

Green Bank Telescope Opens

Arrays of radio antennas may be the trend, but, says Phil Jewell, "single dish telescopes still have their place in radio astronomy. They're more sensitive to large-scale structures in the sky, and they can do rapid imaging of large fields." Jewell is site director of the National Radio Astronomy Observatory in Green Bank, West Virginia, where the world's largest fully steerable, single-dish telescope was named in honor of state senator Robert C. Byrd on 25 August.

The Robert C. Byrd Green Bank Telescope replaces the site's 300 Foot Telescope, which collapsed in 1988 under its own weight. The new 100-meter dish was a decade in the making and cost the National Science Foundation about \$75 million. It can detect wavelengths from 3 mm to 3 m (0.1–100 GHz).

The Green Bank telescope will be tested over the next few months. Starting next year scientists will use it to

study distant galaxies, star formation, pulsars, and astrochemistry, among other things. Says Jewell, "The Green Bank telescope adds another weapon to the overall arsenal we have. It's extremely complementary to [radio telescope] arrays."

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MIKE BAILEY FOR NRAO/AUI

star formation, and galactic remnants. "This is a win-win situation," says Jill Tarter, research director of the Mountain View, California-based SETI Institute. "The Allen Telescope Array can be used by both radio astronomers and SETI scientists all the time."

US radio astronomers are also crossing their fingers that the Allen array design will be chosen for the planned 100-fold larger Square Kilometre Array (see story on page 70).

The clever innovation of the Allen Telescope Array is to use hundreds of commercial-type satellite dishes to keep down the price tag while still getting a large collecting area. The computationally intensive plan banks on Moore's Law continuing; that is, on computing power doubling every 18 months. Says UCB radio astronomer Leo Blitz, "We are looking to design the telescope so that software is the

capital cost—the permanent part of the telescope—and the hardware is the operating cost, because we know that whatever we build will effectively be obsolete in about five years. No telescope has yet been designed like this." Details, such as whether to go with 500 5-meter dishes or 1000 3-meter ones—a trade-off between keeping down computing and electronics costs and getting a larger field of view—still have to be worked out.

The money raised so far should cover building a prototype array by 2003. If that goes well, it's hoped that Allen and other private investors will pony up the rest of the \$26 million for the full array, which is scheduled to go online in 2005. The private funding has meant a speedy path from concept to construction. "A government-funded project of this scope necessarily takes much longer," says Blitz.

Coming up with about \$1.5 million a year to run the array will fall largely to the academics on the team. But you can help: Donate \$50 000 and get your name on a dish.

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HUNDREDS OF SATELLITE DISHES will give the Allen Telescope Array a large collecting area at a comparatively low cost. (Artist's rendering courtesy of the SETI Institute.)

Hawaiian Astronomy Gets New Director, Plans Expansion

Rolf-Peter Kudritzki takes the helm of the University of Hawaii's Institute for Astronomy this month, just in time to start implementing recently approved plans to expand the

observatories on Mauna Kea—a job that includes coping with some community opposition and seeking outside telescope builders. The political side of the job made it hard to fill, and Kudritzki's appointment caps a three-year search to replace Donald Hall, who lost the directorship amid claims that he treated solar astronomy unfairly (see PHYSICS TODAY, October 1996, page 62).

The university's plans for beefing up the observatories on Mauna Kea call for, among other things, building a 25–50-meter telescope, doubling the number of antennas in the submillimeter array from 12 to 24, and upgrading many of the site's aging observatories. Up to six 1.8-meter telescopes are also to be added to the twin Keck telescopes, which would make the collection the largest optical interferometer in the world.

However, the university doesn't own most of the telescopes—although it does get free viewing time—so it must attract outside projects to realize these plans. So far, only the Keck additions have been funded, by NASA. "The rest is a projection of what we may expect to be proposed over the next 20 years," says interim director Bob McLaren.

The observatories lie on state conservation land that is sacred to native Hawaiians and home to rare insect species, and a 1998 state audit found the university's management of the mountaintop was inadequate. Although the development plans were scaled back, Nelson Ho of the Sierra Club says there are still too many new telescopes, unnecessary public access restrictions, and not enough funds for environmental and cultural protections.

But Kudritzki says the plans are well balanced and "preserve Mauna Kea as a cultural and ecological site." Among other things, they limit the total area of development to 150 acres, cancel two of the five new observatories originally proposed by the university, require case-by-case approval for all proposals, and rule out building on pristine summit cones, or *pu'u*.

Kudritzki, whose current research interests include the study of hot massive stars and telescope instrumentation, is leaving the directorship of Munich's Institute for Astronomy and Astrophysics to come to Hawaii. He



KUDRITZKI

says that Mauna Kea, with its dry, cloud-free, and stable atmosphere, "is probably the best place in the world for ground-based optical astronomy."

LYNLEY HARGREAVES

Darwin Returns to Kansas

Scientists and educators in Kansas are breathing easier now that two of the six anti-evolutionists on the state's board of education lost their primary elections in August and a third resigned, assuring that the theory of evolution will be reinstated in the state's K-12 science standards.

"We're headed in the right direction," said John Staver, director of the Center for Science Education at Kansas State University. The board's new makeup means that a majority will be "back in the moderate direction," he said.

Staver was a cochair of the 27-member committee of science teachers, educators, and scientists that two years ago wrote a lengthy set of standards for K-12 science education in Kansas. The board adopted the standards, but only after voting 6 to 4 to revise them and cut all references to Darwinian evolution, the Big Bang, the age of both the universe and Earth, and, curiously, global warming. (See PHYSICS TODAY, November 1999, page 59.)

The standards are the basis for the statewide achievement tests all students must take beginning in 2001. While the board didn't ban the teaching of evolution and cosmology outright, scientists and educators alike feared that without the standards to back them up, many teachers would avoid what to some are controversial subjects.

The state's 1 August Republican primary election became a referendum on evolution versus creationism when three of the conservative incumbents were challenged by Republican moderates who campaigned on the issue of putting real science back in the standards. The outcome is seen as a victory for grassroots organizing by scientists and others in the state. The most telling defeat was of Linda Hol-loway, who spearheaded the anti-evolution effort and spent about \$90 000 on her reelection bid. Her challenger, Sue Gamble, spent about \$36 000 and won 60% of the vote.

"I would like to think public education by the Kansas Citizens for Science [a group that coalesced around the science standards issue] made the

difference," said Adrian Melott, a University of Kansas cosmologist. "Our focus has been not to campaign, but education. We held public lectures and we targeted newspapers and radio. We didn't let any of [the anti-evolution claims] go unchallenged."

While the original 27-member science standards committee was disbanded after turning in its recommendations more than a year ago, Staver planned to call the group back together on 9 September to review its original standards and have them ready for the new board, which takes office 1 January.

There is still the general board of education election in November, but for this issue who wins doesn't matter because the majority of the Republican and Democratic candidates have stated they will overturn the anti-evolution vote.

This battle has been won in Kansas, Staver said, "but there will never be a time to relax because this kind of thing has been going on since Darwin published the *Origin of Species*. The folks on the [creationist] side of this issue believe they are right, and they believe absolutely."

JIM DAWSON

Newton's Alma Mater Bids for His Papers

The University of Cambridge is attempting to buy one of the most



LETTERS FROM ISAAC NEWTON in the Macclesfield collection could give scholars new insight into the writing of *The Principia*.

important collections of scientific papers from the 17th century still in private hands. The Macclesfield collection includes 50 letters from Isaac Newton, which were mainly written in his twenties and thirties, as well as manuscripts and correspondence from the Irish chemist Robert Boyle and letters from Isaac Barrow, Newton's predecessor in the Lucasian professorship of mathematics at Cambridge. Only a few scholars have gained access to the manuscripts since the 1830s—details about them are known mostly from Stephen



Web Watch

<http://star.tau.ac.il/QUIZ/>

Each month, Yakov Kantor, a condensed matter physicist from Tel Aviv University in Israel, updates his *Physics Questions/Problems* Web page with a new puzzle. If you submit an answer, Kantor will review it and, if he thinks yours is the best, he'll publish it on the site. The latest puzzle concerns a radiating spherical shell with a time-dependent radius.



<http://www.nobel.se/physics/articles/fusion/index.html>

The official Web site of the Nobel Foundation currently highlights an article by John Bahcall of Princeton's Institute for Advanced Study. Entitled *How the Sun Shines*, Bahcall's article takes a historical approach, beginning with 19th-century estimates of the Sun's age and ending with the discovery last year of neutrino oscillations.

<http://physics.nist.gov/GenInt/Curie/main.html>

From the physics laboratory of the National Institute of Standards and Technology comes Marie Curie and the NBS Radium Standards, an extensive Web site that describes Curie's role in establishing radiation standards at NIST's forbear, the National Bureau of Standards. Curie died in 1934, but the Web site continues with the story of radiation standards right up to the present day.



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