with new clues to conditions ranging from antibiotic resistance to cholesterol metabolism, says Rockefeller's Stephen Burley, who heads the five-institution consortium.

Each new center is slated to receive about $20 million over 5 years, a number that will vary depending on indirect costs paid to the institutions involved. But more money is in the pipeline. In July, NIGMS released another request for additional structural genomics centers to be funded next year. And when the current program is finished, NIH is expected to select two or three of the current crop of centers and ramp up their funding considerably.

–ROBERT F. SERVICE

CEPHEID VARIABLES

Astronomers Measure Size of a Giant's Sighs

To stargazers, Zeta Geminorum makes up the kneecap of one of the twins in the constellation Gemini. To astronomers, it is also one of the brightest Cepheid variables in the sky—giant yellow stars that grow dimmer and brighter over periods of days or weeks. Astronomers have long presumed that the surface layer of a Cepheid variable, called the photosphere, physically expands and contracts to cause this odd behavior. Now, they have caught Zeta Geminorum in the act of swelling and shrinking, making it the first Cepheid that astronomers have actually seen change its size.

"It's been something that we've always wanted to do," says graduate student Ben Lane of the California Institute of Technology (Caltech) in Pasadena, part of the five-person team that made the observations. Earlier astronomers inferred the size of the oscillations indirectly, through the well-known phenomenon of the Doppler shift. As a Cepheid variable grows, its surface moves closer to Earth, causing its light to appear bluer; as it shrinks, the surface moves away from Earth and the light is redshifted.

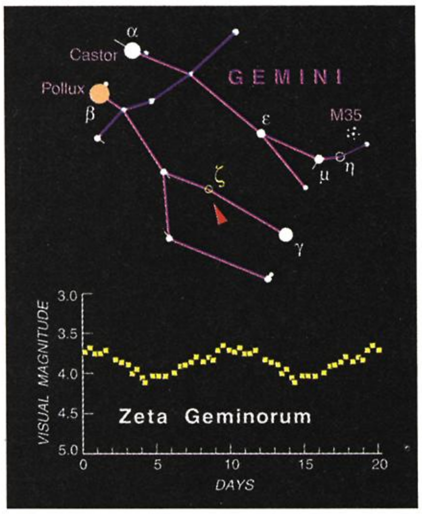
Seeing the size change directly, however, has been a daunting challenge in precision astronomy. The angular diameter of Zeta Geminorum, as seen from Earth, is only about 1.5-thousandths of an arc second, or 0.0000004 degrees, and the change in its diameter over a 10-day cycle is only one-tenth of that. Picking out such a small change is equivalent to spotting a basketball on the moon—a feat beyond the ability of either the largest Earth-based telescopes or the Hubble Space Telescope.

Astronomers have now gotten around that problem by linking two telescopes into a 110-meter-wide interferometer. The Palomar Testbed Interferometer (PTI) in California has as much angular resolving power as a telescope with a mirror larger than a football field. (No such telescope exists, of course.) That makes the interferometer perfect for detecting small motions in relatively nearby objects, such as the wobble of a star with a large planet orbiting it or the pulsing of a Cepheid variable. Nevertheless, previous attempts at the PTI, as well as at two other large interferometers in Arizona and France, failed to separate the expected motion from the random jitters caused by Earth's atmosphere.

Lane attributes the Caltech astronomers' success, reported in this week's issue of *Nature*, to three factors. First, they hiked the interferometer's resolution by retuning the instrument to collect a shorter wavelength of infrared light than it had gathered in previous attempts. Second, the group filtered out atmospheric turbulence with a type of optical fiber that some of the other groups did not have. The third ingredient, Lane says, was "persistence. It took a lot of observing time," which had to be squeezed in around the higher profile search for extrasolar planets.

By last Christmas, Lane already had clear evidence of the star's growth and shrinking, and by this spring he had the most accurate estimate ever of the angular size of the oscillations. Then, by dividing the angular size of the oscillations into their absolute size (as inferred from redshift measurements), Lane calculated the distance of Zeta Geminorum as 1100 light-years from Earth.

But the significance of the result extends far deeper into space. "In time, measurements like these will simplify and therefore strengthen astronomers' measurements of the distances of galaxies, and thus the size and age of the universe," says Jeremy Mould, an astronomer at the Australian National University in Canberra. That is because Cepheid variables are used to calibrate the distances to nearby galaxies, which in turn form a



Throbbing knee. As Zeta Geminorum changes size, it flickers on a 10-day cycle.

CREDITS: (TOP TO BOTTOM) T. MAKEEVA/AP PHOTO; JOHN ISLES/*SKY & TELESCOPE*

ScienceScope

Burning Questions The National Science Foundation (NSF) has been given some high-level advice on how to get the biggest bang for the bucks it wants to spend on environmental research. *Grand Challenges in Environmental Sciences*, released by a National Academy of Sciences panel this week, outlines the eight "most important environmental research challenges of the next generation."

Most in need of "immediate" funding are studies on biodiversity and ecosystem functioning, the consequences of changes in land use and land cover, infectious disease and the environment, and hydrological forecasting of floods and droughts. Also on the list are understanding biogeochemical cycles, climate variability, and how the world uses natural resources and recycles materials.

The report will fuel a bid by the National Science Board (NSB), NSF's overseer, to boost environmental science funding by $1 billion within 5 years; it says funding for the first four topics falls "well within the NSB's recommended increase." NSF environmental czar Margaret Leinen says the recommendations "allow us to proceed with confidence."

Deadly Embrace For the third year in a row, the U.S. Senate has endorsed the idea of doubling federal spending on civilian R&D. But opposition from Representative James Sensenbrenner (R–WI), head of the House Science Committee, will likely doom the bill—along with killing his own bid to boost information technology (IT) research.

The Federal Research Investment Act (S. 2046) passed easily last week. It calls for doubling nondefense R&D spending to more than $70 billion over the next decade. But Sensenbrenner has opposed the bill because it won't force Congress to spend the money (*Science*, 28 May 1999, p. 1452). It allows lawmakers "to champion science once, then forget about it for the next 10 years," he complained in a 19 September letter to Senator Bill Frist (R–TN), an advocate.

Frist tried to sweeten the deal this year by including Sensenbrenner's own IT research bill, already passed by the House. But joining the two bills, Sensenbrenner says, "will only ensure that neither is enacted."

Contributors: Michael Balter and Dennis Normile, Wu Qi, Jocelyn Kaiser, David Malakoff

reference for estimating the distance to those farther away. This leads to an estimate for the Hubble constant—the ratio of the recession speed of the galaxies to their distance from Earth—which, finally, constrains the age and fate of the universe.

"Because we still have a 10% uncertainty, we're not making a dent in the Hubble constant today," says Shrinivas Kulkarni, who supervised Lane's research. "The excitement is that the technique does work. As other optical interferometers come online, they will produce a dozen similar measurements with accuracy to a few percent. This is like an initial public offering." One new interferometer that will probably improve upon the accuracy of the PTI measurements is the Center for High Angular Resolution Astronomy, a 400-meter-wide array of six telescopes on California's Mount Wilson, which will be dedicated on 4 October and is expected to start operations by the end of the year.

–DANA MACKENZIE

Dana Mackenzie is a writer in Santa Cruz, California.

PRESIDENTIAL APPOINTMENTS

Panel Cites Barriers to Government Service

Why don't more scientists want to work as top officials in Washington?

The answer, according to a panel of veteran government policy-makers, is a lack of attention to science by incoming Administrations, a slow appointment process, and outdated rules to prevent conflicts of interest. The problem is particularly acute among high-tech industry executives, according to a new report from the National Academies of Sciences and Engineering and the Institute of Medicine, which urges the next president to give industry a bigger place at the policy table. "We don't want to lower the standards," says Mary Good, dean of engineering at the University of Arkansas and chair of the panel. "But we think that it's fair to ask if the world has changed so much that the rules need to change, too."

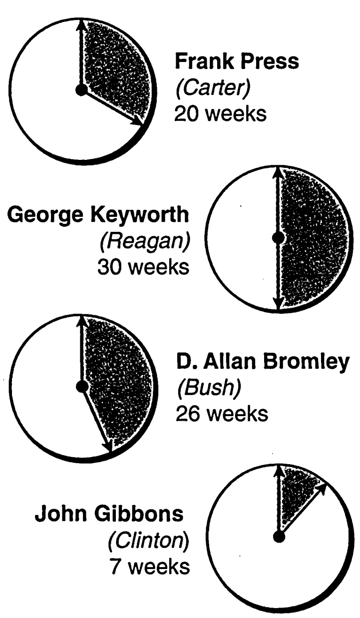
Industry officials don't disagree that recruitment is a serious issue. But many say that considerations such as salary levels and career prospects are bigger disincentives to government service, and that it's also possible to serve the government without working in Washington full-time. "It's not a career path for most people in Silicon Valley," says Tim Newell, an aide to science adviser Jack Gibbons during Clinton's first term and currently managing director at E*Offering, an Internet investment banking firm in San Francisco. "The last few years have seen huge growth and unprecedented economic opportunities," he adds. "Those tremendous opportunities, plus the barriers mentioned in the report, make it harder to attract quality people to Washington."

The eight-page report (www.nationalacademies.org) is a follow-up to a 1992 study by the academies and similar exercises by others carried out during an election year. It urges the incoming Administration to include scientists on its transition team and to appoint a presidential science adviser early enough to play a role in screening for other top positions. For example, President Reagan's decision to wait until May 1981 to appoint his first science adviser, George Keyworth, "was a big problem at the start," notes panelist John McTague, a retired Ford Motor Co. executive and acting presidential science adviser during Reagan's second term. "His first two science budgets were woefully inadequate, not out of malice but out of ignorance."

The science adviser is one of 50 science and technology slots, from the director of the National Institutes of Health to the undersecretary for technology in the Commerce Department, that the panel labeled as "most urgent" of rapid appointment. The panel was also concerned that the Clinton Administration included fewer people from industry in its first batch of nominees for top science jobs than did the Reagan and Bush presidencies. (The report did not tally appointments made after the second year in office.) It blames the decline, from 27% in 1982 to 12% in 1994, in large part on the screening process, which it says has grown so cumbersome that it deters potential hires. Indeed, several executives noted that the long delay between initial consideration and confirmation—data from the panel show that a majority of people now wait more than 4 months—is a big disincentive for industrial leaders, who must put their enterprises on hold while awaiting resolution of their job status.

A Waiting Game

From election day to nomination



Timely hires. Clinton was the speediest of recent U.S. presidents to name his first science adviser.

Part of the problem are rules that require divestiture of stock, stock options, and other financial stakes that could be seen as a potential conflict of interest. To try to avoid these problems, the panel calls for the creation of a bipartisan panel, involving the White House and Congress, that would examine ways "to reduce unreasonable financial and professional losses" for nominees.

However, industry officials say a more important barrier than the ethics rules is the fact that a job in Washington may not look as good on the résumé of a rising executive as it might on the CV of a university administrator.The economy also plays a role in determining the pool of applicants, say industry officials. And good times don't last forever, Newell notes. "Just wait until the next recession," he says. "That could change things in a hurry."

–JEFFREY MERVIS

NEUROSCIENCE

A New Look at How Neurons Compute

The eyes, considered windows to the soul, may offer views of the brain as well. Researchers seeking a simple system in which to study how neurons perform computations—such as tallying the myriad of incoming signals they receive and concluding whether or not to fire—have for decades focused on the retina, which contains neurons that fire only in response to objects moving in certain directions. By studying how those neurons calculate the direction of movement, they hoped to learn general lessons about how brain neurons compute. But the studies were handicapped because no one knew which retinal neurons do the math. Now, on page 2347, a team led by W. Rowland Taylor of Australian National University in Canberra and David Vaney of the University of Queensland in Brisbane, Australia, reports evidence that the directional computations take place in retinal neurons called ganglion cells.

"This is really important work," says Alexander Borst, a neuroscientist at the University of California, Berkeley—especially because it offers researchers a welcome chance to explore how neurons compute in a well-defined system. The Australian work might not be the last word, however. Another group has evidence that the site of computation lies elsewhere—a discrepancy that is likely to spark a flurry