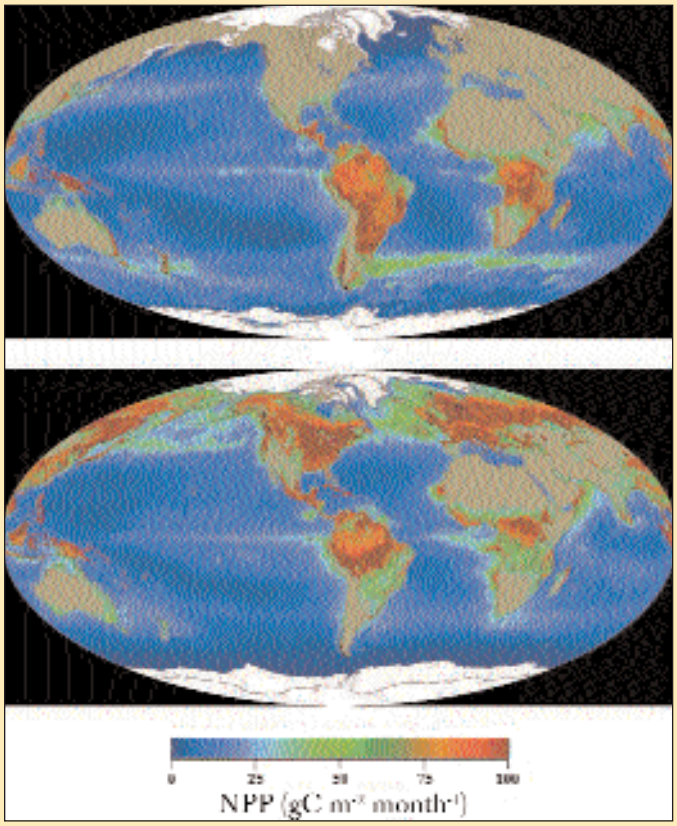
SPECTRA

Summer 2001

THE NEWSLETTER OF THE CARNEGIE INSTITUTION

Extending the Frontiers of Science



The seasonal shift in the amount of plant growth worldwide is shown in these SeaWiFS satellite images. See page 5 for the story. (Image reprinted with permission from *Science 291,* p. 2596. Copyright 2001 American Association for the Advancement of Science.)

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What's in a century?

Tom Urban

Every civilization catalogues the passage of time. The ancient Egyptians, Greeks, and Chinese kept track of planetary motions, seasonal changes, and the celebration of anniversaries using a system based on the number 10.

In our own base-10 culture, one hundred years has always been a particularly significant milestone–just longer than a normal human lifetime, but not beyond our ability to imagine. Carnegie is about to celebrate such a landmark anniversary, and it is an especially important one to us because the 10 decades of our existence have coincided with unprecedented changes in every aspect of human society. What's more, many of society's accomplishments stand on the shoulders of the scientific advancements that came from our research.

As inspiring as our past has been, we should also celebrate the work we do now that will affect the next one hundred years. Astrobiology at the Geophysical Lab (GL) and the Department of Terrestrial Magnetism (DTM) is a case in point. George Cody, Nabil Boctor, Bob Hazen, Alan Boss, Paul Butler, and their colleagues are all making significant contributions to answering some of the most intriguing questions humans have ever asked: How did life originate on Earth, and are there worlds elsewhere similar to our own? In just a few short years, these scientists have made huge strides in this emerging field. (See page 10.)

The high-pressure work led by Rus Hemley and Dave Mao at GL is another area that will continue to reveal astonishing and relevant results. By pushing the limits of technology, these scientists and their collaborators have created new semiconducting materials that have the potential for unimaginable applications as the 21st century unfolds.

The current work at Embryology and Plant Biology is no less amazing. Both departments are studying the function of genes and how animals and plants develop. This work is yielding insights into the genetics of human disease and may eventually help solve many other problems of a growing population.

When Hubble discovered that the universe is expanding and that our galaxy is but a small piece of it, it shattered what we thought we knew about our place in the cosmos. With the Magellan telescopes up and running, the Observatories staff will build on this knowledge and no doubt surprise us all with what they will learn.

Andrew Carnegie launched our institution with these words, "Your work now begins, your aims are high, you seek to expand known forces, [and] to discover and utilize unknown forces for the benefit of man." Our achievements of the last century–and our work now–are the result of aiming high. As we embark on the next century of Carnegie science we should keep this aim squarely in sight.

Tom Urban, Chairman

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Trustees' May Meeting

The spring 2001 meeting of the board of trustees was held at the Department of Plant Biology in Palo Alto, California, on May 3 and 4. The Finance Committee began the session with a report on the general good health of the Carnegie endowment. The board also discussed a variety of initiatives planned for Carnegie's centennial year and they voted to establish a new department dedicated to the study of global ecology; it will be officially launched in July 2002.

William Coleman, Jr., has become a senior trustee. At the meeting, the board voted to add a new trustee, Deborah Rose. Rose received her Ph.D. from Yale's Department of Epidemiology and Public Health. She works for the National Center for Health Statistics of the Centers for Disease Control. Among her many affiliations, she is a member of Harvard's School of Public Health Alumni Council, the American Public Health Association, and the Society for Epidemiologic Research. Over the years, Rose has been active in a variety of public service projects.

Four new staff appointments were also announced at the meeting. The Department of Terrestrial Magnetism welcomes two new researchers, and the Geophysical Lab and Plant Biology each gain one new investigator. (See page 8 for details.)

In light of recent declines of major stock market indexes, such as the S&P 500 and NASDAQ, some have wondered how Carnegie's endowment has fared. Thus far it has weathered the downturn admirably. The endowment is broadly diversified among stocks, bonds, and alternative assets. The equity portion has a value-oriented emphasis. These factors contributed to its total return of 12.7% for the year ending March 31, 2001. During the same period the S&P 500 returned -21.6 percent.

Trustees Learn About Plant Biology and More

Between the business sessions of the meeting, several Carnegie scientists talked to the trustees about their research. Board members and their guests were also given tours of Plant Biology laboratories and the Jasper Ridge Biological Reserve.

On Thursday, May 3, Dave Ehrhardt gave a presentation about the work his lab is doing visualizing live plant cells using a fluorescent molecular tag. Also that day, Chris Field hosted a trip to Jasper Ridge and described the nuts and bolts of his long-term global-change project. The research looks at the interactive effects of four global change factors: carbon dioxide, warming, water, and nitrogen. That evening board members, their guests, and members of the Carnegie staff enjoyed a dinner at the University Club arranged by Plant Biology's business manager, Mary Smith.

Two Observatories Staff Members gave presentations to the trustees on Friday. Luis Ho talked about his work on black holes and quasars, and Michael Rauch discussed his research on the intergalactic medium and the distribution of matter in the universe.

Staff Member Chris Field (left) describes his global-change project at Jasper Ridge near the Plant Biology Department. David Greenewalt, secretary to the board, senior trustee Sidney Weinberg, and trustee John Crawford (left to right) listen as Field describes how the equipment operates.

Carnegie Evening 2001

Winslow Briggs, director emeritus of the Department of Plant Biology, was this year's Carnegie Evening speaker. The lecture and reception took place on May 17 at the administration building. Briggs began his talk, "Phototropism: How Plants Seek the Light," with an introduction about the four properties of light that plants sense and respond to: quality or color, duration, quantity, and direction. Briggs showed a variety of slides that illustrated each of these points as he introduced the concept of photoreceptors—proteins that absorb light. Briggs has spent most of his career studying the photoreceptors responsible for how plants respond to light direction—a mechanism called phototropism. A plant hormone called auxin activates the growth of plant cells, allowing the plant to bend toward the light source. Briggs's lab investigates the proteins responsible for this phenomenon. He described some of the experiments he and his colleagues have conducted that led to the discovery of a protein responsible for phototropism, and described two domains of the protein they identified that are involved in the job of light absorption. These domains are designated LOV1 and LOV2 because they are thought to react to *L*ight, *O*xygen, and *V*oltage. He concluded his talk with remarks on what the researchers are finding out about the differences between LOV1 and LOV2.

Below: Dave Mao (left) of the Geophysical Lab talks with Yang Song (right) from Iowa State University during the reception. Song will be joining the high-pressure group later this summer.

Above: Carnegie Evening speaker, Winslow Briggs, and his wife, Anne, enjoy a moment after the lecture.

Right: The Department of Terrestrial Magnetism's electronics engineer, Ben Pandit (left), brought his son, Ranjan Kumar Pandit, to this year's Carnegie Evening.

"Cafeteria Math" Wins CASE Alumni GIFT Award

Dan Feinberg and Sam Reheard, both Carnegie science education graduates, received a $15,000 award from the Growth Initiatives For Teachers (GIFT) program to support the development of an integrated science and mathematics lesson that grew out of Feinberg's summer CASE work. The award is given by Verizon Communications to teams of science and math teachers in grades 6 through 12 to support "an innovative school enrichment project." Seventy teams, each consisting of one math and one science teacher from the same school, received this year's prize. The duo's winning lesson was the first D.C. public school-sponsored application chosen for this award in three years.

Feinberg, a science teacher, and Reheard, who teaches math, are on the seventh-grade faculty of the Hardy Middle School in Washington, D.C. The idea for the team's proposal grew out of an original lesson, "Hamburger Dissection," developed by Feinberg while he was at CASE in 1998. The lesson began with an all-encompassing view of the digestive system, which was then related to nutrition. The GIFT proposal, "Cafeteria Math," is a cross-curricular unit that emphasizes the interrelationship of science and math by studying the digestive system. First, the students determine what their bodies' energy requirements are. They then learn where they get this energy, what the body does with it, where it is used, and what happens if there are nutritional deficiencies. By studying the school lunch menu at Hardy, they are learning if and how their daily requirements are being met. Ultimately the students will build a cost-effective, nutritionally balanced public school menu and submit it to the District of Columbia Public Schools director in charge of meals.

Student reaction to the proposal has been very positive. According to Feinberg, "One of the largest problems facing teachers is student motivation. The students must see why information is important to them. It's not enough to simply put the information out there and expect the students to come get it. For as long as there has been school lunch, students have complained about it. The value of an everyday example, such as this one, is that it delivers the material to the students. This project will hopefully address what for many of them is a very serious concern: that their food taste good!" Feinberg and Reheard will receive their prize this June at a conference to be held in Washington, D.C.

Centennial Activities Shape Up

Plans for Carnegie's centennial celebration are well under way. The exhibition, *Our Expanding Universe,* will open to the public on December 7, 2001, and run through May 31, 2002, at the administration building. The hours will be 12 to 5 p.m., Tuesday through Sunday, and 12 to 8 p.m. on Thursdays. A gala grand opening of the exhibition is scheduled for Thursday, December 6, from 8 to 10 p.m. On Saturday, December 1, Carnegie scientists, staff, and their families are cordially invited to preview the exhibit from 2 until 4 p.m.

The institution will also sponsor a number of events during the centennial year, including screenings of five NOVA episodes accompanied by discussions with Carnegie scientists, and an All-Carnegie Symposium on the relationship between the physical and biological features of the Earth. The symposium, which will be held at the administration building, will begin Friday evening, May 3, 2002, with a keynote address. It will continue through Saturday, May 4, and conclude with a barbecue picnic at the Broad Branch Road campus that evening. There are also plans for a contest for local students, who will be invited to produce a graphic design based on Carnegie science. The winning design will appear on centennial T-shirts.

A celebration of Andrew Carnegie's philanthropy is scheduled for Monday, December 10, 2001, in New York City. This event will gather the board members from Carnegie's many foundations for discussions and conversation. It will conclude with a concert at Carnegie Hall.

The Joseph Henry Press, an arm of the National Academy Press, is publishing an illustrated book about the history and achievements of the Carnegie Institution. James Trefil is writing the book, which will be available for the exhibition's opening. Five departmental histories are also in the works. In addition, each of the five departments is planning its own celebratory events.

Free Floaters: Are They Planets or What?

Recently several different groups of scientists have uncovered evidence for free-floating celestial objects that have masses believed to be as low as 5 to 13 times the mass of Jupiter. Although they do not orbit a star, they have been labeled planets by some because they are not massive enough to burn deuterium. As astrophysicist Alan Boss of the Department of Terrestrial Magnetism says, "This use of the 'p-word' has created considerable controversy." Many scientists think that it is unlikely that objects so low in mass could have formed in the same way in which stars form, leading to the suggestion that they were tossed out of planetary systems. A recent paper by Boss published in the *Astrophysical Journal (Letters)* shows that magnetic fields may be the responsible party allowing stars to form with masses as low as about one Jupiter mass. In this case, free-floating objects below 13 Jupiter masses would be best termed sub-brown dwarfs, not planets, according to Boss.

Searches for very low mass, free-floating objects in young star clusters, such as Orion, have revealed hundreds of brown dwarf candidates with estimated masses below the hydrogen-burning limit, equivalent to about 75 Jupiters. Some have even been found with inferred masses below the deuterium-burning limit of 13 Jupiters. In other studies, radial velocity surveys have detected over 50 likely planets orbiting Sun-like stars with masses from lower than one Saturn mass to more than 15 Jupiters. Evidently the least massive floating objects can be less massive than the heftiest planetary companions to Sun-like stars. And this blurs a mass-based distinction between stars and planets. These observations also raise an important theoretical question: Can very low mass, free-floating objects be formed directly in star-forming regions, or must they form in planetary systems and later be ejected?

Stars form when dense clouds of gas and dust are driven to collapse by their own gravity. During this collapse phase, protostellar clouds can subdivide, or fragment, into objects of smaller and smaller mass until the cloud begins to heat above its initial temperature, increasing the pressure of the gas and helping to stifle any further fragmentation. Theoretical estimates of the minimum mass of an object formed by this process have predicted that no star could have a mass of less than about 3 to 10 Jupiter masses. Most

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La Niña Boosts Productivity of the World's Oceans

The climate cycle of El Niño and La Niña has been blamed for severe weather conditions worldwide, causing droughts in some areas and floods in others. Now scientists have evaluated the global-scale impacts of the most recent cycle on the growth of land and ocean plants and found that over a three-year period starting during El Niño and ending in La Niña, global ocean productivity increased by nearly 10%. The investigators, who included Christopher Field of Carnegie's Department of Plant Biology, reported their findings in the March 30, 2001, issue of *Science*. In contrast to the oceans, plant growth on land did not change consistently during this period. "This study makes it clear that the ecology of the global oceans reverberates with the beat of El Niño," says Field.

Plants provide food for nearly all life on Earth. All plants harvest energy from the Sun and convert it into growth through photosynthesis. The amount of growth is known as the net primary production (NPP). The more NPP there is, the more food is available for consumption by animals, including humans. The 1997 launch of the satellite SeaWiFS allowed scientists for the first time to simultaneously measure the absorption of sunlight by land and ocean plants, a key factor that determines NPP. The data were collected over the entire globe between September 1997 and August 2000. This period includes the last part of the strong El Niño of 1997-1998 and the onset of La Niña, which continues to the present.

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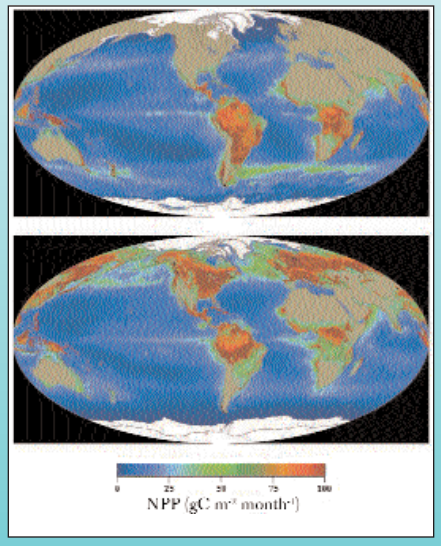

This image was generated from data obtained by the SeaWiFS satellite, which measured global plant growth, or net primary production (NPP). The top globe shows productivity during the La Niña austral summer from December 1998 to February 1999. Frame B shows productivity at the boreal summer from June to August 1999. (Image reprinted with permission from *Science 291,* p. 2596. Copyright 2001 American Association for the Advancement of Science.)

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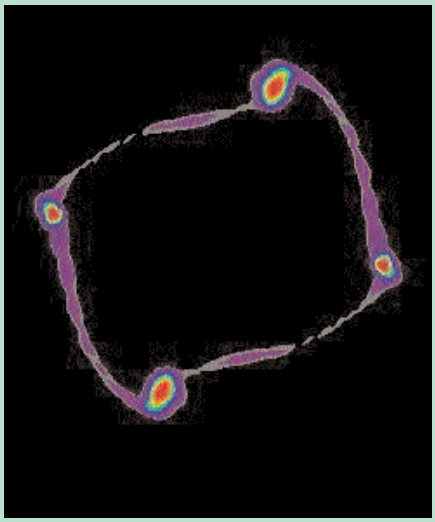
likely, such an object would end up with a considerably higher mass because it would continue to gain material after it first formed. More than a decade ago, Boss performed detailed computer calculations of this process suggesting that the lowest-mass object formed by protostellar collapse should be well over 10 Jupiter masses.

All of the previous estimates of the minimum mass, however, neglected to account for the effects of magnetic fields. In a new set of detailed computer calculations, Boss has included these effects on protostellar fragmentation in an approximation that is crude but appears to capture the essence of the physical effects. As Boss explains, "Magnetic fields can be thought of as stretched rubber bands, with a tension force that resists their being pinched together." Because of this tension force, during the star-formation process the magnetic fields help stop the cloud from collapsing into a single object at the cloud's center. As a result, the cloud remains more distended, and thus more able to break up and fragment into objects of smaller mass. Magnetic tension also helps the cloud to rebound away from the center once it begins to heat, leading to decompressional cooling and the formation of fragments of even smaller mass. Boss finds that four fragments with masses as low as about one Saturn mass may form in a single collapsing cloud in this way. A system of four fragments is expected to be highly unstable and should decay by ejecting single fragments; these would then appear as isolated objects. The fragments would continue to gain mass rapidly only until they were ejected. As a result, their masses could be within the range inferred for the Orion free floaters.



This model shows an unstable quadruple protostar system consisting of sub-Jupiter-mass components.

Boss suggests calling the free-floating objects sub-brown dwarfs because they probably formed in the same way that stars and brown dwarfs form but with less mass, and as a result would be less luminous.

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From their measurements, the investigators estimated the total NPP using an approach that integrates two production models: the Carnegie-Ames-Stanford model for land, and the Vertically Generalized Production Model for the oceans. Both models calculate NPP based on a combination of light availability, the fraction of sunlight that is harvested, and the efficiency of photosynthesis and growth. This efficiency is sensitive to a number of environmental stresses.

The results showed large seasonal and regional variations. On land, increased NPP in some places more or less canceled decreased NPP in others. In the oceans, however, NPP during El Niño was substantially lower than during La Niña. The difference is about 10% of ocean NPP, or about 5 billion tons of carbon per year. The increased productivity during La Niña appears to reflect increased availability of nutrients in several parts of the ocean, including the equatorial Pacific, the South Atlantic, and the Indian Ocean. La Niña changes ocean circulation in these places in a way that brings more nutrients to the surface, where they can be used by phytoplankton. The SeaWiFS data also revealed a striking difference between NPP in the northern and southern oceans. In the northern oceans, a strong summer bloom leads to very high productivity from 50 to 70 degrees north, or about the latitude range from the southern tip of England to the northern end of Finland. A comparable peak is absent from the southern oceans, probably because productivity is limited by nutrients, especially iron.

The El Niño/La Niña cycle has massive implications for agriculture and natural disasters in many parts of the world. Until the data from SeaWiFS became available, it was impossible to accurately assess the impacts for ocean production. Does the cycle make a difference? "You bet it does," says Field. "Ocean processes ranging from fish production to carbon storage are potentially affected by NPP. Now that we see the global patterns, we can probe more effectively for underlying mechanisms."

SeaWiFS is one of a number of recently launched satellite instruments that open new doors in global ecology. With the quality and coverage of the SeaWiFS data, scientists really can study the whole planet as if it were in their backyard. According to Field, "We were blown away at the magnitude of the NPP effect in the ocean. But I have a feeling that is not the last surprise we will see from the latest earth-observation satellites."

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Senior trustee **William Golden** was the subject of an article in the April 9, issue of the *New Yorker* for receiving the 2001 Scholar-Patriot Distinguished Service Award from the American Academy of Arts and Sciences. The prize is given to those "who embody the Academy's 221-year-old commitment to promoting the arts and sciences in the service of the community and nation." Golden has made many important contributions to science over a long career, including acting as advisor to President Truman on science-related matters. Golden was also the subject of a major feature in the May 1, *New York Times*.

Carnegie president **Maxine Singer** was quoted in the May 11, issue of the *Chronicle of Higher Education* in an article about the lack of ethnic and gender diversity in the membership of the National Academy of Sciences. Singer, a member of the academy, said that "it's just astounding that in a lot of [scientific disciplines] there's not a woman who turns up on the final ballot, when you know that there are people doing interesting and exciting work in those fields."

Mark Phillips, associate director of Las Campanas Observatory, was cited in the April 3, *New York Times* about his Hubble Space Telescope work in 1997 that captured an image of a distant supernova. The image has been used as evidence for the existence of dark energy, or negative gravity, which is thought to account for observations that the universe is expanding at an accelerating rate.

Theorist **Alan Boss** of the Department of Terrestrial Magnetism has been interviewed extensively about the recent flurry of discoveries of extrasolar objects. He was quoted in the April 17, *New York Times* on his proposal to call "floating planets" sub-brown dwarfs. On April 27, the *Washington Post* recorded his thoughts on the discovery of infant planets forming in the Orion Nebula. Other publications that have sought Boss's opinion include the *Los Angeles Times,* the *New Scientist, Science News,* and *Sky & Space.*

A discovery made by the Geophysical Lab's **Bob Hazen** and colleagues was the News of the Week in the May 5, issue of *Science News*. The scientists showed that the common mineral calcite might have been the catalyst that sparked the transition from an era dominated by chemistry to one dominated by biology about 4 billion years ago. The finding was also reported in *Chemical & Engineering News.* The BBC, *Earth & Sky,* and other media sources have also interviewed Hazen on the subject. See page 10 for details on the research.

Valarie Miller-Bertoglio, a former student in **Marnie Halpern's** lab, and Halpern herself were featured in an article about women scientists who choose to be mothers. The article was in a special edition of *U.S. News & World Report*. Halpern, a mother of two, said that women who want both science and family have to be tougher and more persistent than their male colleagues.

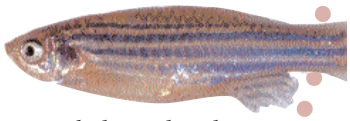
Genetics of Fat and Cholesterol Processing

Scientists at Embryology have developed a way to identify genes involved in the processing of cholesterol and fat; their method can also be used to discover new cholesterol-controlling drugs. Steven Farber, a former Carnegie Fellow, worked in Marnie Halpern's lab when he conducted the work with coinvestigator Michael Pack of the University of Pennsylvania. The study, with Halpern as a collaborator, was published in the May 18, 2001, issue of *Science.* The results of the research will help identify genes responsible for atherosclerosis, diseases associated with bile secretion in the liver, and some cancers.

Currently, there are only a few ongoing genetic screens that study vertebrate physiology. The screening method devised in this study, therefore, represents an important milestone for the real-time observations of lipid transport and processing in live animals. The scientists used the tiny, clear zebrafish larva for their research; its transparency allows them to watch what happens when fat and cholesterol are digested. They fed five-day-old larvae a custom-synthesized phospholipid that emits a bright green fluorescence when digested. Phospholipids are fats that form cell membranes and cellular messengers. The labeled lipids are able to reveal lipid-processing enzymes that are produced by specific genes in the digestive system.

The researchers used the custom lipids to screen zebrafish that carried a host of unknown mutations. The goal was to find larvae whose digestive organs exhibited an atypical fluorescence after eating the lipids, indicating a mutation in a lipid-processing gene. The team describes one such mutation, which they named *fat free,* in their *Science* paper. Fish with a mutated *fat free* gene appear to have normal digestive organs, but fail to accumulate the fluorescent lipid. They process fat and cholesterol at a significantly lower rate, leading the scientists to conclude that the *fat free* gene may be a regulator of dietary cholesterol use.

What does this mean for human lipid disorders? The investigators suggest that drugs that interfere with the *fat free* gene may be a useful way to control high cholesterol in people. Basing their conclusion on an experiment they conducted incubating fish with atorvastatin (Lipitor by Parke-Davis), they also claim that zebrafish should be as good as mice for identifying genes that are involved in human lipid metabolism and lipid disorders. Lipitor, a widely prescribed drug used to treat hypercholesterolemia, inhibits cholesterol synthesis. Fish on Lipitor were barely able to digest the green fluorescent phospholipid, suggesting that the gall bladder did not release bile, which is necessary for fat digestion. The scientists believe that the drug works by inhibiting the synthesis of cholesterol-derived bile, which is required for fat breakdown. A major effort to identify the molecular identity of the *fat free* gene is now under way in the Farber laboratory in the Kimmel Cancer Center at Thomas Jefferson University.



Pictured above is an adult zebrafish.

Carnegie Welcomes Four

Four new researchers are joining the Carnegie staff. Zhi-Yong Wang comes to Plant Biology from the Salk Institute and the Howard Hughes Medical Institute in San Diego, California. He received his Ph.D. in molecular, cell, and developmental biology from the University of California, Los Angeles. The Geophysical Lab welcomes Andrew Steele. Steele has been consulting at NASA's Johnson Space Center, astrobiology division, and serving as an assistant research professor in the Department of Microbiology at Montana State University. He also lectures at the School of Earth, Environmental and Physical Sciences at the University of Portsmouth in the United Kingdom, and

Zhi-Yong Wang studies a plant steroid hormone called brassinosteroid, which is important to growth and development, particularly in respect to the way light is used for growth. He is interested in identifying and understanding the genes involved in the series of signals that are required for the steroid to function in the model plant *Arabidopsis*. His ultimate goal is to unravel this molecular network and determine how light, the brassinosteroid, and the circadian clock interact in plant development. His research is advancing our understanding of the environmental and hormonal cues that regulate plant growth, and will provide new tools for improving plant productivity.

Andrew Steele uses high-magnification microscopy and surface-sensitive analysis to study a variety of terrestrial and extraterrestrial samples to establish biosignatures, which indicate the presence of life. Some of the samples Steele analyzes include microbial mats from hot springs, Antarctic rocks, and Martian meteorites. Using approaches from biotechnology, he classifies microbial contamination of the extraterrestrial samples to determine whether microbiota found in these samples originate from Earth or from extraterrestrial sources. In addition, Steele is adapting microarray technology used for DNA analysis on Earth to space missions, which will look for life elsewhere.

New form of Nitrogen: Pressurized

For the first time, scientists have subjected condensed nitrogen gas to record pressures and turned the material into an opaque semiconducting solid. Mikhail Eremets, Russell Hemley, Ho-kwang Mao, and Eugene Gregoryanz of the Geophysical Laboratory and the Center for High Pressure Research at Carnegie reported their results in the May 10, 2001, issue of *Nature*.

In addition to pressurizing the two-atom molecule, which makes up 75% of Earth's atmosphere, to almost 2.4 millions times the atmospheric pressure at sea level (240 gigapascals), the researchers were able to recover the new nonmolecular material at atmospheric pressure. The experiment also represents the first time that a team has been able to make electrical measurements on any condensed gas under such extreme high-pressure conditions.

The new dense semiconducting form of nitrogen stores a large amount of energy and could potentially serve as a new energetic material. Dense materials that have formed from light elements might also be part of the cores of large gas planets. According to Hemley, "The fact that the major portion of the air has been turned into a semiconducting solid and brought back to be stable at ambient pressure is an important breakthrough for us."

For years theorists have predicted that molecular nitrogen, N_2, would undergo a transition to a nonmolecular state at pressures near 1 million atmospheres (100 gigapascals) to become either a semiconductor or a metal. The latter would be similar to solid metallic hydrogen, which was predicted more than 65 years ago, but has not yet been produced in the laboratory.

Because of technical constraints, previous high-pressure experiments were limited in the range of pressures that could be reached on nitrogen and in the number of measurements that could be performed while the gas was under pressure. Last year the Carnegie scientists reported signs of the transformation at room temperature using optical methods alone.

In the present experiment, the

New Staff Researchers

he is a visiting researcher at the Department of Earth Sciences at Oxford. Steele received his Ph.D. from the University of Portsmouth, where he studied environmental microbiology and biotechnology.

The Department of Terrestrial Magnetism is gaining two new staff researchers. Alycia Weinberger comes from UCLA, where she was a NICMOS postdoctoral research astronomer. She received her Ph.D. from the California Institute of Technology. Sara Seager, who is also joining the DTM staff, is from the Institute for Advanced Study at Princeton. She received her Ph.D. from Harvard studying extrasolar giant planets.

Alycia Weinberger is studying planetary system formation. Using infrared instrumentation, she detects and analyzes disks surrounding stars of different ages and spectral types to determine how the raw materials of dust and gas can form into and be sculpted by planets. Weinberger uses the Hubble Space Telescope and the W. M. Keck Observatory in Hawaii for her observations. To complement this effort, she is working on adaptive optics systems for ground-based telescopes. Adaptive optics technology corrects for the distorting effects of Earth's atmosphere.

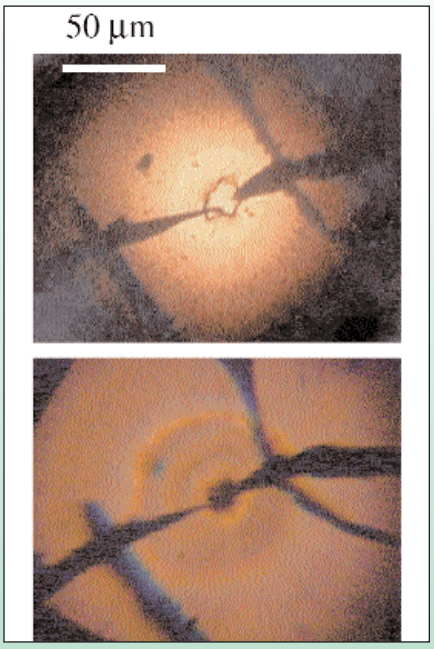
Sara Seager's research is in two very different areas: cosmology and extrasolar planets. In her cosmology work she studies what happened in the early universe when electrons and protons combined to form hydrogen and helium. It was during this "recombination epoch," 300,000 years after the Big Bang, that photons last interacted with matter. We see them today as cosmic background radiation. In her work on extrasolar planets, on which she collaborates with both theoretical and observational groups, Seager has developed models characterizing the atmospheres of gas giant planets that are in close proximity to their stars. This work is helping researchers to understand planetary evolution and formation, and to predict and interpret observations.

Gas Becomes a Solid Semiconductor

investigators used newly developed techniques that directly measure electrical conductivity of the material while it is at varying temperatures under very high pressure. They found that nonmolecular semiconducting nitrogen can be maintained over a remarkably wide pressure range, and that it can retain this state when it is decompressed at low temperature.

The observations of this new material suggest that other novel high-density products made from simple molecules–perhaps even solid metallic hydrogen–could be created at high pressure and recovered at ambient pressure conditions. The recent work also confirms the prediction of the transition pressure using so-called first-principles theory, which has been used extensively for predicting new properties, such as high-temperature superconductivity in metallic hydrogen.

The National Science Foundation and the Carnegie Institution supported this work.



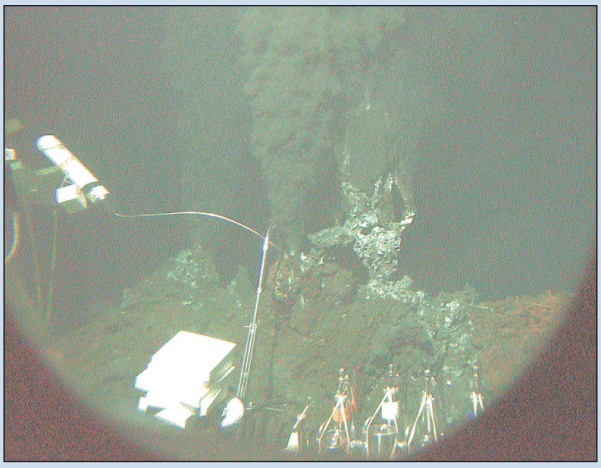
These are photomicrographs of a sample of nitrogen at 70 gigapascals (GPa) (top panel) and 193 GPa (bottom panel) at 80 K. At these low temperatures, nitrogen transitions abruptly at 190 GPa to a nonmolecular solid. The sample is characterized by contraction and darkening and the loss of vibrational modes characteristic of molecular nitrogen. The platinum microelectrodes for measuring electrical conductivity of the sample are visible.

Astrobiologists Congregate at Carnegie

The 2001 general meeting of NASA's Astrobiology Institute (NAI) was held at Carnegie's P Street building in Washington, D.C., April 10-12. Several Carnegie scientists from the Department of Terrestrial Magnetism (DTM) and the Geophysical Laboratory (GL) who are members of the institute gave talks and chaired sessions. President Maxine Singer, a participant on the NAI director's Science Council, began the program by welcoming everyone and explaining how Carnegie became one of the lead partners in the NAI. She also talked about the educational programs at the Carnegie Academy for Science Education (CASE), which are part of this astrobiology work.

Biochemistry at hydrothermal vents

George Cody of the Geophysical Lab gave the first paper of the conference. The paper was coauthored by colleagues at GL. Cody's talk, "Could Biochemistry Have Hydrothermal Origins?" described experiments mimicking conditions at high-pressure, high-temperature hydrothermal vents at the ocean bottom. Among the broad range of experiments conducted, the group looked at how pyruvic acid and citric acid systems responded to increases in pressure and temperature. The synthesis of pyruvic acid and citric acid is crucial to the development of prebiotic carbon fixation pathways–the process whereby carbon is incorporated into organic molecules. Both compounds play critical roles in energy production through metabolisms in living organisms. In the citric acid system they found that increased pressure enhanced certain reactions, which accelerated catabolic, or decomposition, processes. They also examined the catalytic properties of a naturally occurring transition metal sulfide–a compound where the mineral iron sulfide and organic molecules combine–to determine if it has a biochemical function. The researchers found that in fact such compounds can promote reactions that could function biochemically, suggesting such materials might be involved in promoting early life. The combination of these potentially natural catalysts with the citric acid system reveals a viable prebiotic pathway for useful carbon fixation.



This picture was taken from the *ALVIN* submersible during GL's John Frantz's dive on the Juan de Fuca Plate. The hydrogen fugacity measurement sensor is being deployed into an active hydrothermal vent. (Image courtesy John Frantz.)

Amino acids on early Earth

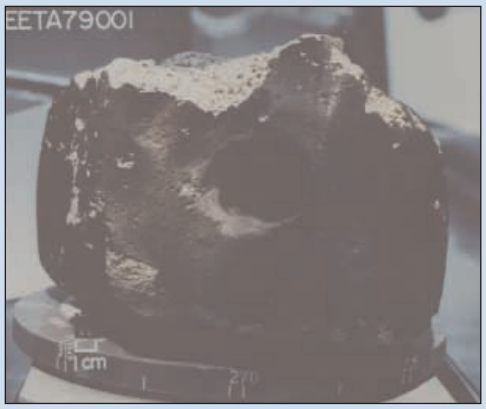
In the same session Bob Hazen, also from GL, talked about a discovery made by his group that might explain one important step in the evolution from the chemical world to the biological world of today. For a transition to occur amino acids–the building blocks of proteins in all living systems–had to link into chainlike molecules. This is a first step in the formation of proteins with molecules of pure L amino acids, and D sugars as found in DNA and RNA. The molecular structure of all but one amino acid consists of an asymmetrical arrangement grouped around carbon. This means that there are two mirror-image forms of each amino acid, and they have been designated left- and right-handed. All of the chemistry of living systems is distinguished by its use of these left- (L) and right-handed (D), or chiral, molecules. Nonbiological processes, on the other hand, do not usually distinguish between L and D variants. For the transition to occur between the chemical and biological eras, something had to separate and concentrate the left- and right-handed amino acids. The search for this mechanism has baffled researchers for more than half a century. Now, Hazen and Timothy Filley of Carnegie, and Glenn Goodfriend of George Washington University, have found that when they exposed crystals of the common mineral calcite to a dilute solution of the amino acid aspartic acid, the

This is a photo of the mineral calcite. (Image courtesy Bob Hazen.)

left- and right-handed molecules adsorbed preferentially onto different faces of the calcite crystal. Calcite crystals, common today, were also prevalent during the Archean Era some 4 billion years ago, when life first emerged. This study suggests a plausible process by which the mixed D and L amino acids in the very dilute "primordial soup" could be both concentrated and selected on a readily available mineral surface.

The origin of water in Martian meteorites

DTM director Sean Solomon chaired the session on what space missions will find on Mars, Europa, and elsewhere. Nabil Boctor of GL presented results of research on the origin of extraterrestrial water in meteorites from Mars, on which he collaborated with DTM's Conel Alexander, Jianhua Wang, and Erik Hauri. Martian meteorites contain evidence of the environment in which they were formed. In particular, hydrogen isotopes can yield information on the history and sources of water, and this can help researchers determine if conditions once existed on Mars to support life. The Martian atmosphere has a ratio of deuterium (an isotope of hydrogen that is twice the element's normal mass) to hydrogen that is five times greater than that found on Earth. Until recently, the high concentration of this so-called heavy hydrogen found in meteorites has been explained by the interaction of water near the surface of Mars with the Martian atmosphere. The Carnegie scientists investigated seven Martian meteorites. They looked at the petrology, shock history, and composition of hydrogen isotopes in the samples and found evidence that extraterrestrial heavy hydrogen was mixed in with terrestrial hydrogen. Previous shock experiments had shown that water becomes isotopically heavy when subjected to conditions similar to the impact process meteorites experienced when ejected from the surface of Mars. The researchers believe that at least some of the isotopic changes of the hydrogen in the samples are a result of the impact process and are not simply an interaction with the Martian atmosphere.



This is Martian meteorite EETA 79001, one of the samples used in the study. (Image courtesy NASA.)

The latest on extrasolar planets

The final session of the conference, chaired by DTM's Alan Boss, presented research on what we are finding outside our solar system. Paul Butler, also of DTM, gave a status report on the latest research in extrasolar planets. All of the 60 to 70 "exoplanets" now found were discovered with the precision Doppler technique pioneered by Butler and longtime collaborator Geoffrey Marcy. Recent discoveries from the Butler/Marcy group include all three of the multiple-planet systems thus far found, the only instance of planets locked in synchronous orbits, and the only known transit planet. On the basis of the current tally, it appears that between 7% and 10% of stars have planets around them and that most of the planets have masses equivalent to five Jupiters or less. The task for astrobiology is to find planets in solar systems similar to our own. Out of the entire collection of exoplanets only one is in an Earth-like circular orbit. By 2010 the group will have completed their survey of 2,000 Sun-like stars, at which point researchers will have a better understanding of how typical a solar system like ours is.

Maxine Singer

The Postdoc Plight

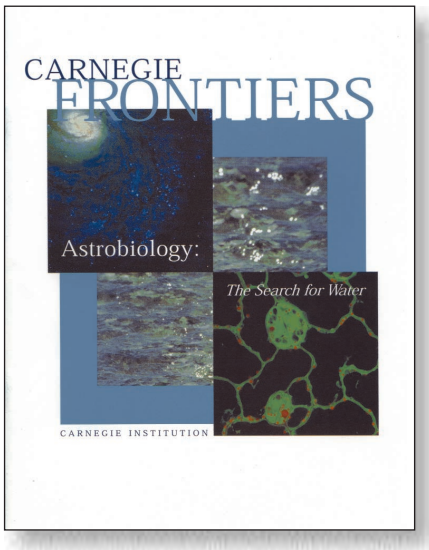
There are some 52,000 postdoctoral researchers working in U.S. institutions. A conference hosted earlier this year by the Committee on Science, Engineering and Public Policy (COSEPUP) of the National Academies focused on changing the adverse conditions under which many of these researchers work. Last fall COSEPUP issued a report citing that postdocs are poorly compensated, have low status, and receive few benefits. At the same time, they make "creative and fundamental contributions to research projects," says Maxine Singer, Carnegie's president and chair of COSEPUP. The point of the recent gathering was to disseminate information about the problem to affected groups and get them moving toward solutions. Attendees included academic advisors, administrators, scientific organizations, and postdoctoral associations. Singer told *Chemical & Engineering News* that "it's everybody's responsibility…everybody may have to ante up" to solve the complex problem. More information on the subject can be found at http://www4.nationalacademies.org/pd/cosepup.nsf.

Carnegie Frontiers

As part of its astrobiology work, the Carnegie Academy for Science Education (CASE) has published the first volume of a new series of booklets called Carnegie Frontiers to supplement science education in kindergarten through grade 12. The first installment, *Astrobiology: The Search for Water,* introduces the science of astrobiology, which is an interdisciplinary approach to understanding the origins of life on Earth and its potential for existence elsewhere. The text explores the importance of water to life on Earth and examines the question of whether water is necessary for life on other celestial bodies as well.

The series has an added feature. It employs a bar code-like technology that allows readers to access related Web sites without having to type in lengthy Universal Resource Locators (URLs). A mouselike device called a :CueCat is used to swipe any of 10 bar codes that link the reader to specific Internet pages on subjects such as "extraterrestrial water" and "evidence from Mars."

The booklets are being used as part of the CASE curriculum and have been distributed to science teachers nationwide through the National Science Teachers Association and NASA.



This is a deep, near-infrared image of the elliptical galaxy NGC 5090 (center) and the spiral galaxy NGC 5091 (lower right), taken with the new Walter Baade 6.5-meter telescope at Carnegie's Las Campanas Observatory. The globular clusters surrounding NGC 5090 are evident as faint, fuzzy points. The image was captured over 46 minutes using a CCD (charge-coupled device) of 2048 x 2048 pixels at 0.51 arc-second, which is excellent "seeing." (Exposure taken by Alan Dressler of the Observatories on April 1, 2001.)

In Brief. . .

ADMINISTRATION

Maxine Singer was profiled in the *Radcliffe Quarterly* for her Sept. 26, 2000, discussion on the genetic modification of plants at the second of the Radcliffe Institute inaugural lectures. She spoke on the same topic at the Philosophical Society of Washington on Jan. 26, 2001, and also on Feb. 23 at a symposium in memory of Carlos Chagas at the Pontifical Academy of Science, Vatican City.

CASE/First Light's **Greg Taylor** has been accepted into the Intel Master Teacher Program. Upon completion of the program, Greg will receive a $5,000 cash grant for First Light to purchase computer equipment. Intel Master Teachers are also expected to train at least 40 other teachers over the next two years.

PLANT BIOLOGY

Shauna Somerville's lab welcomed **Miroslova Kaloper**, computer analyst; **Damares Monte**, postdoctoral research assistant from EMBRAPA in Brazil; **Laurent Zimmerli**, postdoctoral research assistant from U. Fribourg, Switzerland; and **Serry Koh**, postdoctoral research assistant from U. Tennessee.

Chris Field's lab welcomed **Florent Mouillot**, postdoctoral research assistant from U. Corsica, France; **Emily Goodwin**, lab assistant; and Forrest Fleischman, lab assistant.

Arthur Grossman's lab welcomed **Wing-On Ng**, postdoctoral research assistant from Washington U., St. Louis, and **Melynda Barnes**, lab assistant.

Sue Rhee's lab welcomed **Jill Larimore**, lab assistant from Foothill Coll., Los Altos Hills, CA; **Holly Nottage**, curator intern, also from Foothill Coll.; **Bryan Murtha**, Web-application developer; **Jungwon Yoon**, curator assistant; **Bengt Anell**, predoctoral research assistant from Uppsala U., Sweden; and **Aisling Doyle**, curator intern from Ireland.

Dave Ehrhardt welcomed **Jan McConnell**, postdoctoral research assistant from U. Wisconsin, Madison, to his lab.

Joe Berry welcomed **Lawrence Giles**, senior lab technician, to his lab.

Susan Cortinas, secretary/receptionist, and **Erin Desing**, administrative assistant, joined the staff.

On Oct. 19 **Chris Somerville** gave a talk entitled "The Future of Plant Biotechnology" at Rothamstead Experimental Station in Harpenden, England. Three days later, he spoke on "Mutant Analysis of Early Pattern Formation in *Arabidopsis*" at a conference on plant development in Capri, Italy.

On Nov. 9 **Shauna Somerville** gave a talk at the Academia Sinica in Taiwan as part of the Symposium on Plant Science for the 21st Century.

In Dec. **Winslow Briggs** participated as an invited speaker in a symposium on plant signaling held at U. Bochum, Germany, and also presented a seminar, "The Phototropin Family of Plant Photoreceptors," at U. Freiburg.

From Dec. 7 to Dec. 13, **Margarita Garcia-Hernandez** and **Eva Huala** attended the *Arabidopsis* Genome Meeting at Cold Spring Harbor Laboratory. Margarita gave a talk on "The *Arabidopsis* Information Resource (TAIR): A Comprehensive Database for *Arabidopsis thaliana*."

From Jan. 13 to Jan. 18, 2001, **Sue Rhee** and **Leonore Reiser** attended the Plant and Animal Genome Meeting in San Diego, CA. Sue Rhee gave a talk entitled "Integration of *Arabidopsis* Data via the Web." Leonore Reiser spoke on "Development of Controlled Vocabularies for The *Arabidopsis* Information Resource (TAIR) Database."

OBSERVATORIES

Many astronomers from the Observatories, including **Scott Chapman**, **Hsiao-Wen Chen**, **Alan Dressler**, **Luis Ho**, **Paul Martini**, **Pat McCarthy**, **John Mulchaey**, **Jason Prochaska**, **Michael Rauch**, and **François Schweizer**, attended the 197th meeting of the American Astronomical Society, held in Jan. in San Diego. Pat McCarthy gave a talk entitled "The Clustering of Faint Red Galaxies in the Las Campanas IR Survey" at the meeting.

Plant Biology's newest staff scientist Zhi-Yong Wang (see page 8.).

Pat McCarthy participated in the Science Oversight Committee meeting for the Wide Field Camera 3 for the Hubble Space Telescope and gave a presentation entitled "Deep Panochromatic Surveys of Faint Galaxies from Orbit."

Wendy Freedman, **Michael Rauch**, **François Schweizer**, and **Scott Trager** participated in an international conference on Astrophysical Ages and Timescales held in Hilo, HI, Feb. 5-9. Freedman summarized her team's finding on the Hubble constant and age of the universe, and Trager presented results on the formation timescale of elliptical galaxies and bulges. Following the meeting, Schweizer participated in a guided tour of the Gemini North 8-m telescope and the Subaru 8.2-m telescope atop Mauna Kea.

In Jan. Schweizer also visited the Gemini South 8-m telescope on Cerro Pachon and the Cerro Tololo Observatory as part of a joint meeting held in La Serena, Chile, by the AURA Observatories Council and the AURA Oversight Committee for Gemini.

Carnegie Fellow **Jason Prochaska** has just been awarded a Hubble Fellowship, which he intends to use to pursue his research at the Observatories.

Rebecca Bernstein gave an invited talk at the Feb. 2001 Conference of the American Association for the Advancement of Science in a session called "Assembling the Universe: The History of Star Formation."

A scientific workshop in honor of Ray Weymann was held at the Observatories on April 4-6. The title of the workshop was "Extragalactic Gas at Low Redshift." Over 80 scientists from around the world attended the event.

EMBRYOLOGY

Postdoctoral fellow **Ararat Jan Ablooglu**, from Mount Sinai Graduate School of Biological Sciences and New York U., joined the Halpern lab on Feb. 12. He is studying neuronal development in zebrafish.

Tavon Burton joined the Halpern lab as a new animal-care technician.

Postdoc **Amy Rubinstein** accepted a position at Zygogen, a new zebrafish biotechnology company in Atlanta.

Erika Matunis received an R01 Award for her study "Control of Stem Cell Fate in *Drosophila* Spermatogenesis" from the National Institute of Child Health and Human Development, National Institutes of Health. Erika has also been invited to lecture at the 16th Testis Workshop, "Regulatory Mechanisms of Testicular Cell Differentiation."

Alejandro Sánchez Alvarado and his lab's research on planarians were featured in the Feb. 2001 issue of *Findings,* a publication of the NIH's National Institute of General Medical Sciences.

Dr. Chiyoko Kobayashi returned to U. Okayama in Japan after spending five months in the laboratory of Sánchez Alvarado training in the use of double-stranded RNA to study neuronal activity in planarians.

Jim Wilhelm has been awarded a Life Sciences Research Foundation Fellowship beginning June 1, 2001. Wilhelm will be giving the Larry Sandler Memorial Lecture on his thesis research at the annual *Drosophila* research meeting.

Olayemi (Yemi) Ikusika has joined the Wilhelm lab.

Postdoctoral fellow **Andrew Wilde** accepted a position as an assistant professor at U. Toronto.

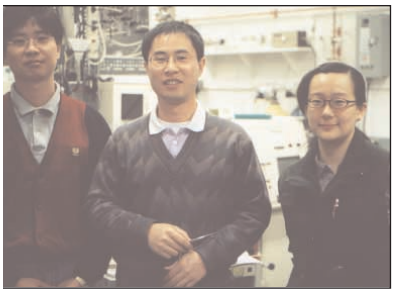
New members of the Zheng lab are Drs. **Ming-Ying Tsai** (UT Southwestern Medical Center), **Shinichi Kawaguchi** (Osaka U., Japan), **Hoi Yeung Li** (Hong Kong Chinese U., Hong Kong), and graduate student **Kan Cao** (Johns Hopkins U.).

In Brief. . .

GEOPHYSICAL LABORATORY

Robert Hazen gave the first Distinguished Lecture Series presentation at the Smithsonian Institution on "Emergence and the Origin of Life." He appeared on Virginia Public Radio's *With Good Reason* in a program on high-pressure research. In Jan. he spent a week as Visiting Investigator at UC-Santa Cruz, where he worked with chemistry professor David Deamer on the hydrothermal synthesis of molecules that form membranelike structures.

On Jan. 10 **David Mao** gave an invited talk, "High Pressure–A New Dimension in Studies of Earth and Planetary Interiors," at the Geological Society of Washington. Mao also gave an invited talk for the Zhong Guan Cun Forum of Condensed Matter Physics at the Institute of Physics, Chinese Academy of Sciences, on Nov. 3, and an invited talk at the Symposium on Strongly Correlated Electron Phase under Multiple Environments organized by Osaka U., Japan, on Nov. 8. He participated in the ERL (Energy Recovery Linac) Workshop on Novel Science at Cornell U. Dec. 2-3. At the fall AGU meeting in San Francisco Mao gave an invited talk, "Dynamics of hcp Iron at Core Conditions," and on Jan. 19 he delivered another invited talk, "High Pressure–A New Dimension in Physical Science," at the Laser Processing Consortium (LPC) Workshop and FEL User Meeting at Jefferson Lab., Newport News, VA. From Feb. 2 to Feb. 4 he attended the San Diego Mineral Physics Workshop.



Shown (from left) are GL's Visiting Investigator Guk Lac Kim, postdoctoral associate Guixing Hu, and Visiting Investigator Pei-Ling Wang. All are currently working in Doug Rumble's lab.

The **Hatten S. Yoder, Jr.**, 80th birthday symposium and dinner was held on Mar. 24. Co-workers and colleagues from GL and around the world presented talks covering many aspects of igneous petrology.

On Jan. 16 **Hatten Yoder** met with Congresswoman Constance Morella and the staff director of the U.S. House of Representatives Subcommittee on Technology, Jeffrey H. Grove, to discuss the problem of future U.S. accessibility to dwindling mineral resources. Yoder was also elected an honorary fellow of the World Innovation Foundation. Lastly, in recognition of his service during the Cold War, Yoder received a certificate of recognition from the secretary of defense for "promoting peace and stability for this nation." Yoder served as a navy meteorologist at the U.S. Weather Central in Siberia, which was established to forecast the weather for the planned invasion of Japan in Nov. 1945.

Guk Lac Kim, who has been appointed Visiting Investigator at GL, is also a postdoctoral fellow at the Smithsonian Institution, where he is working with Glenn MacPherson on meteorites. At GL, Kim will be using Doug Rumble's laboratory facilities to analyze chondritic meteorites, focusing special attention on individual chondrules and CAI minerals.

Fraukje Brouwer (Utrecht U.) has been appointed a Visiting Investigator at GL and will also be working in Doug Rumble's laboratory.

Wendy Mao (MIT) has been appointed a graduate intern and will be working with Dave Mao and others in the area of high-pressure physics, chemistry, and materials research.

George Cody participated in the 2000 International Chemical Congress of Pacific Basin Societies, where he presented two invited talks, one on "Hydrothermal Organic Chemistry and the Origins of Life," and the other titled "From Biomacromolecules to Geomacromolecules–A Complex Evolutionary Tale."

Plant Biology's **Chris Field** and GL's **Russell Hemley** were elected to the membership of the National Academy of Sciences at the Academy's 138th annual meeting.

Achintya Madduri, son of **Maddury Somayazulu** and a senior at Thomas Jefferson High School for Science and Technology in Alexandria, VA, was a finalist in the Intel National Science Talent Search. While working on the project "Pressure-Induced Transformations in Molecular Solids–N_2O and CO_2," Madduri mentored at GL in **Rus Hemley's** laboratory. **Lora Armstrong**, a senior at Montgomery Blair High School in Maryland, was selected as a semifinalist in the Intel National Science Talent Search. She worked with **Bjørn Mysen** as a summer intern for two years on a project studying the solution behavior of major elements in aqueous fluids and element partitioning between aqueous fluids and silicate melts at high pressure and temperature.

In Feb. **Jie Li**, **James Van Orman**, and **Bill Minarik** journeyed to the Kobe region of Japan to use the Spring-8 synchrotron facility. There they were joined by former GL researchers **Kei Hirose** (Tokyo Inst. Technology) and **Mike Walter** (Okayama U.). Their experiments are a continuation of a project begun at Spring-8 in Apr. 2000 to calibrate the equations of state (EOS) of several cubic metals against one another, and to tie the phase-transformation pressures of several binary silicate systems to the EOS of gold.

Rus and Amanda are pleased to announce the arrival of **Emerson Davis Hemley**, who came into this world on Jan. 19, 2001.

Shown (from left) are DTM's Paul Butler, and Geoffrey Marcy and Debra Fischer of UC-Berkeley at a press conference at the AAS meeting in San Diego in Jan., announcing the discovery of two bizarre new multiplanet systems around nearby stars.

GL/DTM

Ken Nealson, director of the Center for Life Detection at the Jet Propulsion Laboratory, has been appointed the Cecil and Ida Green Senior Visiting Fellow. Dr. Nealson works in the field of astrobiology, developing methods to detect life forms on other planets, specifically Mars. He also investigates early life on Earth, and the biogeochemistry of metals. The Cecil and Ida Green Foundation has contributed funds to support visiting scientists at the Carnegie Institution. The foundation, established in 1958, is known for its contributions to education, health services, and scientific research.

Francis Boyd, **Richard Carlson**, **David Mao**, **Steven Shirey**, and former DTM postdoctoral fellows **Sonia Esperança** and **Graham Pearson** participated in the White House Diamond Conference: Technologies for Identification and Certification in Jan. The conference was sponsored by the White House Office of Science and Technology Policy. Discussions centered on defining the technical capacities and limitations of chemical and physical analyses to distinguish illegally traded diamonds, the profits from which fund the conflicts in central Africa that have displaced millions of people and produced egregious human rights violations.

Broad Branch Road facility manager **Mike Day** accepted a position as director of maintenance and operations for the Arlington, VA, public school system. He was honored at the spring picnic held on Apr. 6. **Roy Dingus** has been appointed the new facility manager. Roy first joined the Carnegie staff in 1984 as an instrument maker at the Geophysical Laboratory.

TERRESTRIAL MAGNETISM

Sean Solomon delivered the Harold Masursky Lecture at the Lunar and Planetary Science Conference in Mar. He also gave a seminar at Johns Hopkins U. in Feb., and spoke to the National Astronomers in Dec. and the Potomac Geophysical Society in Feb. In Apr. he participated in an Academic Program Review for the Dept. of Geosciences at U. Arizona.

Alan Boss chaired a group for the NASA Astrobiology Institute review panel meeting held in Monterey, CA, in Dec. In Jan. Boss spoke about extrasolar planets and models of their formation in two talks at the Dept. of Physics and Astronomy at Northwestern U. Boss reviewed models of triggered star formation and shock-wave injection at the Royal Society discussion meeting, "Origin and Early Evolution of Solid Matter in the Solar System," held in London, England, in Feb. He spoke about gas giant planet formation in Mar. at the Dept. of Physics and Astronomy at U. Rochester, NY.

Paul Butler delivered a colloquium on extrasolar planets at the Dept of Physics, Arizona State U., in Dec. He was an invited panelist on astrophysics and astrobiology at the World Economic Forum in Davos, Switzerland, in Jan. On Apr. 30 Paul Butler and Geoffrey Marcy were awarded the Henry Draper Medal at the National Academy of Sciences' 138th meeting. The award recognizes their "pioneering investigations of planets orbiting other stars via high-precision radial velocities."

David James delivered an invited lecture entitled "Formation and Evolution of Archaean Cratons: Insights from the Kaapvaal Project of Southern Africa" at the Hales Symposium sponsored by the Research School of Earth Sciences of Australian National U. in Canberra. The symposium, held in Feb., was in celebration of Anton Hales's 90th birthday and was a highlight of a longer four-day conference entitled "Exploring the Earth: A Celebration of Four Journeys." Among those giving invited

Shown (from left) are DTM's Alan Linde and Michael Acierno, and JAMSTEC's Eiichiro Arcki and Kyohiko Mitsuzawa, in front of the remotely operated submersible vehicle Hyper-Dolphin on board the JAMSTEC ship *Keiyo*. The *Keiyo* cruised off the coast of Tohoku, Japan, in Nov., servicing ocean-bottom borehole sites.

presentations at the conference were former postdoctoral fellows **Malcolm Sambridge** (1988-1989) and **Mark Harrison** (1981-1982), the latter of whom will assume the directorship of the Research School of Earth Sciences in June of this year.

Vera Rubin spoke at the luncheon in honor of E. Margaret Burbidge at the American Astronomical Society meeting in San Diego in Jan. In Mar. she participated in the National Academy of Sciences panel on "Enhancing the Postdoctoral Experience," was the keynote speaker at the Towson U. Women in Science Program, and was a judge for the Intel National Science Talent Search. Rubin was appointed a senior fellow in the department as of Apr. 1.

Paul Silver organized the Second Plate Boundary Observatory Workshop in Palm Springs from Oct. 28 to Nov. 2, with **Selwyn Sacks** and **Alan Linde** among the 125 participants. He visited the Institute of Earth Sciences, Academia Sinica, Taiwan, from Jan. 26 through Feb. 3 to assist in the establishment of a Taiwan Plate Boundary Observatory, and he plans to return for a workshop in Oct. 2001. Institute director **Typhoon Lee** is a former DTM scientific staff member. Silver gave seminars at Duke U. in Nov. and Penn State in Dec.

DTM attendees at the fall AGU meeting in San Francisco included **Alan Linde**, **Selwyn Sacks**, **Paul Silver**, **Sean Solomon**, and **Fouad Tera**, and postdoctoral fellows **Jon Aurnou**, **Andrew Freed**, and **Fenglin Niu**.

Conel Alexander, **Alan Boss**, **Erik Hauri**, **Larry Nittler**, **Paul Silver**, **Sean Solomon**, **Fouad Tera**, and **George Wetherill**, and postdoctoral fellows **Andrew Dombard**, **Stephen Kortenkamp**, **Karl Kehm**, and **James Van Orman** presented papers at the 32nd Lunar and Planetary Science Conference in Houston in Mar.

Visiting Investigator **V. Rama Murthy**, Institute of Technology Distinguished Professor in the Dept. of Geology and Geophysics, U. Minnesota, is visiting DTM and GL this semester to continue his work on the chemical evolution of the Earth and planets.

Postdoctoral associate **Laurie Benton** left DTM in Dec. to join the environmental group at Exponent in Bellevue, WA. At DTM she worked on the Li isotope geochemistry of serpentine seamounts and arc volcanic rocks in the Marianas, and on developing methodology for measuring B isotope compositions on the Axiom ICP-MS.

Harry Oscar Wood Fellow **Matthew Fouch** moved in Dec. to the Dept. of Geological Sciences, Arizona State U., as an assistant professor. At DTM he led the tomographic imaging of the mantle structure of southern Africa obtained from the inversion of shear-wave arrival times at the portable broadband stations of the Kaapvaal craton project. He also contributed substantially to the field servicing of the network during its final year of operation.

Visiting Investigator **Stephen Alexander** has returned to his position as an associate professor of physics at Miami U. after spending the winter working with George Wetherill and Alan Boss. He worked on scientific topics and on the development of computer codes that made optimum use of Alan's workstation cluster.

Julie Morris, a Visiting Investigator at DTM for the past semester, returned in Dec. to the Dept. of Earth and Planetary Sciences, Washington U., St. Louis. At DTM she worked on the B and Li isotope systematics of the Mariana subduction zone and island arc.

Professor **Robert Tucker** of the Dept. of Earth and Planetary Sciences, Washington U., ended his six-month sabbatical at DTM in Dec. A geologist and geochronologist, Tucker applies U-Pb dating to unravel the geological evolution of mountain belts, cratons, island arcs, and hot spots.

Visiting Investigator **Steven Vogt** returned in Dec. to the Lick Observatory. He spent five months at DTM working with Paul Butler on their latest extrasolar planet finds as well as on the manufacture of more iodine cells for planet searches on new telescopes.

Other recent visitors include **Vickie Bennett** (Australian National U.), **Shan Gao** (China U. of Geosciences), **Philip Janney** (Field Museum of Natural History, Chicago), and **Darin Snyder** (Miami U.).

One of DTM's newest staff scientists Alycia Weinberger. (See page 9.)

Chris McCarthy (left) and Petrus le Roux, who both arrived in March to take up NSF postdoctoral positions, are shown in the DTM library. McCarthy will work with Paul Butler on the measurement of precise stellar radial velocities for planet detection. Geologist and geochemist le Roux received his Ph.D. in June 2000 from U. CapeTown. At DTM he is utilizing the ion microprobe and multi-collector inductively coupled plasma mass spectrometers to determine the abundances and isotopic compositions of volatile (H, C, S, Cl) and light (Li, B) elements in basalt glasses collected by Steve Shirey from the East Pacific Rise.

Trustee and former Carnegie president James D. Ebert and wife, Alma, die

James Ebert and wife, Alma, in 1979.

James D. Ebert, 79, trustee, former president of the Carnegie Institution and former director of the Department of Embryology, and his wife, Alma, 78, died in an automobile accident near Baltimore on May 22, 2001. Ebert was affiliated with Carnegie for 45 years. During World War II Lieutenant Ebert served in the U.S. Navy; he was decorated with the Purple Heart. He received his Ph.D. in experimental embryology from the Johns Hopkins University in 1950 and then served on the faculties of the Massachusetts Institute of Technology and Indiana University. He directed the Department of Embryology from 1956 until 1976. For several of those years he concurrently served as president and director of the Marine Biological Laboratory at Woods Hole, Massachusetts. During his tenure at Embryology, Ebert forged a close relationship between Hopkins and Carnegie, and he was instrumental in bolstering a new research focus on developmental mechanisms at the cellular and molecular levels. He became president of Carnegie in 1978, a position he held until 1987.

Ebert received many awards and served on a number of advisory panels over his long and fruitful career. Among his affiliations, he was elected vice president of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, a member of the American Philosophical Society, and a member of the Institute of Medicine. Alma was active in fund-raising for Carnegie and Woods Hole, and volunteered in the Baltimore public schools. The Eberts are survived by their three children, Frances Schwartz of Dublin, Maryland, David of Cape Coral, Florida, Rebecca Coyle of Owings Mills, Maryland, seven grandchildren, and one great-grandchild. A memorial service was held at Mudd Hall on the Hopkins campus on May 31, 2001.

Capital Science Lecture Series 2001-2002

The speakers for next season's Capital Science Lecture Series are listed below. All lectures are on Tuesday evenings starting at 6:30 p.m. at the Carnegie Building, 1530 P St., N.W., Washington, D.C. Schedule subject to change.

October 23: Michael Rabin, Harvard University
Theoretical approaches to computer security

November 27: Jack Szostak, Harvard Medical School
Origins of cellular life

December 11: Jasper Rine, University of California, Berkeley
DNA replication, the cell cycle, and silencing

January 15: Linda Griffith, Massachusetts Institute of Technology
Tissue engineering

February 5: Jane Lubchenco, Oregon State University
Dynamics of Earth's ecosystems

March 12: Susan Lindquist, University of Chicago
Protein-folding and prions

March 19: Robert Kirshner, Harvard University
Cosmology and supernovae

April 9: Daphne Preuss, University of Chicago
Plant reproduction and development

May 7: Steven Pinker, Massachusetts Institute of Technolgy
Language and cognition

H. Clark Dalton and his wife, Ellie, now residents of Kauai, Hawaii, contributed their memories and photos to the upcoming centennial exhibition opening this December at the Carnegie administration building in Washington, D.C. Dalton, now 86, was a postdoc at Cold Spring Harbor from 1948 through 1950, working with Barbara McClintock on her genetic studies of corn. The Daltons have donated four photos of the lab where he worked, a letter from McClintock, and a taped interview in which they reminisce about that time. They have been loyal supporters of Carnegie scientists for many years.

David Singer, son of Carnegie president Maxine Singer and a Yale alumnus, recently gave a gift to Yale University to establish the Maxine F. Singer (Ph.D. Yale, 1957) Professorship in the Biological Sciences. The endowment will support an exceptional nontenured faculty scholar.

What's New on the Web

The *Carnegie Institution Academic Catalog 2001-2003* is now available on the Web. Expanded versions of the 1999/2000 *Year Book* and videos of the Capital Science Lectures are also posted. See the home page, www.CarnegieInstitution.org, to access the new material. If you have any suggestions for improving the site, please contact John Strom at Jstrom@pst.ciw.edu.