Dordrecht, 2010.

____ Chambers, J. E., Stellar elemental abundance patterns: implications for planet formation, *Astrophys. J.,* in press.

6724 Chambers, J. E., D. P. O'Brien, and A. M. Davis, Accretion of planetesimals and the formation of rocky planets, in *Protoplanetary Dust: Astrophysical and Cosmochemical Perspectives,* D. Apai and D. S. Lauretta, eds., pp. 299-335, Cambridge University Press, New York, 2010.

6789 Chanamé, J., J. Bruursema, R. Chandar, J. Anderson, R. van der Marel, and H. Ford, *HST*'s hunt for intermediate-mass black holes in star clusters, in *Star Clusters,* R. de Grijs and J. R. D. Lépine, eds., pp. 231-237, International Astronomical Union Symposium 266, Cambridge University Press, New York, 2010.

6834 Chardot, L., B. Voight, R. Foroozan, S. Sacks, A. Linde, R. Stewart, D. Hidayat, A. Clarke, D. Elsworth, N. Fournier, J.-C. Komorowski, G. Mattioli, R. S. J. Sparks, and C. Widiwijayanti, Explosion dynamics from strainmeter and microbarometer observations, Soufrière Hills Volcano, Montserrat: 2008-2009, *Geophys. Res. Lett. 37,* L00E24, 10.1029/2010GL044661, 2010.

6836 Coughlin, J. L., G. S. Stringfellow, A. C. Becker, M. López-Morales, F. Mezzalira, and T. Krajci, New observations and a possible detection of parameter variations in the transits of Gliese 436b, *Astrophys. J. (Lett.) 689,* L149-L152, 2008.

____ Courtin, R., A. Boss, and M. Mayor, Planetary systems as potential sites for life, in *Highlights of Astronomy 15,* I. Corbett, ed., Cambridge University Press, in press.

6833 Crane, J. D., S. A. Shectman, R. P. Butler, I. B. Thompson, C. Birk, P. Jones, and G. S. Burley, The Carnegie Planet Finder Spectrograph: integration and commissioning, in *Ground-based and Airborne Instrumentation for Astronomy III,* I. S. McLean, S. K. Ramsay, and H. Takami, eds., paper 773553, SPIE Proceedings Vol. 7737, SPIE, Bellingham, Wash., 2010.

6735 Dasgupta, R., M. G. Jackson, and C.-T. A. Lee, Major element chemistry of ocean island basalts–conditions of mantle melting and heterogeneity of mantle source, *Earth Planet. Sci. Lett. 289,* 377-392, 2010.

6794 De Gregorio, B. T., R. M. Stroud, L. R. Nittler, C. M. O'D. Alexander, A. L. D. Kilcoyne, and T. J. Zega, Isotopic anomalies in organic nanoglobules from Comet 81P/Wild 2: comparison to Murchison nanoglobules and isotopic anomalies induced in terrestrial organics by electron irradiation, *Geochim. Cosmochim. Acta 74,* 4454-4470, 2010.

6809 de Moor, J. M., T. P. Fischer, Z. D. Sharp, E. H. Hauri, D. R. Hilton, and V. Atudorei, Sulfur isotope fractionation during the May 2003 eruption of Anatahan volcano, Mariana Islands: implications for sulfur sources and plume processes, *Geochim. Cosmochim. Acta 74,* 5382-5397, 2010.

6726 Dick, H. J. B., C. J. Lissenberg, and J. M. Warren, Mantle melting, melt transport, and delivery beneath a slow-spreading ridge: the paleo-MAR from 23°15'N to 23°45'N, *J. Petrol. 51,* 425-467, 2010.

6824 Eagar, K. C., M. J. Fouch, and D. E. James, Receiver function imaging of upper mantle complexity beneath the Pacific Northwest, United States, *Earth Planet. Sci. Lett. 297,* 141-153, 2010.

6776 Elliot, J. L., M. J. Person, C. A. Zuluaga, A. S. Bosh, E. R. Adams, T. C. Brothers, A. A. S. Gulbis, S. E. Levine, M. Lockhart, A. M. Zangari, B. A. Babcock, K. DuPré, J. M. Pasachoff, S. P. Souza, W. Rosing, N. Secrest, L. Bright, E. W. Dunham, S. S. Sheppard, M. Kakkala, T. Tilleman, B. Berger, J. W. Briggs, G. Jacobson, P. Valleli, B. Volz, S. Rapoport, R. Hart, M. Brucker, R. Michel, A. Mattingly, L. Zambrano-Marin, A. W. Meyer, J. Wolf, E. V. Ryan, W. H. Ryan, K. Morzinski, B. Grigsby, J. Brimacombe, D. Ragozzine, H. G. Montano, and A. Gilmore, Size and albedo of Kuiper belt object 55636 from a stellar occultation, *Nature 465,* 897-900, 2010.

6819 Ernst, C. M., S. L. Murchie, O. S. Barnouin, M. S. Robinson, B. W. Denevi, D. T. Blewett, J. W. Head, N. R. Izenberg, S. C. Solomon, and J. H. Roberts, Exposure of spectrally distinct material by impact craters on Mercury: implications for global stratigraphy, *Icarus 209,* 210-223, 2010.

6796 Fares, R., J.-F. Donati, C. Moutou, M. M. Jardine, J.-M. Grießmeier, P. Zarka, E. L. Shkolnik, D. Bohlender, C. Catala, and A. C. Cameron, Searching for star-planet interactions within the magnetosphere of HD189733, *Mon. Not. Roy. Astron. Soc. 406,* 409-419, 2010.

6746 Feldman, W. C., D. J. Lawrence, J. O. Goldsten, R. E. Gold, D. N. Baker, D. K. Haggerty, G. C. Ho, S. Krucker, R. P. Lin, R. A. Mewaldt, R. J. Murphy, L. R. Nittler, E. A. Rhodes, J. A. Slavin, S. C. Solomon, R. D. Starr, F. Vilas, and A. Vourlidas, Evidence for extended acceleration of solar flare ions from 1-8 MeV solar neutrons detected with the MESSENGER Neutron Spectrometer, *J. Geophys. Res. 115,* A01102, 10.1029/2009JA014535, 2010.

6813 Fossati, L., S. Bagnulo, A. Elmasli, C. A. Haswell, S. Holmes, O. Kochukhov, E. L. Shkolnik, D. V. Shulyak, D. Bohlender, B. Albayrak, C. Froning, and L. Hebb, A detailed spectropolarimetric analysis of the planet-hosting star WASP-12, *Astrophys. J. 720,* 872-886, 2010.

6810 Gallego, A., R. M. Russo, D. Comte, V. I. Mocanu, R. E. Murdie, and J. C. Vandecar, Seismic noise tomography in the Chile Ridge subduction region, *Geophys. J. Int. 182,* 1478-1492, 2010.

6792 Gómez-Pérez, N., M. Heimpel, and J. Wicht, Effects of a radially varying electrical conductivity on 3D numerical dynamos, *Phys. Earth Planet. Inter. 181,* 42-53, 2010.

____ Gómez-Pérez, N., and S. C. Solomon, Mercury's weak magnetic field: a result of magnetospheric feedback? *Geophys. Res. Lett.,* in press.

6816 Gómez-Pérez, N., and J. Wicht, Behavior of planetary dynamos under the influence of external magnetic fields: application to Mercury and Ganymede, *Icarus 209,* 53-62, 2010.

6767 Gore, J., D. E. James, T. G. Zengeni, and O. Gwavava, Crustal structure of the Zimbabwe Craton and the Limpopo Belt of southern Africa: new constraints from seismic data and implications for its evolution, *S. Afr. J. Geol. 112,* 213-228, 2009.

6781 Gurney, J. J., H. H. Helmstaedt, S. H. Richardson, and S. B. Shirey, Diamonds through time, *Econ. Geol. 105,* 689-712, 2010.

6782 Gyngard, F., E. Zinner, L. R. Nittler, A. Morgand, F. J. Stadermann, and K. M. Hynes, Automated nanoSIMS measurements of spinel stardust from the Murray meteorite, *Astrophys. J. 717,* 107-120, 2010.

6766 Haghighipour, N., S. S. Vogt, R. P. Butler, E. J. Rivera, G. Laughlin, S. Meschiari, and G. W. Henry, The Lick-Carnegie Exoplanet Survey: a Saturn-mass planet in the habitable zone of the nearby M4V star HIP 57050, *Astrophys. J. 715,* 271-276, 2010.

6716 Hartman, J. D., G. Á. Bakos, G. Torres, G. Kovács, R. W. Noyes, A. Pál, D. W. Latham, B. Sipőcz, D. A. Fischer, J. A. Johnson, G. W. Marcy, R. P. Butler, A. W. Howard, G. A. Esquerdo, D. D. Sasselov, G. Kovács, R. P. Stefanik, J. M. Fernandez, J. Lázár, I. Papp, and P. Sári, HAT-P-12b: a low-density sub-Saturn mass planet transiting a metal-poor K dwarf, *Astrophys. J. 706,* 785-796, 2009.

6753 Hautmann, S., J. Gottsmann, A. G. Camacho, N. Fournier, I. S. Sacks, and R. S. J. Sparks, Mass variations in response to magmatic stress changes at Soufrière Hills Volcano, Montserrat (W.I.): insights from 4-D gravity data, *Earth Planet. Sci. Lett. 290,* 83-89, 2010.

6826 Hautmann, S., J. Gottsmann, R. S. J. Sparks, G. S. Mattioli, I. S. Sacks, and M. H. Strutt, Effect of mechanical heterogeneity in arc crust on volcano deformation with application to Soufrière Hills Volcano, Montserrat, West Indies, *J. Geophys. Res. 115,* B09203, 10.1029/2009JB006909, 2010.

____ Heinonen, J., R. W. Carlson, and A. V. Luttinen, Isotopic (Sr, Nd, Pb, and Os) constraints on the sublithospheric mantle origins of the Jurassic Karoo large igneous province, *Chem. Geol.,* in press.

6760 Hernán-Obispo, H., M. C. Gálvez-Ortiz, G. Anglada-Escudé, S. R. Kane, J. R. Barnes, E. de Castro, and M. Cornide, Evidence of a massive planet candidate orbiting the young active K5V star BD+20 1790, *Astron. Astrophys. 512,* A45, 2010.

6771 Honeycutt, R. K., and S. Kafka, FBS 0107-082: a symbiotic binary in a rare prolonged outburst? *Astron. J. 139,* 2706-2713, 2010.

6741 Horan, M. F., C. M. O'D. Alexander, and R. J. Walker, Highly siderophile element evidence for early solar system processes in components from ordinary chondrites, *Geochim. Cosmochim. Acta 73,* 6984-6997, 2009.

6725 Horner, J., B. W. Jones, and J. Chambers, Jupiter–friend or foe? III: the Oort cloud comets, *Int. J. Astrobiol. 9,* 1-10, 2010.

____ Howard, A. W., G. Á. Bakos, J. Hartman, G. Torres, A. Shporer, T. Mazeh, G. Kovacs, D. W. Latham, R. W. Noyes, D. A. Fischer, J. A. Johnson, G. W. Marcy, G. A. Esquerdo, B. Béky, R. P. Butler, D. D. Sasselov, R. P. Stefanik, G. Perumpilly, J. Lázár, I. Papp, and P. Sári, HAT-P-17b,c: a transiting, eccentric, hot Saturn and a long-period, cold Jupiter, *Astrophys. J.,* in press.

6805 Jackson, M. G., R. W. Carlson, M. D. Kurz, P. D. Kempton, D. Francis, and J. Blusztajn, Evidence for the survival of the oldest terrestrial mantle reservoir, *Nature 466,* 853-856, 2010.

6734 Jackson, M. G., M. D. Kurz, and S. R. Hart, Helium and neon isotopes in phenocrysts from Samoan lavas: evidence for heterogeneity in the terrestrial high $^{3}He/^{4}He$ mantle, *Earth Planet. Sci. Lett. 287,* 519-528, 2009.

6811 Janney, P. E., S. B. Shirey, R. W. Carlson, D. G. Pearson, D. R. Bell, A. P. Le Roex, A. Ishikawa, P. H. Nixon, and F. R. Boyd, Age, composition and thermal characteristics of South African off-craton mantle lithosphere: evidence for a multi-stage history, *J. Petrol. 51,* 1849-1890, 2010.

6775 Jenkins, J. S., H. R. A. Jones, B. Biller, S. J. O'Toole, D. J. Pinfield, L. Close, C. G. Tinney, R. P. Butler, R. Wittenmyer, B. Carter, and A. C. Day-Jones, NACO-SDI imaging of known companion host stars from the AAPS and Keck planet search surveys, *Astron. Astrophys. 515,* A17, 2010.

6761 Jones, H. R. A., R. P. Butler, C. G. Tinney, S. O'Toole, R. Wittenmyer, G. W. Henry, S. Meschiari, S. Vogt, E. Rivera, G. Laughlin, B. D. Carter, J. Bailey, and J. S. Jenkins, A long-period planet orbiting a nearby Sun-like star, *Mon. Not. Roy. Astron. Soc. 403,* 1703-1713, 2010.

____ Kafka, S., C. Tappert, T. Ribeiro, R. K. Honeycutt, D. W. Hoard, and S. Saar, Low-state magnetic structures in Polars: nature or nurture? *Astrophys. J.,* in press.

6798 Kelley, K. A., T. Plank, S. Newman, E. M. Stolper, T. L. Grove, S. Parman, and E. H. Hauri, Mantle melting as a function of water content beneath the Mariana arc, *J. Petrol. 51,* 1711-1738, 2010.

6719 Klein-BenDavid, O., A. M. Logvinova, M. Schrauder, Z. V. Spetius, Y. Weiss, E. H. Hauri, F. V. Kaminsky, N. V. Sobolev, and O. Navon, High-Mg carbonatitic microinclusions in some Yakutian diamonds—a new type of diamond-forming fluid, *Lithos 112, Suppl. 2,* 648-659, 2009.

6764 Koch, D. G., W. J. Borucki, G. Basri, N. M. Batalha, T. M. Brown, D. Caldwell, J. Christensen-Dalsgaard, W. D. Cochran, E. DeVore, E. W. Dunham, T. N. Gautier, J. C. Geary, R. L. Gilliland, A. Gould, J. Jenkins, Y. Kondo, D. W. Latham, J. J. Lissauer, G. Marcy, D. Monet, D. Sasselov, A. Boss, D. Brownlee, J. Caldwell, A. K. Dupree, S. B. Howell, H. Kjeldsen, S. Meibom, D. Morrison, T. Owen, H. Reitsema, J. Tarter, S. T. Bryson, J. L. Dotson, P. Gazis, M. R. Haas, J. Kolodziejczak, J. F. Rowe, J. E. Van Cleve, C. Allen, H. Chandrasekaran, B. D. Clarke, J. Li, E. V. Quintana, P. Tenenbaum, J. D. Twicken, and H. Wu, *Kepler Mission* design, realized photometric performance, and early science, *Astrophys. J. (Lett.) 713,* L79-L86, 2010.

6732 Koleszar, A. M., A. E. Saal, E. H. Hauri, A. N. Nagle, Y. Liang, and M. D. Kurz, The volatile contents of the Galapagos plume; evidence for H_2O and F open system behavior in melt inclusions, *Earth Planet. Sci. Lett. 287,* 442-452, 2009.

6728 Kovács, I., H. St.C. O'Neill, J. Hermann, and E. H. Hauri, Site-specific infrared O-H absorption coefficients for water substitution into olivine, *Am. Mineral. 95,* 292-299, 2010.

6736 Kurz, M. D., J. M. Warren, and J. Curtice, Mantle deformation and noble gases: helium and neon in oceanic mylonites, *Chem. Geol. 266,* 10-18, 2009.

6708 Laske, G., J. A. Collins, C. J. Wolfe, S. C. Solomon, R. S. Detrick, J. A. Orcutt, D. Bercovici, and E. H. Hauri, Probing the Hawaiian hotspot with new broadband ocean bottom instruments, *Eos, Trans. Am. Geophys. Union 90,* 362-363, 2009.

6711 Latham, D. W., G. Á. Bakos, G. Torres, R. P. Stefanik, R. W. Noyes, G. Kovács, A. Pál, G. W. Marcy, D. A. Fischer, R. P. Butler, B. Sipőcz, D. D. Sasselov, G. A. Esquerdo, S. S. Vogt, J. D. Hartman, G. Kovács, J. Lázár, I. Papp, and P. Sári, Discovery of a transiting planet and eight eclipsing binaries in HATNet field G205, *Astrophys. J. 704,* 1107-1119, 2009.

6818 Lawrence, D. J., W. C. Feldman, J. O. Goldsten, T. J. McCoy, D. T. Blewett, W. V. Boynton, L. G. Evans, L. R. Nittler, E. A. Rhodes, and S. C. Solomon, Identification and measurement of neutron-absorbing elements on Mercury's surface, *Icarus 209,* 195-209, 2010.

____ Leahy, G. M., J. A. Collins, C. J. Wolfe, G. Laske, and S. C. Solomon, Underplating of the Hawaiian Swell: evidence from teleseismic receiver functions, *Geophys. J. Int.,* in press.

6731 Linde, A. T., S. Sacks, D. Hidayat, B. Voight, A. Clarke, D. Elsworth, G. Mattioli, P. Malin, E. Shalev, S. Sparks, and C. Widiwijayanti, Vulcanian explosion at Soufrière Hills Volcano, Montserrat, on March 2004 as revealed by strain data, *Geophys. Res. Lett. 37,* L00E07, 10.1029/2009GL041988, 2010.

6808 Liu, M. C., L. R. Nittler, C. M. O'D. Alexander, and T. Lee, Lithium-beryllium-boron isotopic compositions in meteoritic hibonite: implications for origin of ^{10}Be and early solar system irradiation, *Astrophys. J. (Lett.) 719,* L99-L103, 2010.

6837 Liu, M. C., Z. Wahhaj, B. A. Biller, E. L. Nielsen, M. Chun, L. M. Close, C. Ftaclas, M. Hartung, T. L. Hayward, F. Clarke, I. N. Reid, E. L. Shkolnik, M. Tecza, N. Thatte, S. Alencar, P. Artymowicz, A. Boss, A. Burrows, E. de Gouveia Dal Pino, J. Gregorio-Hetem, S. Ida, M. J. Kuchner, D. Lin, and D. Toomey, The Gemini NICI Planet-Finding Campaign, in *Adaptive Optics Systems II,* B. L. Ellerbroek et al., eds., paper 77361K, SPIE Proceedings Vol. 7736, SPIE, Bellingham, Wash., 2010.

6718 Long, M. D., H. Gao, A. Klaus, L. S. Wagner, M. J. Fouch, D. E. James, and E. Humphreys, Shear wave splitting and the pattern of mantle flow beneath eastern Oregon, *Earth Planet. Sci. Lett. 288,* 359-369, 2009.

6709 Long, M. D., and P. G. Silver, Shear wave splitting and mantle anisotropy: measurements, interpretations, and new directions, *Surv. Geophys. 30,* 407-461, 2009.

6713 Long, M. D., and P. G. Silver, Mantle flow in subduction systems: the subslab flow field and implications for mantle dynamics, *J. Geophys. Res. 114,* B10312, 10.1029/2008JB006200, 2009.

6779 López-Morales, M., Exoplanet caught speeding, *Nature 465,* 1017-1018, 2010.

6778 López-Morales, M., J. L. Coughlin, D. K. Sing, A. Burrows, D. Apai, J. C. Rogers, D. S. Spiegel, and E. R. Adams, Day-side *z′*-band emission and eccentricity of WASP-12b, *Astrophys. J. (Lett.) 716,* L36-L40, 2010.

6828 Matsuyama, I., Dispersal of protoplanetary disks by wind stripping, in *Physics and Astrophysics of Planetary Systems,* T. Montmerle, D. Ehrenreich, and A.-M. Lagrange, eds., pp. 171-175, European Astronomical Society Publications Series, Vol. 41, EDP Sciences, Les Ulis, France, 2010.

6831 Mayer, L., A. Boss, and A. F. Nelson, Gravitational instability in binary protoplanetary disks, in *Planets in Binary Star Systems,* N. Haghighipour, ed., pp. 195-238, Springer, Dordrecht, 2010.

6772 McArthur, B. E., G. F. Benedict, R. Barnes, E. Martioli, S. Korzennik, E. Nelan, and R. P. Butler, New observational constraints on the υ Andromedae system with data from the *Hubble Space Telescope* and Hobby-Eberly Telescope, *Astrophys. J. 715,* 1203-1220, 2010.

6729 McCubbin, F. M., A. Smirnov, H. Nekvasil, J. Wang, E. Hauri, and D. H. Lindsley, Hydrous magmatism on Mars: a source of water for the surface and subsurface during the Amazonian, *Earth Planet. Sci. Lett. 292,* 132-138, 2010.

6783 McCubbin, F. M., A. Steele, E. H. Hauri, H. Nekvasil, S. Yamashita, and R. J. Hemley, Nominally hydrous magmatism on the Moon, *Proc. Natl. Acad. Sci. USA 107,* 11223-11228, 2010.

____ McNutt, R. L., Jr., S. C. Solomon, P. D. Bedini, E. J. Finnegan, and D. G. Grant, The MESSENGER mission: results from the first two Mercury flybys, *Acta Astronaut.,* in press.

6748 Mitchell, E. C., T. P. Fischer, D. R. Hilton, E. H. Hauri, A. M. Shaw, J. M. de Moor, Z. D. Sharp, and K. Kazahaya, Nitrogen sources and recycling at subduction zones: insights from the Izu-Bonin-Mariana arc, *Geochem. Geophys. Geosyst. 11,* Q02X11, 10.1029/2009GC002783, 2010.

6801 Moskovitz, N. A., M. Willman, T. H. Burbine, R. P. Binzel, and S. J. Bus, A spectroscopic comparison of HED meteorites and V-type asteroids in the inner Main Belt, *Icarus 208,* 773-788, 2010.

6806 Nguyen, A. N., L. R. Nittler, F. J. Stadermann, R. M. Stroud, and C. M. O'D. Alexander, Coordinated analyses of presolar grains in the Allan Hills 77307 and Queen Elizabeth Range 99177 meteorites, *Astrophys. J. 719,* 166-189, 2010.

6765 Nittler, L. R., Cometary dust in the laboratory, *Science 328,* 698-699, 2010.

6820 Oberst, J., F. Preusker, R. J. Phillips, T. R. Watters, J. W. Head, M. T. Zuber, and S. C. Solomon, The morphology of Mercury's Caloris basin as seen in MESSENGER stereo topographic models, *Icarus 209,* 230-238, 2010.

6825 O'Leary, J. A., G. A. Gaetani, and E. H. Hauri, The effect of tetrahedral Al^{3+} on the partitioning of water between clinopyroxene and silicate melt, *Earth Planet. Sci. Lett. 297,* 111-120, 2010.

6743 Pál, A. , G.Á. Bakos, G. Torres, R. W. Noyes, D. A. Fischer, J. A. Johnson, G. W. Henry, R. P. Butler, G. W. Marcy, A. W. Howard, B. Sipőcz, D. W. Latham, and G. A. Esquerdo, Refined stellar, orbital and planetary parameters of the eccentric HAT-P-2 planetary system, *Mon. Not. Roy. Astron. Soc. 401,* 2665-2674, 2010.

____ Papineau, D., B. T. De Gregorio, R. M. Stroud, A. Steele, E. Pecoits, K. Konhauser, J. Wang, and M. L. Fogel, Ancient graphite in the Eoarchean quartz-pyroxene rock from Akilia in southern West Greenland II: isotopic and chemical compositions and comparison with Paleoproterozoic banded iron formations, *Geochim. Cosmochim. Acta,* in press.

6830 Prato, L., and A. J. Weinberger, Disks around young binary stars, in *Planets in Binary Star Systems,* N. Haghighipour, ed., pp. 1-18, Springer, Dordrecht, 2010.

6803 Prockter, L. M., C. M. Ernst, B. W. Denevi, C. R. Chapman, J. W. Head, III, C. I. Fassett, W. J. Merline, S. C. Solomon, T. R. Watters, R. G. Strom, G. Cremonese, S. Marchi, and M. Massironi, Evidence for young volcanism on Mercury from the third MESSENGER flyby, *Science 329,* 668-671, 2010.

6727 Qin, L., C. M. O'D. Alexander, R. W. Carlson, M. F. Horan, and T. Yokoyama, Contributors to chromium isotope variation of meteorites, *Geochim. Cosmochim. Acta 74,* 1122-1145, 2010.

____ Qin, L., L. R. Nittler, C. M. O'D. Alexander, J. Wang, F. J. Stadermann, and R. W. Carlson, Extreme ^{54}Cr-rich grains in the CI chondrite Orgueil: evidence for a single late supernova injection into the Solar System, *Geochim. Cosmochim. Acta,* in press.

____ Qin, L., D. Rumble, C. M. O'D. Alexander, R. W. Carlson, P. Jenniskens, and M. H. Shaddad, The chromium composition of Almahata Sitta, *Meteorit. Planet. Sci.,* in press.

6737 Ray, M. C., D. R. Hilton, J. Muñoz, T. P. Fischer, and A. M. Shaw, The effects of volatile recycling, degassing and crustal contamination on the helium and carbon geochemistry of hydrothermal fluids from the Southern Volcanic Zone of Chile, *Chem. Geol. 266,* 38-49, 2009.

6751 Ribeiro, T., S. Kafka, R. Baptista, and C. Tappert, Activity on the M star of QS Vir, *Astron. J. 139,* 1106-1116, 2010.

6721 Richardson, S. H., P. F. Pöml, S. B. Shirey, and J. W. Harris, Age and origin of peridotitic diamonds from Venetia, Limpopo Belt, Kaapvaal-Zimbabwe craton, *Lithos 112, Suppl. 2,* 785-792, 2009.

6740 Rivera, E. J., R. P. Butler, S. S. Vogt, G. Laughlin, G. W. Henry, and S. Meschiari, A super-Earth orbiting the nearby Sun-like star HD 1461, *Astrophys. J. 708,* 1492-1499, 2010.

6807 Rivera, E. J., G. Laughlin, R. P. Butler, S. S. Vogt, N. Haghighipour, and S. Meschiari, Lick-Carnegie Exoplanet Survey: a Uranus-mass fourth planet for GJ 876 in an extrasolar Laplace configuration, *Astrophys. J. 719,* 890-899, 2010.

6788 Rogers, J. C., D Apai, M. López-Morales, D. K. Sing, and A. Burrows, *Ks*-band detection of thermal emission and color constraints to CoRoT-1b: a low-albedo planet with inefficient atmospheric energy redistribution and a temperature inversion, *Astrophys. J. 707,* 1707-1716, 2009.

6829 Rubin, V. C., "Charlotte Moore Sitterly," *J. Astron. Hist. Heritage 13,* 145-148, 2010.

6797 Russo, R.M., A. Gallego, D. Comte, V.I. Mocanu, R.E. Murdie, and J.C. VanDecar, Source-side shear wave splitting and upper mantle flow in the Chile Ridge subduction region, *Geology 38,* 707-710, 2010.

6723 Savov, I. P., W. P. Leeman, C.-T. A. Lee, and S. B. Shirey, Boron isotopic variations in NW USA rhyolites: Yellowstone, Snake River Plain, eastern Oregon, *J. Volcanol. Geotherm. Res. 188,* 162-172, 2009.

6777 Schmerr, N., E. Garnero, and A. McNamara, Deep mantle plumes and convective upwelling beneath the Pacific Ocean, *Earth Planet. Sci. Lett. 294,* 143-151, 2010.

6768 Schönbächler, M., R. W. Carlson, M. F. Horan, T. D. Mock, and E. H. Hauri, Heterogeneous accretion and the moderately volatile element budget of Earth, *Science 328,* 884-887, 2010.

6770 Sedransk, N., L. J. Young, K. L. Kelner, R. A. Moffitt, A. Thakar, J. Raddick, E. J. Ungvarsky, R. W. Carlson, R. Apweiler, L. H. Cox, D. Nolan, K. Soper, and C. Spiegelman, Make research data public?—not always so simple: a dialogue for statisticians and science editors, *Stat. Sci. 25,* 41-50, 2010.

6757 Sheppard, S. S., The colors of extreme outer solar system objects, *Astron. J. 139,* 1394-1405, 2010.

6823 Sheppard, S. S., and C. A. Trujillo, Detection of a trailing (L5) Neptune Trojan, *Science 329,* 1304, 2010.

____ Sheppard, S. S., and C. A. Trujillo, The size distribution of the Neptune Trojans and the missing intermediate sized planetesimals, *Astrophys. J. (Lett.),* in press.

6774 Shkolnik, E. L., L. Hebb, M. C. Liu, I. N. Reid, and A. C. Cameron, Thirty new low-mass spectroscopic binaries, *Astrophys. J. 716,* 1522-1530, 2010.

6744 Skemer, P., J. M. Warren, P. B. Kelemen, and G. Hirth, Microstructural and rheological evolution of a mantle shear zone, *J. Petrol. 51,* 43-53, 2010.

6802 Slavin, J. A., B. J. Anderson, D. N. Baker, M. Benna, S. A. Boardsen, G. Gloeckler, R. E. Gold, G. C. Ho, H. Korth, S. M. Krimigis, R. L. McNutt, Jr., L. R. Nittler, J. M. Raines, M. Sarantos, D. Schriver, S. C. Solomon, R. D. Starr, P. M. Trávníček, and T. H. Zurbuchen, MESSENGER observations of extreme loading and unloading of Mercury's magnetic tail, *Science 329,* 665-668, 2010.

6747 Slavin, J. A., R. P. Lepping, C.-C. Wu, B. J. Anderson, D. N. Baker, M. Benna, S. A. Boardsen, R. M. Killen, H. Korth, S. M. Krimigis, W. E. McClintock, R. L. McNutt, Jr., M. Sarantos, D. Schriver, S. C. Solomon, P. Trávníček, and T. H. Zurbuchen, MESSENGER observations of large flux transfer events at Mercury, *Geophys. Res. Lett. 37,* L02105, 10.1029/2009GL041485, 2010.

6769 Smit, K. V., S. B. Shirey, S. H. Richardson, A. P. le Roex, and J. J. Gurney, Re-Os isotopic composition of peridotitic sulphide inclusions in diamonds from Ellendale, Australia: age constraints on Kimberley cratonic lithosphere, *Geochim. Cosmochim. Acta 74,* 3292-3306, 2010.

6722 Smith, C. B., D. G. Pearson, G. P. Bulanova, A. D. Beard, R. W. Carlson, N. Wittig, K. Sims, L. Chimuka, and E. Muchemwa, Extremely depleted lithospheric mantle and diamonds beneath the southern Zimbabwe Craton, *Lithos 112, Suppl. 2,* 1120-1132, 2009.

6817 Smith, D. E., M. T. Zuber, R. J. Phillips, S. C. Solomon, G. A. Neumann, F. G. Lemoine, S. J. Peale, J.-L. Margot, M. H. Torrence, M. J. Talpe, J. W. Head III, S. A. Hauck II, C. L. Johnson, M. E. Perry, O. S. Barnouin, R. L. McNutt, Jr., and J. Oberst, The equatorial shape and gravity field of Mercury from MESSENGER flybys 1 and 2, *Icarus 209,* 88-100, 2010.

6785 Sozzetti, A., D. W. Latham, G. Torres, B. W. Carney, J. B. Laird, R. P. Stefanik, A. P. Boss, and S. Korzennik, On the frequency of gas giant planets in the metal-poor regime, in *Chemical Abundances in the Universe,* K. Cunha, M. Spite, and B. Barbuy, eds., pp. 416-419, International Astronomical Union Symposium 265, Cambridge University Press, New York, 2010.

6710 Taira, T., P. G. Silver, F. Niu, and R. M. Nadeau, Remote triggering of fault-strength changes on the San Andreas Fault at Parkfield, *Nature 461,* 636-639, 2009. [Erratum published in *Nature 462,* 674, 2009.]

6786 Traub, W. A., C. Beichman, A. F. Boden, A. P. Boss, S. Casertano, J. Catanzarite, D. Fischer, E. B. Ford, A. Gould, S. Halverson, A. Howard, S. Ida, N. J. Kasdin, G. P. Laughlin, H. F. Levison, D. Lin, V. Makarov, J. Marr, M. Muterspaugh, S. N. Raymond, D. Savransky, M. Shao, A. Sozzetti, and C. Zhai, Detectability of Earth-like planets in multi-planet systems: preliminary report, in *Extrasolar Planets in Multi-Body Systems: Theory and Observations,* K. Goździewski, A. Niedzielski, and J. Schneider, eds., pp. 191-199, European Astronomical Society Publications Series, vol. 42, EDP Sciences, Les Ulis, France, 2010.

6804 Vervack, R. J., Jr., W. E. McClintock, R. M. Killen, A. L. Sprague, B. J. Anderson, M. H. Burger, E. T. Bradley, N. Mouawad, S. C. Solomon, and N. R. Izenberg, Mercury's complex exosphere: results from MESSENGER's third flyby, *Science 329,* 672-675, 2010.

____ Vogt, S. S., R. P. Butler, E. J. Rivera, N. Haghighipour, G. W Henry, and M. H. Williamson, The Lick-Carnegie Exoplanet Survey: a 3.1$M_{\oplus}$ planet in the habitable zone of the nearby M3V star Gliese 581, *Astrophys. J.,* in press.

6739 Vogt, S. S., R. A. Wittenmyer, R. P. Butler, S. O'Toole, G. W Henry, E. J. Rivera, S. Meschiari, G. Laughlin, C. G. Tinney, H. R. A. Jones, J. Bailey, B. D. Carter, and K. Batygin, A super-Earth and two Neptunes orbiting the nearby Sun-like star 61 Virginis, *Astrophys. J. 708,* 1366-1375, 2010.

6773 Voight, B., D. Hidayat, S. Sacks, A. Linde, L. Chardot, A. Clarke, D. Elsworth, R. Foroozan, P. Malin, G. Mattioli, N. McWhorter, E. Shalev, R. S. J. Sparks, C. Widiwijayanti, and S. R. Young, Unique strainmeter observations of Vulcanian explosions, Soufrière Hills Volcano, Montserrat, July 2003, *Geophys. Res. Lett. 37,* L00E18, 10.1029/2010GL042551, 2010.

____ Wagner, L., D. W. Forsyth, M. J. Fouch, and D. E. James, Detailed three-dimensional shear wave velocity structure of the northwestern United States from Rayleigh wave tomography, *Earth Planet. Sci. Lett.,* in press.

6749 Wang, C.-Y., H. Lou, P. G. Silver, L. Zhu, and L. Chang, Crustal structure variation along 30°N in the eastern Tibetan Plateau and its tectonic implications, *Earth Planet. Sci. Lett. 289,* 367-376, 2010.

6745 Warren, J. M., and N. Shimizu, Cryptic variations in abyssal peridotite compositions: evidence for shallow-level melt infiltration in the oceanic lithosphere, *J. Petrol. 51,* 395-423, 2010.

6800 Willman, M., R. Jedicke, N. Moskovitz, D. Nesvorný, D. Vokrouhlický, and T. Mothé-Diniz, Using the youngest asteroid clusters to constrain the space weathering and gardening rate on S-complex asteroids, *Icarus 208,* 758-772, 2010.

6730 Wolfe, C. J., S. C. Solomon, G. Laske, J. A. Collins, R. S. Detrick, J. A. Orcutt, D. Bercovici, and E. H. Hauri, Mantle shear-wave velocity structure beneath the Hawaiian hot spot, *Science 326,* 1388-1390, 2009.

6755 Yokoyama, T., C. M. O'D. Alexander, and R. J. Walker, Osmium isotope anomalies in chondrites: results for acid residues and related leachates, *Earth Planet. Sci. Lett. 291,* 48-59, 2010.

____ Zega, T. J., C. M. O'D. Alexander, H. Busemann, L. R. Nittler, P. Hoppe, R. M. Stroud, and A. F. Young, Mineral associations and character of isotopically anomalous organic material in the Tagish Lake carbonaceous chondrite, *Geochim. Cosmochim. Acta,* in press.

6822 Zuber, M. T., L. G. J. Montési, G. T. Farmer, S. A. Hauck II, J. A. Ritzer, R. J. Phillips, S. C. Solomon, D. E. Smith, M. J. Talpe, J. W. Head III, G. A. Neumann, T. R. Watters, and C. L. Johnson, Accommodation of lithospheric shortening on Mercury from altimetric profiles of ridges and lobate scarps measured during MESSENGER flybys 1 and 2, *Icarus 209,* 247-255, 2010.
