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SPECTRA

THE NEWSLETTER OF THE CARNEGIE INSTITUTION (FALL 2001

Opening New Horizons for Scientific Research

Image courtesy NASA.

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INSIDE

DEPARTMENT OF PLANT BIOLOGY • DEPARTMENT OF TERRESTRIAL MAGNETISM • DEPARTMENT OF EMBRYOLOGY • THE OBSERVATORIES • GEOPHYSICAL LABORATORY • CASE/ FIRST LIGHT

A Bold Beginning for Our Next Century

Carnegie's centennial gives us a chance to reflect on our core values, take stock of our extraordinary past, and assess how we will face the future. Throughout our history Carnegie scientists have been at the forefront of discovery by consistently adapting to the new challenges of a changing world. Our ingenuity, perseverance, and flexibility have yielded impressive results and will continue to do so as we begin our second century. To ensure that our tradition of adaptability and excellence continues, the board of trustees has set in motion one of the most ambitious efforts in our 100-year history. This endeavor—the *Carnegie Campaign for Science*—is a four-year fund-raising initiative with five major aims, whose realization will ensure that we remain independent and that Andrew Carnegie's dream of expanding human knowledge will live on.

Perhaps the most exciting component of the initiative is the creation of the first new Carnegie department in over 80 years. The Department of Global Ecology, a natural outgrowth of the Department of Plant Biology, will begin operations in 2002 on the Stanford campus. It promises to accelerate our understanding of the Earth's environment and why the environment is changing the way it is.

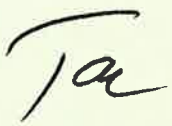
World-class science requires a strong foundation. For more than a decade Carnegie president Maxine Singer has been improving our foundation by upgrading and renovating the scientific infrastructure. In line with this essential work, and as the second part of the campaign, we are constructing a new facility for the Department of Embryology on the Johns Hopkins campus in Baltimore. In recognition of her remarkable service to Carnegie, the trustees decided unanimously to name the new structure the Maxine F. Singer Building. It will be ready in 2004.

We are delighted that new data from the Magellan telescope project are already exceeding expectations. The third part of the campaign will help us build on our unsurpassed legacy in astronomy by funding new instrumentation and scientific staff at the Observatories.

Recent discoveries about the fundamental properties of materials and the detection of planets around other stars are just two of the exciting areas being explored at the Geophysical Laboratory and the Department of Terrestrial Magnetism. In support of these and other projects, resources from the campaign will be used for instrumentation and for transforming the now obsolete Experiment Building into a modern seminar and dining facility for the entire Broad Branch Road campus.

Finally, we need to make sure that the caliber of research we've come to expect will endure. This requires an investment in young scientists and their new ideas. Therefore, the final component of the campaign will be a postdoctoral fellowship fund to endow named fellowships to attract the best young minds available.

The Carnegie Institution is an unusual place. For 100 years we have been able to encourage our scientists to pursue their personal visions, not the visions of others. We have succeeded in doing this by managing our endowment wisely and by attracting new funds for special projects and new programs. *The Carnegie Campaign for Science* is a bold step into the future that will help us continue this tradition. To achieve our goals we must rely on the generosity of those who agree with us that basic research is vital to progress, and that independence is vital to basic research.



—Tom Urban
Chairman

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Answers From Outside the Box

By Maxine Singer

From ***The Washington Post***, September 24, 2001

> "The methods and mechanisms of warfare have altered radically in recent times, and they will alter still further in the future. The country is singularly fitted, by reason of the ingenuity of its people, the knowledge and skill of its scientists, the flexibility of its industrial structure, to excel in the arts of peace, and to excel in the arts of war if that be necessary. The scientists and engineers of the country, in close collaboration with the armed services, can be of substantial aid in the task which lies before us."

Vannevar Bush wrote these words in June 1940. They describe our national situation since Sept. 11 as well as they did in the early days of World War II. And once again, the country's scientists and engineers can be of substantial aid.

President Roosevelt signed his name to Bush's words in the document authorizing the establishment of what was to become the Office of Scientific Research and Development (OSRD). By the end of World War II, the OSRD had enlisted and supported scientists, physicians and engineers nationwide to apply their originality, special mind-sets and skills to a new kind of warfare. Radar, the atomic bomb, the proximity fuse and penicillin were among the novel contributions to the Allied victories by the OSRD.

Bush believed that the bureaucracy, secrecy and habits of the military establishment walled it off from access to the most innovative scientific and technical ideas. It was a two-way street, blocked in both directions. The military could not, or would not, engage the most inventive and original minds from the private sector, and the private sector had no route to reach the military. Moreover, Bush believed that the lack of full communication and cooperation between the branches of the military itself further diminished their ability to respond to the war that he and the president knew would soon engage the nation.

Opening those streets for traffic was not easy. Bush schemed incessantly against the several sectors of the military establishment most resistant to cooperation with civilians and one another. He was determined to convince the military that he and the president envisioned a cooperative effort. He made it clear that the OSRD's job was to provide ideas and research. It had no intention of taking over the development of weaponry or the tactical and strategic responsibilities of the armed forces. Eventually, he succeeded in fostering joint efforts between the military scientists and engineers and those the OSRD mustered from the universities and industry.

President Bush and the American military know that we are once again faced with a new kind of warfare. The tragic turmoil that Vannevar Bush foresaw and hoped to avoid are already with us. In a commencement address at Harvard in June 1941 he stressed that "the power of an attack 'rests very largely on surprise, and surprise in turn rests on ignorance' " (as quoted by G. Pascal Zachary in "Endless Frontier"). We now know the horrendous price of ignorance and have lost our chance at the head start that the earlier Bush obtained for the country in 1940. But it is not too late.

The scholars, scientists and engineers who work in our great universities, industries and research institutions can, as they have done before, bring deep understanding and original ideas to bear on our new challenges. They can contribute much more than just novel ways of using technology. Many are trained and experienced problem solvers whose approach to difficult problems is to step "out of the box" because that is where scientific and technical questions are most likely to yield. Others are scholars with profound knowledge of fundamentalism of all kinds or with comprehensive insight into nations that harbor terrorists. Our fight against international terrorism will require their attention and ideas if it is to succeed.

Professionals, including those in the military, regardless of how skilled and dedicated, tend to see new challenges in their customary frameworks. This is not a criticism, it is simply the way most of us function. With every good intention, the U.S. military will be hampered if it ignores the resources of knowledge and ideas outside the government. It recognized this long ago when it established the Defense Advanced Research Projects Agency (DARPA). An enhanced DARPA, reaching out more widely than it has in the past, may now be desirable. However, a special organization, independent as was the OSRD, might be the most productive way to help the nation excel and prevail in the 21st century's arts of war.

Our country and the world will be better off if the military reaches out to gather even the off-the-wall ideas it could receive by asking scholars, scientists and engineers to focus and cooperate on the current challenges. If we are to excel and prevail in our battle with international terrorism, Vannevar Bush's prescription that our country should enlist "the ingenuity of its people, the knowledge and skill of its scientists, the flexibility of its industrial structure" should be as compelling today to President Bush as it was more than 60 years ago.

The writer is president of the Carnegie Institution of Washington, the position held by Vannevar Bush from 1939 to 1955.

A Strong Start to **Carnegie's Second Century**

As the Carnegie Institution of Washington enters its second century, some fundamental questions are being asked: What kinds of science are worth supporting? Should we invest more in curiosity-driven scientific research or in the development and practical application of already known scientific results? Which fields and specialties show promise, and which are becoming obsolete? What should science do for us as individuals, as members of society, and as inhabitants of the Earth?

When Andrew Carnegie made plans for his new research institution, his intention was to create a resource for the nation, one that would expand the horizons of human understanding while securing American leadership in the world of science. Indeed, Mr. Carnegie's original vision for the institution was unusually broad for its time, giving the trustees and scientists unparalleled freedom to chart their own course.

While Andrew Carnegie's broad mandate is sometimes a challenge to those who lead, it is in many ways responsible for the prominence and adaptability the institution has maintained over the past hundred years. The principles of Carnegie's philosophy are to invest in the exceptional individual, to keep a flexible and spare administrative structure, to stay financially independent, to commit to interdisciplinary collaborations and subject diversity, to expect and prepare for change, and to pursue science that is neither "big" nor "small."

None of the science that we do today was envisioned a hundred years ago. Nor can we imagine what the next hundred years will bring. However, we do know that as long as the Carnegie Institution retains its independence, flexibility, and commitment to excellence, our scientists will continue to provide the foundation upon which future science will be built.

Chief among Carnegie's guiding principles is the premium placed on independence. The institution sees its future as distinct from that of large or mission-driven research organizations in which scientists must undertake work that conforms to the aims of federal or private-sector interests. Carnegie supports almost two-thirds of its research from its own endowment. To ensure that this tradition of independence continues we are, therefore, launching the *Carnegie Campaign for Science*, a $75-million, four-year fund-raising effort that will sustain the best of ongoing Carnegie science and open up new avenues for scientific research.

As outlined below, there are five major components to the campaign, each with its own objectives:

The Global Ecology Initiative Fund. The objective is to raise $20 million to endow a sixth Carnegie department—the Department of Global Ecology—and $5 million for a new building to house the department, to be located adjacent to the Department of Plant Biology on the campus of Stanford University.

The Embryology Facility Fund. The goal is to raise $5 million (to supplement a $25 million construction bond) for construction of a new building on the campus of Johns Hopkins University and $15 million for an endowment in support of building operations and maintenance. It will be named for retiring president Maxine F. Singer.

The Observatories Enhancement Fund. This is a $15-million effort to support new scientific staff members and instrumentation.

The Earth and Planetary Science Innovation Fund. The aim is to raise $11 million for instrumentation and facilities renewal at the Department of Terrestrial Magnetism and the Geophysical Laboratory.

The Postdoctoral Fellowship Fund. The goal is to raise $4 million to endow named fellowships.

The Carnegie Campaign for Science is the most ambitious fund-raising campaign in the hundred-year history of the Carnegie Institution. Our success in reaching our goals will depend upon the generosity of individuals, foundations, and corporations that believe, as we do, in the importance and value of independent scientific research.

Postdoctoral fellows at Carnegie are selected on the basis of their creativity and their potential for growth. The research of two current fellows provides examples of the innovative work that Carnegie can expect from new fellowships created by the *Carnegie Campaign for Science.*

Dario Bonetta, a McClintock Fellow at Plant Biology, uses the model plant *Arabidopsis* to study cell-wall biosynthesis. He wants to identify and understand the production of enzymes responsible for the variety of polymers in plant cell walls. This work may eventually lead to the synthesis of plant materials that can be used in place of petrochemicals. Bonetta's decision to come to Carnegie was "based on the reputation and quality of work done [here]." The McClintock Fellowship allows him to pursue research he might not have been able to do otherwise.

Paul Martini, a Starr Fellow at the Observatories, uses a high-resolution technique to study black holes at galactic centers. Some of these objects consume large amounts of gas and dust whereas others do not. Martini's focus is on understanding these differences and on determining how fast active black holes grow. He is also helping to build a near-infrared camera for the Magellan project. According to Martini, "The Starr Fellowship has made it possible to devote myself to research full-time." His work is advancing our understanding of fundamental properties of astrophysics and is strengthening our ability to observe such phenomena.

First New Department in over 80 Years!

For the first time since 1914, the trustees of the Carnegie Institution have created a new scientific department—the Department of Global Ecology. It will be located adjacent to the Department of Plant Biology on the campus of Stanford University in Palo Alto, California, and begin operations in 2002, culminating the activities of Carnegie's centennial year.

Carnegie president Maxine F. Singer will retire at the end of 2002 making the creation of the new department particularly fitting. It is among the last of her many initiatives that will influence Carnegie science for years to come.

The new department has the opportunity to answer a broad range of fundamental questions about the workings of the biosphere. Questions about large-scale ecological patterns and interactions between biological and physical components of the Earth system will form the core agenda for the new department. Plant Biology's Christopher Field, who is serving as Global Ecology's interim director, and longtime Staff Member Joseph Berry, both highly regarded physiological ecologists, will form the nexus of the new department. The plan is to recruit three additional staff members to expand expertise in fields such as biogeochemistry, biological oceanography, microbiology, population biology, and/or atmospheric science. A biogeochemist specializing in remote sensing was recently recruited and will join the department this winter. As this group forms it will build on existing expertise to address new challenges.

Image courtesy NASA.

Plans for the new facility are centered on the idea of creating a "green building"—a structure that will incorporate the most efficient means of conserving energy and sustaining resources. The building will house lab and office space for faculty members and accommodate students, postdoctoral fellows, and visiting scientists.

Global Ecology is a field in which a small group can have a large impact, an impact that can be magnified enormously by strong partnerships. The ecology group will continue to benefit from interactions with the molecular biologists at Plant Biology. Molecular tools and techniques have the potential to dramatically improve some kinds of environmental diagnosis and play a central role in solving environmental problems. Possible contributions range from creating transgenic plants to be used as efficient energy sources to engineering microbes that mitigate problems associated with the greenhouse gas N_2O. Even more may be achieved through the use of ecosystem models that have grown increasingly sophisticated with the addition of new satellite sensors, computer models, and other information resources. These advances promise to fuel a revolution in our understanding of the biological and physical aspects of our planet.

The new department will also benefit tremendously from interactions with other parts of the institution. Programs in planetary sciences, stable isotopes, and the origins of life all overlap with core topics of global ecology. Collaborative efforts to address specific research questions will strengthen interdepartmental links.

Once Global Ecology's group of five environmental scientists is in place, the highly interdisciplinary nature of the staff and the breadth of their research will lead to a new and expansive understanding of ecological phenomena on a worldwide scale. •

Embryology Building Named for **Maxine Singer**

In recognition of Carnegie president Maxine F. Singer's outstanding scientific leadership, including her many contributions to society as a molecular biologist and her work as a scientific mentor and educator, the trustees plan to name a new $30-million research laboratory in her honor.

The new building will house the Department of Embryology and will be located on the main campus of Johns Hopkins University in Baltimore. It will occupy a three-acre tract along a stream valley with rocky slopes bounded on the east by San Martin Drive and on the west by a city public park. The property has an attractive natural setting within a larger urban context. The architectural firm of Zimmer Gunsul Frasca Partnership, which designed the Bunting-Blaustein Cancer Research Building for Johns Hopkins, will design the complex. It will provide a new home for over 100 scientists, lab technicians, postdoctoral fellows, graduate stu-

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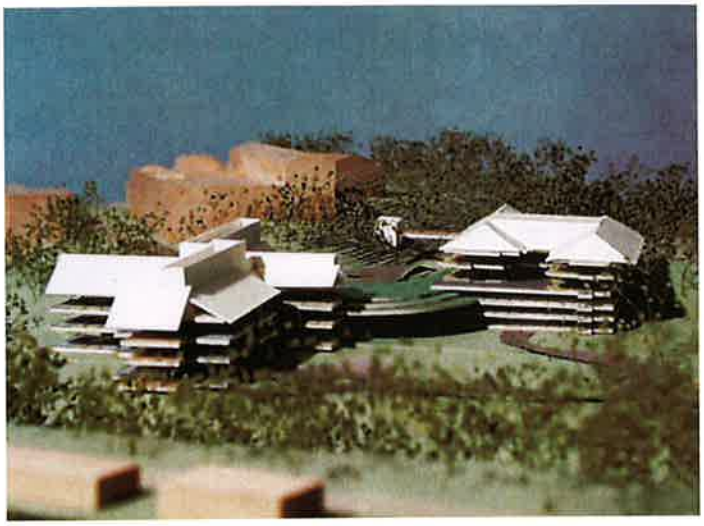


This is a model of the new Maxine F. Singer embryology building to be constructed on the Johns Hopkins Homewood campus. It is scheduled for occupancy in 2004.

dents, and administrative staff. The move from the current building will take place in 2004.

The staff of the Department of Embryology has been housed in the same 48,600-square-foot facility on the Homewood campus since 1960. The number of scientists in the department is at an all-time high, and the complexity and diversity of their projects are placing unprecedented demands on the existing structure. There is inadequate space for housing and care of experimental animals, little flexibility for new work configurations, and an insufficient number of seminar and meeting rooms.

The new building will provide 13 modern and well-equipped research laboratories, as well as shared spaces such as a library, meeting rooms, animal quarters, specialized instrument rooms, supply rooms, and an auditorium. As the building is envisioned by both the scientific staff and the architects, it will be "Spartan yet beautiful" and flexible enough to promote collegial interactions among all the staff.

The Department of Embryology was founded in 1914 to study human embryo development. Researchers now study developmental biology at the genetic, biochemical, and cellular levels using a variety of animal organisms. Scientists at the department explore some of the most fundamental questions of development. How do genes turn on and off during development to give rise to an orderly array of cells and tissues? How do cells differentiate into, for example, nerve or skin cells? How do complex systems involving multiple genes work? How do cells communicate with each other to affect the profound changes accompanying growth? These questions are central to all of biology—indeed to all of society—since a solid understanding of them can help yield solutions for human diseases and birth defects.

The new biomedical research building for Carnegie's Department of Embryology will be a focal point for continuing the productive and collegial relationship that has endured for almost 90 years between Johns Hopkins University and the Carnegie Institution. An outstanding contribution both to the Johns Hopkins research community and to the city of Baltimore, the Maxine F. Singer Building will expand the horizons of research.

Into the Future with **Engineered Algae**

Arthur Grossman, Dave Ehrhardt, and Connie Shih of Plant Biology, with collaborators from Martek Biosciences Corporation, have engineered a photosynthetic alga to grow without light. The group published their results in the June 15, 2001, issue of *Science*. Photosynthetic algae are the major primary producers in aquatic environments. They are also used in industry for food, pigments, and cosmetics. Commercially algae are grown in open ponds, where variability of the environment and light, in addition to contamination are frequent problems. The scientists' work is therefore a critical first step toward large-scale, high-density, cost-effective algae cultivation.

The researchers found that they could make this fundamental change by inserting just one gene—a gene that catalyzes glucose transport—into the diatom *Phaeodactylum tricornutum*. The inserted gene allows the organism to get its energy exclusively from glucose—the primary energy source for most cells—allowing it to thrive in the dark. "It is sobering to think that it required just one gene to create such a dramatic difference in lifestyle," says Arthur Grossman.

The scientists individually inserted several genes responsible for glucose transport from three different organisms into the diatom. One of the genes, *Hup1*, is from the green alga *Chlorella kessleri*. Three other genes, *Hxt1*, *Hxt2*, and *Hxt4*, come from the yeast *Saccharomyces cerevisiae*, which is widely used in the brewing and baking industries. The final gene, *Glut1*, and the one that has shown the most promise, is involved in transporting glucose into human red blood cells. The investigators introduced each of these genes into the alga and found that both the *Hup1* and *Glut1* genes allowed it to take up high levels of glucose and thrive in the dark. In addition to its industrial potential, the newly engineered diatom will allow scientists to make fundamental discoveries about the process of photosynthesis and other metabolic activities in algae. The study also has interesting evolutionary implications. According to Grossman, "This is the first time that a eukaryotic organism has been transformed from a light-dependent to a light-independent growth mode."

The News

The July 8 *New York Times* announced the marriage of senior trustee **William Golden** to professor of mathematics Dr. Jean E. Taylor. Taylor teaches at Rutgers University in New Brunswick, N.J. She is a past president of the Association for Women in Mathematics and belongs to a variety of other organizations.

Trustee emeritus **Charles Townes** was quoted in the July 3 *New York Times* in an article about the renaissance of the Mount Wilson Observatory with the advent of adaptive optics technology. Townes is involved in testing infrared interferometry there. Another story featuring Mount Wilson appeared on Reuters.com, Yahoo.com, and CNN.com on June 28. The article was a retrospective look at the observatory. **George Preston**, former director of the Observatories, was quoted in the article.

Carnegie president **Maxine Singer** wrote an Op-Ed piece for the July 2 *Washington Post* about the organizational changes affecting scientific research at the Smithsonian Institution.

The June 21 issue of *Nature* reported on the work conducted by **George Wetherill** of the Department of Terrestrial Magnetism (DTM) and colleague John Chambers that may provide some answers to what occurred in the early solar system to form the asteroid belt and the terrestrial planets. The two scientists propose that large, Earth-massed objects may have originally populated the belt, but that complicated dynamics cleared the area and may have made the orbits of the giant planets circular.

Staff Member emeritus **Allan Sandage** of the Observatories was quoted in the June 29 "*News of the Week*" in *Science* magazine about his work with Lori Lubin, which looked at the surface brightness of galaxies, providing direct evidence of the expansion of the universe. The study was cited as one that would set to rest the so-called tired-light hypothesis.

Vera Rubin, astronomer at DTM, was interviewed for the "Planet Washington" section of the July 22 *Washington Post Magazine* about her career and life. She was also interviewed on Diane Rehm's radio show on August 27 regarding the recent findings suggesting that the fine-structure constant—the force that electromagnetic radiation exerts on charged particles—may have changed since the universe began.

Jason Prochaska, Carnegie Fellow at the Observatories, was cited in the August 15 *New York Times* for his work as part of the team of astrophysicists who found that the fine-structure constant may change as the universe ages. Prochaska was quoted on the same topic in *Science* magazine's news section on August 24.

Bob Hazen of the Geophysical Lab (GL) wrote an article for the April issue of *Scientific American* entitled "Life's Rocky Start." The piece chronicles the research into how chemical reactions on mineral surfaces may have been the catalyst for life on the ancient Earth. It includes a description of the recent work conducted by Hazen and colleagues at GL in this area.

The June 19 *New York Times* had an article about the recent successful attempt by **Arthur Grossman** and colleagues to engineer photosynthetic algae to grow in the dark.

The work by **Russell Hemley** and collaborators at GL and the Center for High Pressure Research, squeezing nitrogen into a semiconducting solid, was mentioned in the July issue of *Scientific American*. *Chemical & Engineering News* reported on the team's experiments transforming boron into a superconductor in its July 16 issue.

Planet hunter **Paul Butler** and theorist **Alan Boss** of DTM were part of a front-page article in the June 5 Ventura edition of the *Los Angeles Times*. The feature was an in-depth look at the years of work undertaken by the planet-hunting team headed by Butler and Geoffrey Marcy of UC-Berkeley, which led to their becoming the foremost discoverers of extrasolar planets.

The New York Times, the *Washington Post*, and *Science News* all reported on the discovery by the team headed by Geoffrey Marcy and Paul Butler of a two-planet solar system with nearly circular orbits around a Big Dipper star. The find is particularly important because the vast majority of exoplanets thus far found are characterized by highly elliptical, non-Earthlike orbits. **Alan Boss**, theorist at DTM, was also quoted in the *Science News* article.

Alan Boss has been busy answering questions about a variety of unusual celestial finds. The May issue of *New Scientist* interviewed Boss about his ideas on the formation of a newly discovered young star in an unusual bubblelike cloud. In July the *Washington Post*, *USA Today*, and the *Los Angeles Times* all asked Boss about the implications of the first evidence of water found in another solar system. The water seems to have originated from comets that vaporized from the heat of the dying star. *Astronomy* magazine quoted Boss in August on his thoughts about what is happening around star HD 82943. Some astronomers believe that the star cannibalized one or more orbiting planets. Boss, on the other hand, thinks that the evidence doesn't necessarily show that's what happened. Finally, Boss and fellow DTM Staff Member **Conel M. O'D. Alexander** were cited in an article in the October *Sky & Telescope* about their work on chondrules—small particles of chondritic meteorites.

What is he doing? Find out at *Our Expanding Universe: Celebrating a Century of Carnegie Science.*

Abuzz with **the Birthday**

Our Expanding Universe—an Exhibition to Remember

Carnegie scientists, staff, and their families will be the first to see the centennial exhibition, *Our Expanding Universe: Celebrating a Century of Carnegie Science*, at a special preview to be held Saturday, December 1, 2001, between 2 p.m. and 4 p.m. The exhibition, designed by Threshold Studio of Alexandria, Virginia, will take the observer on a journey through one hundred years of science at Carnegie. An unusual array of artifacts, historic and contemporary photographs, videos, and more will be theatrically displayed in the historic administration building, providing participants with a vivid experience of scientific discovery.

The centennial exhibition will feature many images and objects associated with Carnegie science over the past 100 years. A couple of examples are shown at right. At top, members of the Geophysical Laboratory are collecting volcanic glass at the Papandayan volcano in Java during a 1928 expedition. At bottom is the atomic physics observatory at the Department of Terrestrial Magnetism in 1938.

The story begins with the motivations and philosophy that Andrew Carnegie had, and the board of trustees implemented, which allowed this small organization to have a disproportionately large impact on science. The tale then follows Carnegie explorers during the early years as they battled the extremes of nature and the chaos of political revolution in the search for information about the natural world. It also tours the laboratories where scientists unraveled such mysteries as the behavior of protons and the movement of genes, and developed ingenious devices to probe new problems. Great moments of discovery are then highlighted, such as Edwin Hubble's revelation that the universe is expanding and Alfred Hershey's experiment proving that DNA is the material that makes up our genes. The final part of the exhibition looks at the compelling questions confronting Carnegie scientists today: How did life originate on Earth, and does it exist elsewhere? What makes genes turn on and off, and why does this programming sometimes go awry? How old is the universe, and where does it end?

The exhibition will be open to the public starting December 7, 2001, and will continue through May 31, 2002. The hours are 12 noon to 5 p.m. Tuesday, Wednesday, Friday, Saturday, and Sunday, and 12 noon to 8 p.m. Thursday. It will be closed on Mondays and federal holidays.

A Busy Building

The administration building will be a busy place during the centennial year. Besides the exhibition and the Capital Science Lecture series, there will be special screenings of NOVA episodes accompanied by discussions with Carnegie scientists, Carnegie-Smithsonian Science Nights, and one-time events such as a dramatization of the career of Barbara McClintock. Also during the centennial year, Carnegie will allow outside organizations to use the 400-seat Root Auditorium. Among the groups planning to use the facilities are the American Society for Cell Biology, the National Trust for Historic Preservation, and a meeting of extrasolar planet researchers, who will host an event entitled *Scientific Frontiers in Research on Extrasolar Planets.*

Area Students Get Involved

In the tradition of the First Light Saturday science school and the Carnegie Academy for Science Education, Carnegie is involving students from the Washington, D.C., metropolitan area in its centennial celebrations by sponsoring a T-shirt design contest. Open to middle and high school students, the winning design will represent Carnegie science and become our official centennial T-shirt. Ideas for the designs and instructions for entering the contest are posted on the Web site **www.CarnegieInstitution.org/tshirtcontest.html**. The winner will receive a $200.00 U.S. Savings Bond at the Gala celebration and the shirt will be sold in the Carnegie/Reiters Exhibition Store. The contest is another way students can learn about science and have fun too.

MR. CARNEGIE'S ATTIC

By John Strom

Indiana Jones and Lucky Lindy

Anyone who has seen the movie *Raiders of the Lost Ark* has visions of the romance and adventure of archaeology. Although the improbable exploits of Indiana Jones never actually happened, as with most legends there is a grain of truth.

In 1925 Earl Morris, an archaeologist funded by the Carnegie Institution of Washington, began an excavation in the jungles of Mexico's Yucatán Peninsula that was to have startling consequences. For four years he excavated a steep hill, sometimes employing as many as 85 diggers and masons at one time. He made an extraordinary find: a temple incorporating exquisite sculptures and carvings. Dubbed the Temple of the Warriors, the site was chosen for restoration and soon yielded important insights into the culture and religion of the ancient Maya.

As significant as these initial investigations were, the discovery of a second temple inside the first was even more dramatic. The unexpected juxtaposition of the two temples, one Mayan and one Toltec, gave Morris a unique opportunity to establish the site's chronology and the period of the Toltec influence in the Maya region. In Morris's real-life exploits, we find an intriguing foreshadowing of the adventures of the iconic movie hero.

In 1929 another icon of American culture, Charles Lindbergh, was also in the Yucatán. Two years after his historic solo transatlantic flight, and after contacting the institution's John Merriam about the possibility, Lindbergh arrived with his wife to perform an aerial survey of the Yucatán. Accompanied by Morris's colleague Alfred Kidder, Lindbergh made two flights across the peninsula. The resulting photographs revealed several potential excavation sites.

An enthusiastic Kidder was delighted that a trip that was ordinarily a hard day's ride by mule was made in six minutes. Lindbergh himself proclaimed the airplane a natural tool of archaeology, giving "the eyes of birds to the minds of men." In a scenario worthy of Hollywood, one can imagine Morris and Lindbergh meeting on a jungle landing strip—the archaeologist and the aviator, clasping hands and taking careful measure of each other: one steeped in the past, the other soaring into the future.

Lindbergh's involvement with the Carnegie Institution did not end with his aerial surveys. He would go on to serve on the institution's board of trustees.

[CONTINUED ON PAGE 10]

Andrew Carnegie is shown above in a parade. Below, the Carnegie Institution's Earl Morris *(left)*, who inspired the movie character Indiana Jones, removes a limestone jar containing a turquoise mosaic plaque from the Temple of Warriors in Mexico's Yucatán Peninsula.

Off-the-Shelf Technology

We live in an era of "big science" projects, such as space shuttles, particle accelerators, and missile defense systems. The Carnegie Institution of Washington has long been involved in similar large-scale projects. One example is its partnership with the California Institute of Technology to build the 200-inch telescope on Mount Palomar. Another is the high-pressure sector now under way at the Advanced Photon Source. Sometimes, however, scientific breakthroughs can be accomplished with equipment found on the shelf of a local store.

In 1950, scientists knew that chromosomes were composed of two different kinds of molecules: proteins and DNA. The unanswered question was which kind carried an organism's genetic material. To settle this question, Carnegie scientist Alfred Hershey, along with his research assistant Martha Chase, designed an elegant experiment.

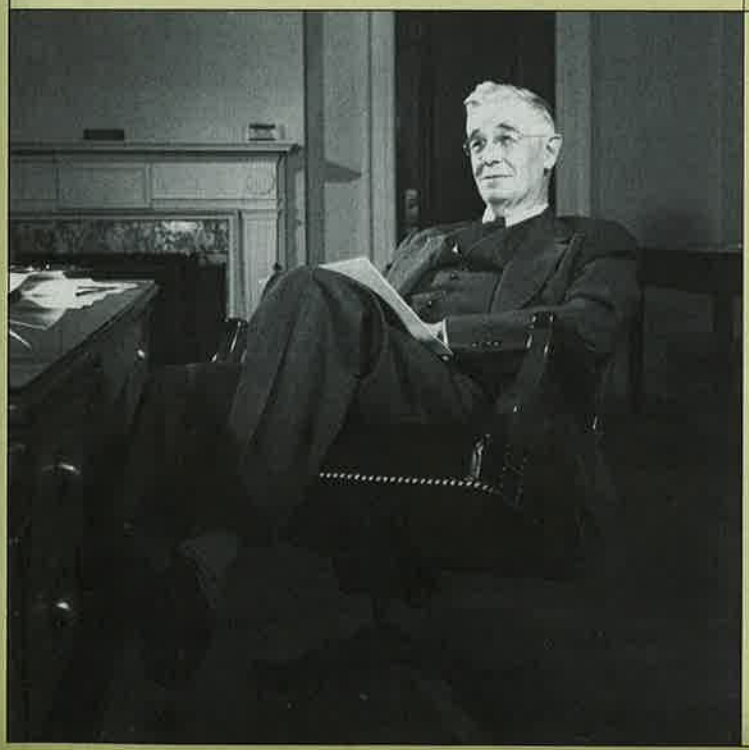
Hershey knew that viruses operate by injecting their genetic material into cells. He also knew that radioactive sulfur-35 can be incorporated into proteins (not DNA), while radioactive phosphorus-32 can be incorporated into DNA (not proteins). By preparing one set of viruses in a medium stocked with sulfur-35 and another in a medium stocked with phosphorus-32, Hershey was able to produce two distinct radioactive tracers. One would follow proteins, the other DNA.

Infecting bacteria with the viruses was easy. However, after injecting the genetic material, the viral shells remained attached to the bacteria. Since the viral shells had to be analyzed separately, the researchers had to find a way to detach them. Hershey hit upon the idea of using a common kitchen appliance—a Waring blender. The unique shearing forces produced by this device were able to detach the viral shells. As Hershey said, "This elegant little machine—which was invented, I think, to make cocktails—worked right away."

Analysis quickly demonstrated that most of the phosphorus-32 (and therefore the DNA) had been taken into the bacteria, while most of the sulfur-35 (the proteins) had remained outside, demonstrating that DNA was the genetic material. In conjunction with the work of Watson and Crick, who discovered the double-helix structure of DNA a year later, this experiment represents a milestone in biological science.

In 1929 Charles Lindbergh performed an aerial survey of Chichén Itzá, an archaeological site in Mexico that was excavated with support from the Carnegie Institution. This photograph was taken during that survey.

Carnegie's Nobel Prize–winning scientist, Alfred Hershey, is shown here in his lab at the former Department of Genetics.



Vannevar Bush was founder of the Office of Scientific Research and Development (OSRD), which coordinated the science effort during World War II, including the direction of the Manhattan Project. He was also the president of Carnegie from 1939 to 1955. Bush is shown here in his office at Carnegie's Washington, D.C., administration building, where the OSRD was headquartered.

The Call of War

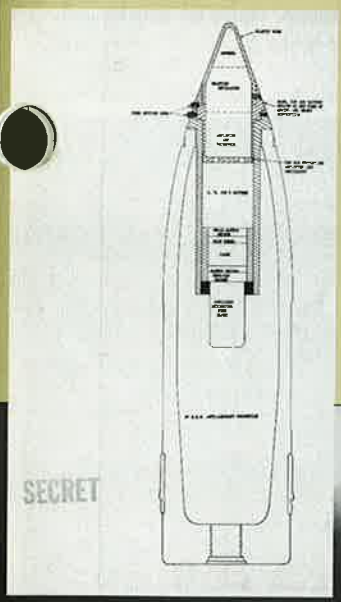
Andrew Carnegie's mandate that the Carnegie Institution work for the "benefit of man" took on a harsh urgency in the context of war. In 1939, as the war in Europe began, Carnegie president Vannevar Bush recommended to President Roosevelt a concentrated collaboration between the nation's scientists and military leaders. With a scrawled "OK" across Bush's proposal, Roosevelt initiated what became the Office of Scientific Research and Development (OSRD).

Carnegie scientists spearheaded the harnessing of science for war. Biologists from Cold Spring Harbor and the Department of Plant Biology developed new antibiotics, petrologists applied their expertise in high-pressure science to the development of improved machine-gun barrels, and physicists from the Department of Terrestrial Magnetism continued their ionospheric studies that paved the way to radar. Eventually, Bush and OSRD guided over 200 projects, including the Manhattan Project, from Carnegie's P Street headquarters building.

No war project was more vital than the development of the proximity fuse. The need was clear: antiaircraft shells detonated by timers or altimeters could be set to detonate only at specific altitudes. A shell that could sense its proximity to a target would be vastly more accurate and deadly. The development team was told that perfection of the proximity fuse would save one battleship every three months, one cruiser a month, and 150 men a day.

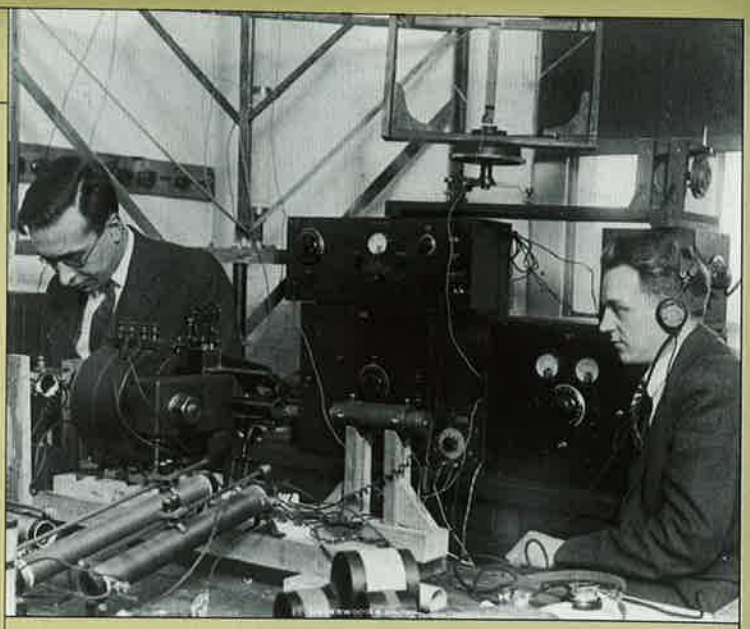
One immediate problem was with the vacuum tubes that formed the basis of electronics in the 1940s. Would the tubes used in the fuse be able to withstand the shock of being fired from an artillery piece? By dropping vacuum tubes mounted to lead hemispheres from the tops of buildings, scientists were able to demonstrate that the electronics could survive.

An abiding legacy of World War II is the large-scale involvement of the government in funding scientific research. The effort begun with OSRD would culminate in the establishment of the National Science Foundation shortly after World War II. Bush himself expressed faith in the ultimately humanizing influence of research and discovery when in his 1939 presidential report he recognized "the abiding value in a Beethoven symphony, or a theory of the cosmos, or the tracing of an ancient culture."



The development of the proximity fuse was among the war projects undertaken by scientists at Carnegie. A diagram for it is shown at left. At bottom is a 1943 test for a variable-time proximity fuse.

(Image at top of page courtesy Los Alamos National Laboratory. Bottom image courtesy Johns Hopkins Applied Physics Laboratory.)



Carnegie's Merle Tuve *(right)* and Gregory Breit work with radio-echo sound equipment used to demonstrate the existence of the ionosphere in 1927.

Practical Science

Carnegie scientists have explored the farthest reaches of the world and the farthest reaches of the universe. But Carnegie science also touches the daily lives of ordinary people. Anyone who flies in a plane or listens to a weather report, for instance, owes a debt to Carnegie scientists Merle Tuve and Gregory Breit. In the 1920s, while Breit was at the Carnegie Department of Terrestrial Magnetism and Tuve was studying for a Ph.D. at Johns Hopkins, they collaborated in using pulsed radio waves to confirm the existence of the ionosphere. By measuring the difference between how long it took a radio pulse to travel directly to a receiver and how long it took it to be reflected back from the ionosphere, they not only demonstrated the existence of a layer in the atmosphere that reflected radio waves but were also able to determine its altitude. Of course, other objects reflect radio waves as well, and in World War II, the principles established by Tuve and Breit were employed in the development of radar, which was used to detect enemy aircraft and enemy submarine periscopes. Even today the same principles guide commercial aircraft and help meteorologists track clouds and storms.

In 1927 Harry Oscar Wood, who was spearheading the Carnegie Seismology Advisory Committee, hired a California Institute of Technology graduate student named Charles Richter, who was destined to give his name to a scale for measuring the strength of earthquakes. At the time, Carnegie scientists were busy gathering and collating an enormous amount of earthquake information that was being gathered via the newly developed Wood-Anderson seismograph. Acting on a suggestion by colleague Beno Gutenberg, Richter plotted the seismic data on a logarithmic scale. The resulting Richter scale came into general use in the 1950s and remains the standard for earthquake measurement today.

In the mid-1940s, Barbara McClintock began her genetic studies as a staff scientist at the Carnegie Institution. Her crossbreeding experiments with maize revealed that segments of DNA (called transposable elements) could move from one location on a chromosome to another, or even between different chromosomes. Although the scientific community was slow to accept her ideas about so-called jumping genes, her pioneering work led eventually to the development of improved crop varieties and laid the groundwork for developments in genetic engineering. She received a Nobel Prize in 1983.

Andrew Carnegie founded the Carnegie Institution for the "benefit of man." The institution has easily fulfilled that part of his intended legacy. Practical benefits emerge from virtually every research project, no matter how academic or abstract its genesis. For the Carnegie Institution, the benefit of man has been found at the heart of its mission to extend the frontiers of science.

New Records from the **High–Pressure Team**

As Carnegie enters its second century, scientists at the Geophysical Laboratory and the Center for High Pressure Research continue to subject materials to ever higher pressures, breaking old records and discovering new materials and fundamental properties along the way. Among their latest achievements, Mikhail Eremets, Viktor Struzhkin, Ho-kwang Mao, and Russell Hemley reported in the July 13, 2001, issue of *Science* that they subjected the light element boron to pressures of up to 250 gigapascals (2.5 million times the atmospheric pressure at sea level) and tested for electrical conductivity. The experiment marks the highest pressure under which scientists have been able to measure electrical conductivity and superconductivity in dense matter.

Boron is the least-studied light element at high pressure. It is particularly interesting because the scientists discovered that it becomes a superconductor—the state in which a material has no electrical resistance—at relatively high temperatures. Through their experiments, the team found that boron becomes metallic at 175 gigapascals at room temperature. The transition pressure was slightly lower than the 200 gigapascals predicted a number of years ago for the material. The researchers also found that the element becomes a superconductor at a temperature of 6 K at 175 gigapascals; this temperature increases steadily to 11.5 K at a pressure of 250 gigapascals. Predicting superconductivity continues to be a challenge for physics. Thus, the body of data from this study, along with that of their previous high-pressure experiments (e.g., on sulfur), will help refine our fundamental understanding of the nature of superconductivity—one of the most unusual states of condensed matter there is. •

The mirror for the Landon Clay telescope is ready for departure from the University of Arizona Steward Observatory Mirror Lab in Tucson *(left)*. Below, Observatories' Matt Johns *(left)* and Steve Warner from the mirror lab pose before departure time.

Superb **Magellan II Mirror** Arrives Safely in Chile

By Matt Johns August 8, 200

In late June the University of Arizona finished testing the second Magellan 6.5-meter primary mirror at the Steward Observatory Mirror Lab in Tucson. They found that it is one of the finest large mirrors ever made, surpassing even the Magellan I mirror in surface quality.

On July 17 the boxed mirror and its supporting cell were loaded onto two trucks bound for the Port of Long Beach. The 7-meter-wide loads spanned more than two lanes of the highway. The convoy departed Tucson at 9 a.m., with a police escort and pilot vehicles clearing traffic out of the way.

Because construction on Interstate 10 blocked the direct route from Tucson to Long Beach, the convoy was routed through Yuma on Interstate 8, around San Diego and up the southern coast of California. After threading its way through the traffic of two major metropolitan areas, construction zones, and tight interchanges, it arrived safely at the port at 2 o'clock the following morning.

In the middle of the night on July 20-21, the shipment was loaded aboard the container vessel *TMM Quetzal*, which set sail for Chile early the next morning. It arrived at the Port of Coquimbo 15 days later, where it was off-loaded onto trucks for the final 150-kilometer trip to Las Campanas. At 2 a.m. on August 6 the convoy headed north on the two-lane Pan American Highway, arriving on the mountain at 10:30 that morning. The mirror was unloaded from the trucks and is now safely stored inside the aluminizing building. It is scheduled to be installed in the Clay telescope this November. •

IN Brief

Former Carnegie President and Trustee Emeritus
Caryl P. Haskins Dies

Caryl Parker Haskins, president of the Carnegie Institution from 1956 to 1971 and trustee emeritus, died on October 8 at the age of 93. On March 6, 1965, the Washington *Evening Star* described Haskins, a biophysicist, as "one of the great scholars of the United States…a leader in the world of science, surrounded by men who are molding the future, and seeking always to touch the scientific revolution of our time to generous social purposes."

Haskins, the son of an inventor and an inventor himself, was the founder of Haskins Laboratories and succeeded Vannevar Bush as president of Carnegie. He shared with his wife, Edna, who died in 2000, an avid interest in entomology, specializing in ants. He was also a prolific writer who appealed to both the scientist and the layperson. His book *Of Ants and Men*, which compared the society of ants to human social systems, was popular worldwide. Haskins was also interested in genetics. In 1930, he graduated from Yale and went on to receive a Ph.D. in physiology from Harvard in 1935. He served as a senior liaison officer of the Office of Scientific Research and Development during World War II, and was a member of the President's Science Advisory Committee, the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences.

When Haskins left the Carnegie presidency in July 1971, the *Washington Post* ran a three-quarter-page feature about him entitled "Renaissance Man Steps Down." The writer characterized him as having "a vast comprehensive knowledge across the whole spectrum of science, the kinetic drive…that would kill a dozen younger men…[and] absolute simplicity, kindness and irrepressible enthusiasm." Both he and his wife remained very close to the institution in the years following his departure.

Caryl Haskins *(above,right)* is shown at a luncheon given in his honor in 1994 after the hundredth meeting of the board of trustees. He is talking with Don Brown *(above, left)*, then director of the Department of Embryology, and Allan Spradling, the current director.

Trustees

Trustee and astronomer **Sandra Faber** was elected to the American Philosophical Society on Apr. 29.

Administration

Maxine Singer attended the American Society for Cell Biology Public Policy Committee meeting on May 11 and the Human Cloning Panel Meeting at the National Academy of Sciences in Washington, DC, on Aug. 7-8. She was also interviewed by Sky News, a British broadcasting station, about human cloning issues.

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The First Light science school and DC ACTS, with teacher **Greg Taylor**, were profiled in the May 2001 issue of the *Howard Hughes Medical Institute (HHMI) Bulletin*. HHMI provides support for both programs.

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Correction! The last issue of Spectra incorrectly described former Carnegie postdoc **H. Clark Dalton's** work. Dr. Dalton studied the effects that specific mutant genes have on the development of pigment cells in salamanders to explore the general question of how genes control development.

Embryology

Don Brown gave the State of the Art Lecture on amphibian metamorphosis at the International Congress of Comparative Endocrinology in May in Sorrento, Italy.

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Chunqiao Liu (Ph.D., Chinese Acad. of Science) has joined the Fan lab to study *Sim1* and *Sim2* regulation in mice.

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Joseph Gall presented an invited lecture at the 27th meeting of the Federation of European Biochemical Societies in Lisbon, Portugal, June 30-July 5.

—

Marnie Halpern was elected to the

Pictured are Karen Gross of the Observatories; Louise Pearson, who is the wife of the winner; Marvin Gross of Union Station; and Grant Couch, who won a night at Las Campanas.

The Carnegie Observatories donated a night of observing with a Carnegie scientist at Las Campanas Observatory in Chile to help raise funds for the Union Station Foundation—Pasadena's homeless shelter. The Aug. 11 fund-raising event was an evening of jazz. The Carnegie contribution raised $10,000 at a silent auction. The winners, Grant Couch and his wife, Louise Pearson, will observe with Pat McCarthy and Luis Ho in Nov. Carnegie has assisted Union Station in the past. Karen Gross, assistant to the director at the Observatories, is on the shelter's board and helps organize these events.

❶ In September Wesley T. Huntress, Jr., director of the Geophysical Lab, was elected president of the Planetary Society. The Planetary Society is the largest such group in the world, promoting space exploration through education, research, and public participation.

❷ In March Bob and Margot Hazen made a multiyear pledge to establish a fund in support of instrumentation at GL as a tribute to the memory of Thomas C. Hoering, an organic geochemist and leading light at the lab for more than 35 years. The Hoering Fund is part of *The Carnegie Campaign for Science's* Earth and Planetary Science Innovation Fund. The Hazens are pictured here in the Gorges du Dades in central Morocco.

board of directors of the Society of Developmental Biology. She was also a speaker at the First Texas Zebrafish meeting on July 26, and an invited speaker at the First International Symposium on Post-Genomic Developmental Genetics: The Role of Model Organisms, in Ribeirao Preto, Brazil, Aug. 4-7.

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New postdoctoral fellow **Jiaojiao Zhang** (Ph.D., New York U.) will be devising new methods to examine neural function in the zebrafish brain.

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Phil Newmark has taken a job as assistant professor in the Dept. of Cell and Structural Biology at U. Illinois, Urbana-Champaign. **Alejandro Sánchez-Alvarado** was an invited speaker at the 14th Annual International Society for Developmental Biology in Kyoto, Japan, and at the 60th Annual Society for Developmental Biology in Seattle. **Nestor Oviedo** and **Edelweiss Pfister** from the Instituto Venezolano de Investigación Científica have joined the Sánchez-Alvarado lab to study planarian regeneration.

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Horacio Frydman, who worked in the Spradling lab, received his Ph.D. from Johns Hopkins U.

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Christiane Wiese has taken a job as assistant professor at the Dept. of Biochemistry, U. Wisconsin.

Observatories

Allan Sandage was elected a Foreign Member of the Royal Society (London).

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Luis Ho helped organize IAU Symposium 207 on "Extragalactic Star Clusters" in Pucon, Chile. He gave a colloquium at Ohio State U. entitled "Black Holes, Nuclear Activity, and Accretion Physics" and attended a workshop on AGNs in Elba, Italy. He also spoke at the IAU Colloquium 184 in Byurakan, Armenia, on "The population of AGNs in nearby galaxies."

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Barry Madore attended a Galaxy Evolution Explorer (GALEX) science-team meeting in Marseille, France in June. He also attended the AAS meeting in Pasadena in June, where he gave the opening invited talk at an all-day session on interacting galaxies.

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Wendy Freedman has been appointed cochair of the National Research Council's Committee on Astronomy and Astrophysics. In May, she gave an invited talk on observational cosmology at the inaugural meeting for the new Michigan Center for Theoretical Physics.

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Hsiao-Wen Chen, Alan Dressler, Wendy Freedman, Luis Ho, Barry Madore, Paul Martini, Pat McCarthy, John Mulchaey, Gus Oemler, Eric Persson, Cristina Popescu, Michael Rauch, Swara Ravindranath, François Schweizer, Linda Schweizer, and **Scott Trager** attended the 198th meeting of the American Astronomical Society, held in June in Pasadena. Madore and François Schweizer presented invited talks on interacting galaxies for the 35th anniversary of the publication of *Atlas of Peculiar Galaxies* by Halton C. Arp, former Staff Member of the Observatories.

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August Evrard (U. Michigan) spent May and June at the Observatories under the new Scientific Visitor program. **Yulei Qiu** (Beijing Astronomical Observatory) is spending July through Sept. at Las Campanas under the same program.

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Hsiao-Wen Chen and **Michael Rauch** participated in the 17th IAP Colloquium, "Gaseous Matter in Galaxies and Intergalactic Space," in Paris in June.

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Hsiao-Wen Chen and **Paul Martini** attended the third international conference of the Laboratoire d'Astrophysique de Marseille in June. Martini presented a poster and Chen gave a talk on the latest results from the Las Campanas Infrared Survey.

Plant Biology

Shauna Somerville's lab welcomed laboratory assistants **Komal Kaura** and **Kelly Wetmore. Suparna Mundodi** (Oklahoma State U.) recently arrived to join the AFGC microarray informatics group. **Georgina Fabro** (U. Cordoba, Argentina) visited Shauna's lab for two months. The lab bade a fond farewell to **Celine Schiff** and **Shu-Hsing Wu. Rob Ewing** left for a bioinformatics position at Incyte. **Stephen Gross** departed to attend graduate school at UC-Berkeley.

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Chris Somerville's lab welcomed summer intern **Abbey Ryan**, a junior at Beaver Coll. in PA. Abbey is developing a series of images of *Arabidopsis* at various stages of development for TAIR. Also joining the lab is **Theodore Raab** (U. Colorado). Ted is using a beamline at the Lawrence Berkeley lab for high-resolution FTIR analysis of cell-wall composition in mutants of *Arabidopsis*. Two students from Mark Stitts's laboratory in Heidelberg, Germany, **Petra Matt** and **Raju Bari**, spent several months working with postdoctoral associate **Wolf Scheible**. Scheible returned to Germany to join **Stitt Abteilung** at the Max Planck Institute.

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Sue Rhee's lab welcomed postdoctoral fellow **Mark Lambrecht** (Catholic U. Leuven, Belgium). Mark and his wife, Inga, also welcomed their new baby, Lawrence Lambrecht. Also joining the lab are **Yi Li**, a visiting scientist from U. York, and **Daniel Yoo**, a programmer from UC-Berkeley.

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Chris Field's lab welcomed **Julie Pagis**, a predoctoral student from France; **George Merchant**, senior programmer; and lab assistants **John O. Niles, Juliette Jeanne, Shasta D. Pister-Lyhne, Benjamin Shaby,** and **Joseph Anderson**. Field's lab said farewell to lab assistant **Forrest Fleischman**. Coming to the Field group from Stanford U. are lab technician **Vivian Schoung** and lab assistants **Kirstin Cummings** and **Ajay Narasimha**.

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Zhiyong Wang welcomes **Jun-Xian He**, a Carnegie Fellow from Ohio State U. Jun-Xian received his degree from Lanz Hou U. in China. **Yanli Yang** (UCLA) joins as a lab technician. **Joshua Gendron** (UC-San Diego) has joined as a lab assistant.

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In Feb. **Sue Rhee** gave an invited talk at the Lorne Genome Conference in Australia on "The *Arabidopsis* Information Resource (TAIR): a comprehensive database and Web-based information retrieval, analysis, and visualization system for a model plant." Rhee presented the same talk in Sydney at Entigen Incorporated and a talk, "Current and future plans for the *Arabidopsis* Information Resource," at the AAAS meeting in San Francisco. She also spoke on "Developing the infrastructure for accessing and analyzing *Arabidopsis* data through the Web in post-genomic era of biological research" at the Plant Gene Expression Center in Albany, CA, in Apr.

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On Feb. 12 **Winslow Briggs** was an invited speaker at U. Arizona. On Feb. 23 he gave a special endowed lecture at Williams Coll. Briggs gave two lectures on Mar. 22 at a special symposium on physics and photoreceptors held in Marburg, Germany.

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In Apr., **Shauna Somerville** gave a talk at Agriculture Canada in Ottawa. In May she gave a talk at the Boyce Thompson Institute in Ithaca, NY.

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Arthur Grossman received a Lady Davis Fellowship as a visiting professor at Hebrew U. in Israel.

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On Apr. 5, **Chris Somerville** presented a talk, "Genetic dissection of the plant cell wall," at the annual meeting of the American Chemical Society in San Diego. Somerville was one of eight colleagues awarded the Kuhmo award by the International Society for Plant Molecular Biology. The award, sponsored annually by the Kuhmo Cultural Foundation of Korea, has a prize of $36,000. The year 2000 award recognized the contribution of the *Arabidopsis* Genome Initiative group in completing the *Arabidopsis* sequence.

Geophysical Laboratory ❶

Mikhail I. Eremets has become a staff member at the Max Planck Institute for Chemistry in Mainz, Germany. Eremets has been appointed a Visiting Investigator at GL and will continue his research in the field of high-pressure research with **Rus Hemley** and **Ho-kwang Mao**.

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The following people have been ap-

❸ Many GL staff attended the Enrico Fermi International School of Physics Summer School, "High-Pressure Phenomena," in Varenna, Italy. Pictured standing from left are Rus Hemley (codirector), Ron Cohen, Henry Scott, Sebastien Merkel, Stephanie Japel, John Loveday, Alex Goncharov, Eugene Gregoryanz, and Wendy Mao. Front row: Agnes Mao, Reed Patterson, Crystele Sanloup, Dave Mao, and Viktor Struzhkin.

❹ Shown here are Carnegie summer interns in geoscience for 2001. Front row (from left): Victoria Lee (Yale U.), Megan O'Grady (Vanderbilt U.), Jean Li (Montgomery Blair High School), Madalyn Blondes (Pomona Coll.), and Barry Reno (Trinity U.). Second row: Jeffrey Murray (William and Mary), Garret Huntress (U. of Maryland), Cullen Blake (Princeton U.), Ashley Smith (Gill U.), Danielle Moser (U. of Illinois), Alexandra Bevan (Yale U.), Juliana Rokosky (Macalester College), and Ivan Eremets (Moscow Engineering Institute).

pointed postdoctoral fellows at GL: **C. Kevin Boyce** (Harvard U.), **Albert Colman** (Yale U.), **Kenji Mibe** (Ph.D., U. Tokyo), **Gerd Steinle-Neumann** (U. Michigan), and **Sarah T. Stewart-Mukhopadhyay** (Caltech). The following have been appointed postdoctoral associates: **Henry P. Scott** (UC-Santa Cruz), **Pei-Ling Wang**, and **Mark Frank** (Ph.D., U. Maryland). **J. Reed Patterson** (U. Alabama-Birmingham) has been appointed a predoctoral fellow.

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NSF Associate **James Scott** spent four weeks in Tanzania examining the role of chemoautolithotrophic bacteria in the cycling of nutrients from the anaerobic deepwater to the oxic waters of Lake Tanganyika.

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Robert Hazen was interviewed about diamond synthesis at the GL's high-pressure facility for the History Channel's *Modern Marvels* series. In May, Robert and Margaret Hazen spent two weeks in the Moroccan Sahara Desert studying Devonian paleoreef complexes. ❷

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A dozen GL scientists attended the 18th AIRAPT high-pressure meeting in Beijing, China, July 23-26. **Dave Mao** gave the first plenary lecture. **Alex Goncharov, Robert Hazen, Jie Li, Charles Prewitt,** and **Ji-an Xu** presented invited lectures. **Yanzhang Ma, Oliver Tschauner, Chrystelle Sanloup, Mikhail Eremets, Eugene Gregoryanz,** and **Jingzhu Hu** presented papers.

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Lora Armstrong, an intern who worked with **Bjørn Mysen** last year, won the first place for best earth science project from AGI; second prize for women in geoscience; and third place in the earth and space science category at the International Intel Science Fair in May.

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H. S. Yoder, Jr. has been nominated as one of the founding members of "International Scientist of the Year" for 2001. The award was made by the Research and Advisory Board of the International Biographical Centre in Cambridge, England.

—

Ho-kwang Mao presented a keynote talk, "Advances in diamond cell techniques—applications to the Earth and planetary interiors," at the 2001 Goldschmidt Conference in May in Hot Springs, VA. He gave three talks at the spring AGU meeting in Boston and presented a talk at the NATO Advanced Study Workshop, June 10-15, in Fort Collins, CO. From July 4 to July 14, he delivered three lectures at the Enrico Fermi International School of Physics in Varenna, Italy. ❸ Lastly, he presented a plenary lecture, "Frontiers of high-pressure science and technology," at 18 AIRAPT International Conference, July 23-27, in Beijing, China.

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Russell J. Hemley codirected the Enrico Fermi International School of Physics Summer School, "High-Pressure Phenomena," at Villa Monastero, Varenna. He gave invited talks at the NATO Advanced Study Workshop—Frontiers of High-Pressure Research II and at the High Energy Density Materials Workshop in Arlington, VA, Aug. 7-8. He was a co-convenor at the 2001 Goldschmidt Conference session on Advances in the Development and Application of In-situ Techniques for the Investigation of Geochemical Systems, , May 20-24.

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Matthew McCarthy left in July for a position at UC-Santa Cruz. **Fred Marton** also left in July for the Bayerisches Geoinstitut, U. Bayreuth, Germany.

Terrestrial Magnetism

NASA Postdoctoral Associate **Steven Hauck** arrived in July from Washington U. At DTM he will investigate the coupling of climate change and interior evolution on Venus and Mars, the thermal and deformational history of Mercury, and the implications of his latest subduction-zone thermal models for deep-earthquake generation.

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Vera Rubin received an honorary D.Sc. degree at the Smith College graduation in May in Northampton, MA. In June, she spoke at the Rose Planetarium in New York City.

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Alan Boss and **Larry Nittler** gave invited talks at the Gordon Research Conference on Origins of Solar Systems in New London, CT, in June. **George Wetherill, Boss,** and postdoctoral fellows **Steven Desch** and **Satoshi Inaba** presented posters.

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In July **Alan Boss** was a commentator on results from NASA's Submillimeter Wave Astronomical Satellite (SWAS) mission at a televised NASA Space Science Update held at NASA headquarters, Washington, DC. He spoke about the search for extrasolar planets at George Mason U. in Apr. and about the formation of protoplanets and protoplanetary disks at University College London's 15th Astronomical Colloquium. In Aug. he chaired a group at the NASA Planetary Geology and Geophysics Review Panel in Washington, DC.

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Rick Carlson, David James, Steve Shirey, and former postdoctoral fellow **Matthew Fouch** attended the 5th Kaapvaal workshop, held in Boston following the spring AGU meeting in June.

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Carnegie Fellow **Monica Handler** has become a postdoctoral fellow in the Dept. of Mineral Sciences at the Smithsonian Institution's National Museum of Natural History.

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NSF Fellow **Andrew Freed** has accepted a position as Visiting Postdoctoral Scholar in the Berkeley Seismological Laboratory.

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Adjunct investigator **Matthew Fouch** (Arizona State U.) visited DTM in July. A former Harry Oscar Wood Fellow, he continued his collaboration with David James and Paul Silver on the Southern Africa Seismic Experiment.

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Visiting Investigator and former DTM Carnegie Fellow **Elisabeth Widom** (Miami U.) arrived in early July for additional Os isotopic analyses on several projects. She joined her graduate student **Darin Snyder**, who arrived in June to work with **Aaron Pietruszka**. Visiting Investigator **V. Rama Murthy** returned to U. Minnesota in early July. Visiting Investigator **Hugh Van Horn** spent the summer at the Dept. of Physics and Astronomy, U. Rochester.

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Teresia Nguuri, a predoctoral fellow from U. Witwatersrand, spent three weeks in May at DTM working with David James as part of the Southern Africa Seismic Experiment. Professor **Samual Mukasa** and his student **Zeb Page** visited from the Dept. of Geological Sciences, U. Michigan, for a week in July. Mukasa worked with Rick Carlson on Re-Os analyses of magnetites from the Dufek intrusion in Antarctica. Page used the P54 for Lu-Hf analyses.

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Darrell Hyde, a graduate student from the Memorial U. of Newfoundland, spent May working with Steve Shirey on the Re-Os and platinum-group element geochemistry of gold-bearing banded iron formations from the Churchill Province of the Canadian Shield. Other short-term visitors were **Suzanne van der Lee** (Institut für Geophysik, Zurich) and **John VanDecar** (*Nature* magazine, London).

DTM/GL ❹

Sujoy Mukhopadhyay (Caltech) has been appointed a Carnegie Fellow at DTM and GL.

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DTM-GL Visiting Investigator **Kevin Burke** returned in May from the Dept. of Geosciences, U. Houston, where he taught last semester.

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Per Dahl, son of former DTM Staff Member **Odd Dahl**, and his wife, Eleanor, visited DTM in May as guests of **Louis Brown**. They brought with them a number of historical photographs of Dahl's 1928-1929 magnetic expedition to the Middle East. Copies were deposited in the department's archives.

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In Aug., the archives received a donation from the grandson of another early magnetic observer, **J. C. Pearson**. **Terrance Egolf** donated a copy of Pearson's diary of his crossing of the Pacific on board the *Galilee*—DTM's first research vessel—in 1906, as well as extracts about Pearson's fieldwork in the Russian, Turkish, and Persian empires from 1908 to 1910.

"Galaxies: Mind over Matter," Symposium **Honoring Vera Rubin**

The Carnegie Institution, in collaboration with NASA and the Space Telescope Science Institute, is hosting a one-and-a-half-day symposium to honor Vera Rubin and her many contributions to astronomy and science. Observatories Staff Member Emeritus Allan Sandage will begin the event with a public lecture, which will take place on Thursday, January 10, 2002, at the administration's P Street building in downtown Washington, D.C. A full day of scientific talks will follow on Friday, January 11, with topics ranging from extrasolar planets to the large-scale distribution of matter in the universe. See the institution's Web site, **www.CarnegieInstitution.org**, for more information.

Vera Rubin has joined the ranks of such notable figures as Thomas Edison and Marie Curie, and Carnegie luminaries Arthur Day, Merle Tuve, and Vannevar Bush by earning the John Scott Medal. The medal has a long history: it was first awarded in the early 1800s. John Scott, an Edinburgh druggist, called on the city of Philadelphia to administer his bequest to ensure the legacy of Ben Franklin. Rubin received the honor for her "major role in changing the way we think about our universe."

Observing the Centennial from Coast to Coast

Besides the exhibition, and related activities planned for Carnegie's administration building, each of the five departments will mark the institution's 100th birthday with its own events. Plant Biology in Stanford will host a one-day symposium and sponsor a lecture series. Both are scheduled for the latter half of 2002. The lectures are modeled after the Capital Science Lectures held at the administration building in Washington. The Plant Biology series will consist of three to four lectures cosponsored by the Stanford Lively Arts Program. The talks will address plant biology topics of general interest, such as global climate change, genetically modified organisms, and the loss of biodiversity.

The Observatories in Pasadena plan to hold a series of three to four public events on astronomy. In addition, Luis Ho is organizing four astrophysics symposia, which will begin in the autumn of 2002. Various staff members will host the separate sessions, which will focus on research that is particularly interesting to Observatories staff. Topics include the coevolution of black holes and galaxies, cosmological parameters, abundances and chemical evolution, and galaxy clusters as tracers of structure. More information can be found at **www.ociw.edu/ociw/symposia/**.

The Geophysical Laboratory (GL) and the Department of Terrestrial Magnetism (DTM) are joining forces to hold a series of eight public lectures at the Broad Branch Road campus. Louis Brown of DTM and Bob Hazen of GL are heading the effort. The talks will begin this fall and continue into next year. Each department will give four lectures, covering topics ranging from what goes on at the center of the Earth to the nuts and bolts of cosmochemistry.

In Baltimore, the Department of Embryology plans to mark the centennial with a special symposium that they hope to time so that it will coincide with the groundbreaking for the new Maxine F. Singer building. *(See page 5)*

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