

## John P. Schaefer Celebrates 20 Years as Foundation President

John P. Schaefer's 20th anniversary as president of Research Corporation on July 1, 2002 was commemorated by the board of directors at their November meeting. Now in his 21st year with the foundation, Schaefer has had the longest tenure of any president of Research Corporation.

However, his association with Research Corporation has been of even greater duration: he received a research grant in 1959 as assistant professor of chemistry at the University of California, Berkeley and again in 1960 when he moved to the University of Arizona. He has also been on the foundation's board of directors since 1974.

Originally from New York City, Dr. Schaefer earned degrees from Polytechnic Institute of Brooklyn and the University of Illinois at Urbana-Champaign. After a year at Caltech and Berkeley, his 22-year career at the University of Arizona began in 1960 as an assistant professor; it culminated in the presidency in 1971, a post he held until joining Research Corporation in 1982.

Under his leadership, the foundation has evolved and undergone many changes (recounted in the Spring 2002 issue of the *Report*): relocation from New York to Tucson, consolidation of three re-

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## Grote Reber 1911–2002

### *"Cosmic Static" Marked the Birth of a New Science*

Grote Reber, the first real practitioner of radio astronomy, died in Tasmania on December 20, 2002 just two days before his 91st birthday. His research was supported for more than 20 years by Research Corporation.

He was born in Chicago in 1911 and graduated in electrical engineering from what is now the Illinois Institute of Technology. A radio engineer and ham radio enthusiast, Reber was the first to follow up Karl Jansky's 1932 discovery of radio emissions emanating

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## Ray Kellman Appointed Vice President

Most recently serving the foundation as Senior Associate, Ray Kellman was announced as the new vice president at the November meeting of the board of directors. His duties include responsibility for the administration of Research Corporation's grants programs. "Dr. Kellman's experience with the college and university communities coupled with experience gained as a teacher-scholar are assets that will serve the foundation well," said President John P. Schaefer in announcing this appointment.

Dr. Kellman has been a program officer, primarily for the Cottrell College Science Awards,

since he joined Research Corporation in 1992. At that time the foundation did not have programs to support faculty at research universities and Kellman was instrumental in the initiation and design of the Cottrell Scholars Awards in 1993. His continued guidance and vision has helped to insure the success of this notable program. "His insights into the mechanisms of science-department building, his interpersonal skills, and his insistence on excel-



lence have set the standard for program-officer performance,"

said former vice president Brian Andreen.

A native of Staten Island, N.Y., Dr. Kellman earned his Ph.D. in organic chemistry from the University of Colorado, Boulder. Prior to joining the foundation he held teaching appointments at the University of Texas at San

Antonio, and San Jose State University. He was also a visiting Fulbright professor at the University of Queensland, Australia.

## Altering the Standard Model of Universe, Milky Way

**Heidi Jo Newberg,  
Rensselaer Polytechnic Institute**

The identification of new star structures in the halo of the Milky Way that could alter the standard model of the galaxy was announced at the January meeting of the American Astronomical Association by Heidi Jo Newberg and Brian Yanny of the Fermi National Accelerator Laboratory.

For four years Newberg, Yanny, and their research team have been examining the spatial distribution of stars in the Milky Way. At the outer edges of the galaxy they found tens of thousands of stars arranged in formations that diverged from standard galactic models.

The star streams were identified after examining the positions, colors and brightness of five million stars detected in the Sloan Digital Sky Survey (SDSS), an international effort to catalogue 100 million celestial objects using a dedicated telescope at the Apache Point Observatory in New Mexico.

"These stars may be what's left of a collision between our galaxy and a smaller, dwarf galaxy," Newberg said. The ring is probably the largest of a series of similar structures being found around the Milky Way, whose gravity can tear stars away from a dwarf galaxy if it comes too close. Hidden from view behind gas and stars on the same visual plane as the Milky Way, the ring of stars is about 120,000 light years in diameter and 35,000 light years from Earth.



Heidi Jo Newberg

It was previously thought that the Milky Way was formed from a ball of hydrogen gas which flattened out into a disk and eventually took on the spiral shape seen today. The dimmer stars in the halo

were believed to have been left behind in a spherical distribution.

When she began to study the stars that form the galactic halo, Newberg imagined that they would be evenly distributed or even randomly distributed. It turned out, however, that enormous groups of stars were clustered together.

Finding this substructure was not the original intent. Explained Newberg, "We intended to measure the global distribution of halo stars to determine whether [the halo] was spherical or oblate." However, they were unable to do that because the stellar distribution turned out to be so "lumpy." Stars in the halo appeared to be grouped into distinct streams across the sky.

The SDSS researchers believe that the clumps are stretched-out remnants of smaller galaxies captured by the Milky Way billions of years ago. This adds to a growing body of evidence that shows that

at least part of the halo of the Milky Way was formed through the accretion of smaller satellite galaxies.

Newberg's research raises many new questions about the previous model of the Milky Way and the history of its formation. "The clumpiness of the stellar distribution in the Milky Way halo suggests that our galactic model needs to be extended," she said.

Recipient of a 2002 Research Corporation grant to continue her current studies, Heidi Jo Newberg has worked in many areas of astronomy over the

course of her career. She received her Ph.D. at the University of California, Berkeley where she worked with the Berkeley Automated Supernova Search, and the Supernova Cosmology Project. Prior to joining the physics department at Rensselaer in 1999, Newberg was a research scientist at the Fermi National Accelerator Laboratory where she began her work with the SDSS. She has published papers in diverse areas of galactic and extragalactic astronomy including supernova phenomenology, galaxy photometry, properties of stars, and the structure of our galaxy. She has been the co-chair of the SDSS Stars Working Group since 2001.

**Max Tegmark,  
University of Pennsylvania**

"Our Universe is a very strange cosmic cocktail," explained Cottrell Scholar Max Tegmark whose work was recently featured



Max Tegmark

in *The New York Times* (“Universe as Doughnut: New Data, New Debate,” March 11). That cocktail is being analyzed by Tegmark and his colleagues who have constructed the most detailed digital map to date of the temperature variations in the cosmic microwave background (CMB) — the relic radiation from the Big Bang — allowing for new interpretations of the composition and shape of the Universe.

The image was produced from data collected by the Wilkinson Microwave Anisotropy Probe (WMAP), a satellite launched by NASA in 2001 to obtain full-sky images of the temperature fluctuations in the CMB. Tegmark produced a “cleaned” CMB map by removing the foreground contaminants — other sources of microwave radiation, such as dust in our galaxy — that could alter the data.

The analysis of the new map suggests that there is a special direction as well as a special scale in the universe. Although Tegmark and his team members had expected that the CMB would not have a preferred direction, they found a pattern that was anything but random. In looking at the symmetry of the CMB — in measurements called its

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## **Grote Reber**

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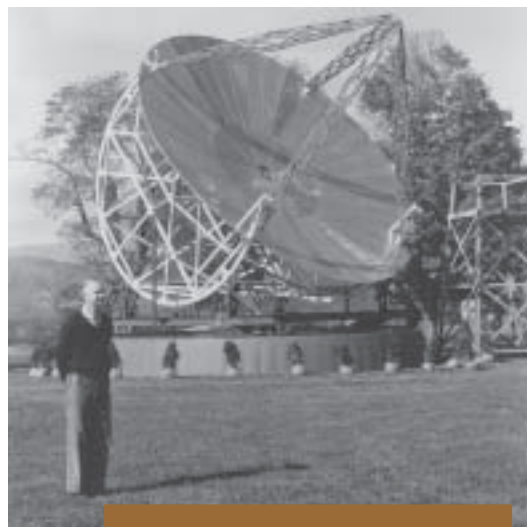
from our galaxy. Devoting nights, weekends and six months’ salary, he designed a solid tilttable parabolic antenna 31 feet in diameter, and with little assistance, constructed it in four months — June to September 1937 — in his backyard in Wheaton, Ill. After experimenting with various frequencies, in 1939 he detected the Jansky radiation at 160 megahertz and within a few years accumulated enough data to

produce the first radio maps of the sky. His 1940 and 1944 articles on “Cosmic Static” published in the *Astrophysical Journal* marked the beginning of intentional radio astronomy.

In 1947 Reber accepted a position with the Bureau of Standards as chief of the Experimental Microwave Research Station and his radio telescope was moved to Sterling, Va. While in Washington, he attempted and failed to get support for his own research from any government agency because it had no “practical” or military significance.

After reading an article in *Physics Today* by Charles H. Schauer, the director of grants at Research Corporation, Reber wrote to him in November of 1950 describing his work and proposed project. His concept was the construction of an observatory on an island peak where the antenna would collect both direct signals from cosmic sources and those reflected from the surrounding water so that large mechanical mirrors would not be needed. While Schauer was taking his proposal to Research Corporation’s Advisory Committee, Reber proceeded with his plans — with no assurance of funding — finding a site that suited his needs at the 10,000-foot Haleakala Peak on Maui, Hawaii. In 1951 the Advisory Committee recommended support of up to \$15,000.

The first of many grants for construction and operation of Reber’s radio telescopes was made in 1952 for the “Study of galactic radio waves which are non-thermal in nature.” To continue to explore the then-neglected area of low-frequency radio waves, Grote Reber left Hawaii in 1954 to design and construct a radio telescope for the



Grote Reber with the radio telescope he first built in Wheaton, Illinois in 1937 — shown here reassembled in Green Bank, W. Va.

Commonwealth Scientific and Industrial Research Organization in Tasmania, one of the few places where long-wavelength signals could penetrate the ionosphere.

He accepted a position in 1957 at the National Radio Astronomy Observatory (NRAO) in Green Bank, W. Va., where in 1959 he assisted in the reassembly of his first telescope. Reber returned to Tasmania in 1961 to again pursue his research in the reception and mapping of low-frequency radio emissions through the 1970s. Research Corporation continued to support his research until 1973.

Grote Reber’s work forever changed the science of astronomy. During the decade after 1937 he worked practically alone in the field of radio astronomy. He produced the first radio maps of the sky, was the first to express radio signals in terms of flux density and brightness, and determined that that galactic radiation was non-thermal.

“All radio astronomers . . . owe Grote Reber a debt for his pioneering work,” said NRAO director Fred Lo. He “gave astronomy a whole new view of the universe.”

# Talking in Class

BY HEATHER MORRISON

For someone whose education (in England and Australia) was quite traditional, the phrase “talking in class” has overtones of the forbidden. But after I left university, I found that the model of learning where a professor talks, students take notes quietly, and working together is frowned upon, is not a good preparation for life either as an academic scientist or in business. More and more, in both environments, people work together in teams, and the ability to work well with others is seen as a definite advantage by prospective employers. It has also been demonstrated that students learn better when they study together.

When I started teaching as a new faculty member at Case Western Reserve University I was lucky to find a mentor who had pioneered the use of collaborative and active learning techniques in science at CWRU — a short (10 to 15 minute) lecture, followed by a group discussion question, followed by a class discussion. I liked this a lot: it gave me instant feedback about whether the class understood the topic, which was particularly helpful for me as I learned to teach. It also got rid of the awful pause that had always followed my enquiry “Any questions?” at the end of a lecture. I found that when students had a chance to discuss things among themselves first, and I asked not “Jenny, what do you think?” but “Jenny, what does your group think?” It was a lot less risky for them to answer, and class discussions followed easily. The students liked it too.

But I noticed that there were al-

ways a few students who stayed almost entirely tongue-tied throughout these collaborative-learning classes. They were usually (although not always) women, and nothing that I tried in that framework seemed to help much. Difficulty speaking up is not just a problem for women students: women scientists can suffer from it too.

When I worked with a learning community for women in science at CWRU (WISeR, the Women in Science Roundtable, <http://burro.astr.cwr.edu/women>), I had an opportunity to talk with other women scientists about what would be helpful to prepare women students to become excellent scientists. A recurring theme across disciplines was a difficulty in talking easily about our work, especially to strangers or to large groups.

We decided to tackle this problem head-on with a discussion class called “On Being a Scientist” to get the students talking about science right from their freshman year. Author Sheila Tobias had just visited CWRU, and she suggested that the articles in the “Science Times” section of *The New York Times* would make a good basis for such a class. We choose, at random, the person who will lead the discussion about the article in class: while it reduces the quality of presentations, it enormously enhances the quality of discussions.

“On Being a Scientist” is a one-credit-hour class with a pass/fail grade granted on attendance only. We work hard to produce a safe, relaxed atmosphere in the class, which we limit to 12 students so that each will have a chance to join

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## GUEST COMMENTARY

## LBT Project Update

The construction of the Large Binocular Telescope (LBT, its history was recounted in the foundation’s recent annual report) is proceeding on course with the completion of its enclosure on Mt. Graham, Arizona. In October 2002 the major mechanical parts for the mounting arrived from Italy and their installation is now in progress. The polishing of the first 8.4-meter diameter primary mirror was completed in December 2002. Within six months the mounting will be fully assembled and by next October the first of two primary mirrors will be on site. It is expected to be operational (“first light”) in June 2004. Second light, with both mirrors in place, is slated for September 2005.

In the LBT’s initial optical configuration there will be a prime-focus charge-coupled device (CCD) camera on the first 8.4-meter mirror. Subsequently two secondary mirrors will be added with adaptive optics that are designed to compensate for turbulence in the Earth’s atmosphere.

### New consortium members

Both the University of Virginia and the University of Minnesota announced their membership in the LBT Consortium last October. They will join the University of Notre Dame and Ohio State in sharing telescope time allotted to Research Corporation as a founding partner of the LBT Project. Other partners in the consortium are the University of Arizona, Ohio State University, and astronomy groups in Italy and Germany.

Several of the partner institutions are in the midst of building auxiliary instrumentation including spectrographs for optical and infrared wavelengths and digital cameras using CCDs.

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## Grantees in the news

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octopole and quadrupole components — they found the large-scale variations arranged in a straight line across the sky like a cosmic equator. “It could be telling us something about the shape of space at the largest scales, said Dr. Tegmark. “We did not expect this and we cannot yet explain it.”

Tegmark and his collaborators have also used the new survey information to assess the type as well as the structure of matter that makes up our universe. They found that only 5 percent of the mass is the kind of ordinary matter that makes up planets, stars and gases.

The other 95 percent is a mixture of curious ingredients that can't yet be seen — dark matter, which appears haphazardly throughout the universe, and dark energy, which is believed to be uniformly distributed.

Tegmark's work on the structure and matter revealed by analysis of the CMB are related to his ongoing research focus on precision cosmology which combines theoretical work with the latest measurements on various aspects of the Universe to place a sharp limit on the number and nature of cosmological models used to explain the data.

Max Tegmark, an assistant professor of physics and astronomy,

was the recipient of a 2002 Cottrell Scholar Award which supports his teaching as well as his research on data coming from observations of the CMB and large-scale structure. His interpretation will rely on model-independent analysis rather than assumptions on the underlying physics. These efforts to illuminate the structure and geometry of the Universe are based on new data coming from a variety of sources that include WMAP, the Sloan Digital Sky Survey, and BOOMERANG 2001. His analysis is focused on the following issues: the nature of dark energy and dark matter, the nature of gravity at large scales, the nature of the early Universe and of structure formation.

One of the most exciting aspects of the research, says Dr. Tegmark, is that model-independent analysis has the potential of revealing that current models are wrong.

Max Tegmark received his Ph.D. from the University of California, Berkeley. Before joining the University of Pennsylvania in 1999 he was a Hubble Fellow and a member of the Institute of Advance Study, and a research associate at the Max-Planck Institute for Physics in Munich. He was also the recipient of a David and Lucile Packard Fellowship in 2001.

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## Schaefer Anniversary

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gional offices into the main office, and the division of grants administration and patent administration functions into two separate organizations.

“John came to Research Corporation at a time when the foundation was experiencing a serious financial crisis and had begun to lose its vision of where it could make a difference,” explained former vice president Brian Andreen. “He was able to steer us through a process which investigated all the possibilities and restored the foundation to viability.”

In 1982, Research Corporation had only two grants programs, the Cottrell Research Program for new faculty at public institutions and the Cottrell College Science Program for private colleges. During his tenure six new grant programs have been implemented which include awards to faculty at various stages in their careers and departmental support.

Dr. Schaefer was also instrumental in securing Research Corporation's intervention in the “rescue” of two Arizona telescopes. In 1992 the foundation promised \$7.5 million to underwrite the Large Binocular Telescope when a partner institution withdrew support from the project, and in 2000, Research Corporation provided \$150,000 in emergency funding to keep the 12-meter radio telescope on Kitt Peak operating until permanent support could be found.

How the foundation could “make a difference” in research and education has been the defining factor in Schaefer's leadership of Research Corporation. It is a philosophy which he believes has been the guiding principle of the foundation throughout its history and that will continue to serve its administration in coming years. Says Schaefer, “Science, wisely supported and applied can be the dominant positive force in shaping the future of mankind. That remains an objective worth pursuing.”

### 2003 Proposal Deadlines

- Research Innovation Awards
- Research Opportunity Awards (nominations)  
May 1
- Cottrell College Science Awards  
May 15
- Cottrell Scholar Awards  
September 2
- Research Opportunity Awards (nominations)  
October 1
- Cottrell College Science Awards  
November 15

# RESEARCH CORPORATION

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## Talking in Class

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the discussion regularly. One of the things that I found hard as a student was to ask questions in class in case the professor thought me dumb. I have since learned that understanding is more important than image, and ask many "dumb" questions in these discussions to make their tone as unthreatening as possible. The first class had nine female and two male students with a wide range of majors, and we discussed topics as diverse as gorillas in Rwanda and knot theory.

It worked! Every student, even some who were very shy, participated in the wide-ranging discussions. Some of the louder students learned to listen too. One student

commented, "It's the only class I really look forward to every week." We often invited a faculty member whose topic was close to the one being discussed, and were astonished when one asked whether he could come back the following week. In addition, the regular meetings and discussions helped build community among the students: many of the women who participated are now mentoring first-year women students. Most importantly, the talking about science was *always* fun.

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*Heather Morrison is Associate Professor of Astronomy at Case Western Reserve University in Cleveland, Ohio. She was a 1997 Cottrell Scholar.*

## New Eligibility Requirements for Research Innovation Awards

The eligibility guidelines for applicants to the Research Innovation Award program were modified in January. Candidates requesting an application to be submitted on May 1, 2003 must have started their first regular tenure-track appointment between July 1, 2002 and June 30, 2003. Only one application per candidate is now allowed. For complete guidelines please see the foundation's Web site.

The previous guidelines stipulated that candidates should have started their first tenure-track position in the previous or current calendar year and allowed them to submit applications in two consecutive years.

## RESEARCH CORPORATION REPORT SPRING 2003

Research Corporation  
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A foundation for the advancement of science, Research Corporation supports basic scientific research at U.S. and Canadian colleges and universities.

### Science Advancement Program

*Cottrell College Science Awards* support research that contributes to the advancement of science and to the development of faculty and their students at undergraduate institutions. *Cottrell Scholar Awards* support beginning faculty members who wish to excel at both research and teaching. *Research Innovation Awards* encourage innovation by scientists early in their academic careers. *Research Opportunity Awards* assist scientists of demonstrated productivity seeking to explore new experimental research. *Special Opportunities in Science Awards* support projects that advance scientific research or that impact the infrastructure of science. Further information on these programs is available from the foundation's Internet site, <http://www.rescorp.org>; by mail to the above address; e-mail to [awards@rescorp.org](mailto:awards@rescorp.org); or telephone (520/571-1111) and fax (520/571-1119).

The RESEARCH CORPORATION REPORT supplements the foundation's annual report, its program guidelines and occasional publications. Submit news items and editorial correspondence to Carmen Vitello, Communications Office, or send via e-mail to [rcbooks@rescorp.org](mailto:rcbooks@rescorp.org).

**Editor: Carmen Vitello**