underpins the patents, also showed for the first time that very bright light acts as a "strong" synchronizer of the body clock, shifting it to a new schedule in as little as 2 or 3 days, Czeisler says. This result, Kronauer maintains, "made the use of light practical in circumstances such as shift work."

Even that finding is controversial, however: In an upcoming issue of the *Journal of Biological Rhythms*, Daan and Domien Beersma, who also works at Groningen, will argue that the Czeisler team has not proven that "strong" resetting occurs in humans.

Not that the Czeisler team is without supporters. Robert Moore, director of the University of Pittsburgh's Center for Neuroscience and president of the Society for Research on Biological Rhythms, says he's not worried because the patents have passed muster at the patent office. Moreover, he says, "Dr. Czeisler has explicitly stated that they will not use the patents to interfere with research."

But not everyone is so sanguine about the implications of the patents. As Eve Van Cauter, a sleep researcher at the University of Chicago Medical School, who also received a licensing agreement from Brigham and Women's asks: Will researchers be able to continue consulting to companies on how to use light therapy protocols that they themselves developed? And, once light therapy is accepted by the American Sleep Disorders Association as a mainstream medical practice—a move that is expected by the fall—will clinical researchers be able to offer light therapy to their patients without violating Harvard's patents? Such questions can probably only be answered in court, predicts patent lawyer David Parker of Arnold, White, and Durkee, of Austin, Texas, who has studied the patents.

Brigham and Women's, meanwhile, has licensed the patents to Shiftwork Systems Inc. of Cambridge, Massachusetts, a company founded last June. The three inventors stand to gain 25% of all royalties with the rest going to Harvard University and Brigham and Women's Hospital. So far, the company, to which Czeisler and Kronauer are scientific advisers, has sold rhythm-resetting systems, for between $150,000 and $300,000, to at least five companies and government agencies—including the National Aeronautics and Space Administration and the Nuclear Regulatory Commission. The systems include high-intensity lights, and the computer equipment needed to change the lights in a manner that will most rapidly adjust the workers to their changing shifts. "We've demonstrated very exciting improvements in alertness, performance, and off-shift sleep quality," says Shiftwork president Theodore Baker. "The application of this technology to benefit shift workers is long overdue."

–Rachel Nowak

SCIENCE FUNDING

Program Gives Some States A Head Start in Bid for Grants

In 1977, Richard Atkinson, then director of the National Science Foundation (NSF), was caught off guard when a congressman from Arkansas tossed him a curve during a hearing: How much research did NSF fund in his state? Atkinson said he wasn't sure, but it probably wasn't very much. The congressman quickly followed up with a soft pitch. "I told him I didn't want a handout," recalls Ray Thornton (D–AR), but "I wanted NSF to realize discoveries could happen anywhere in the country. And to make discoveries, Arkansas scientists had to improve their ability to compete for grants."

Thornton's impromptu remarks set Atkinson thinking about how NSF could narrow the gap between Arkansas and powerhouses like California and Massachusetts in the competition for federal research dollars. Three years later, NSF awarded the first grants in the Experimental Program to Stimulate Competitive Research (EPSCoR), a novel program that makes small, competitive awards to assist academic researchers in "have-not" states. The money helps researchers take the first step on the road to obtaining other federal grants, and a requirement for matching funds forces states to play a more active role in supporting science.

The formula has recently proved to be a winner—at least in accumulating funds. State officials, who view EPSCoR as a valuable supplement to their plans for economic development, have been spectacularly successful in lobbying to expand the program. In the past 3 years, six other federal agencies have launched their own EPSCoR programs and the combined funding has grown 10-fold, to $70 million a year (see map). Congress likes these programs because they spread money around the country. They are also popular with NSF and the research community because they parcel out their funds on the basis of rigorous merit review, not a congressional earmark.

But EPSCoR's popularity is a double-edged sword: States are having an increasingly tough time meeting the requirement that they match whatever money the federal government puts in. Indeed, the program has now grown to the point where some states are beginning to wonder how much more of a good thing they can afford. "This is a case where prosperity could be [EPSCoR's] worst enemy," says Irwin Feller, an economics professor at Pennsylvania State University who has evaluated the program.

For researchers funded by EPSCoR, however, the program can be a godsend. At a recent meeting of EPSCoR's 19 state directors, for example, dozens of scientists, in what one observer described as a revival-like atmosphere, offered personal testimonials to the value of the program to their careers. Take the case of Jack Horner. In 1982, Horner, then a young paleontologist at Montana State University, wanted to lead a dig at "Egg Mountain," a site in the middle of Montana where he had done some preliminary digging a few years earlier. Horner stood little chance of getting a traditional federal grant, however: He lacked a college degree. So he submitted a proposal to the state's EPSCoR committee, which secured $15,000 for his dig. The rest, as they say, is history. Horner's work at Egg Mountain, coupled with observations from earlier digs, led him to posit that dinosaurs nurtured their young—a theory that is now widely accepted by paleontologists and has been popularized in the novel/movie *Jurassic Park*.

In its own way, NSF's approach to helping scientifically disadvantaged states has also become a classic. The feds and the states each invest anywhere from $50,000 to $1.5 million a year in peer-reviewed projects and programs judged most likely to succeed by a network of state scientific committees that NSF helped to set up in the 1980s. NSF reviews the projects to ensure they're scientifically sound and have potential to help states build up their research capacity; it also reviews the funding requests. This system "empowers institutions and states to think about their science and technology goals," says Richard Anderson, NSF's EPSCoR program director.

These modest attempts to improve the ability of scientists to compete for additional federal funds translates into a stronger research infrastructure, say NSF officials, which benefits the entire state. In particular, the program provides more opportunities for undergraduates to learn firsthand about research, gives budding scientists the chance to pursue their careers close to home, and increases the possibility of collaboration with industry, leading to new jobs and economic development. "Some states have traditionally been like Third World countries, simply exporting talent, natural resources, and people," says Joseph Danek, head of NSF's systemic reform program, which operates EPSCoR. "We've begun to change that."

NSF is currently funding a study of how

best to measure EPSCoR's contribution to strengthening a state's scientific infrastructure. But state officials hardly need to be convinced. Arkansas cites a 50-fold increase in the number of peer-reviewed articles authored by researchers in the state, from 18 in 1980 to 876 in 1985. And South Carolina boasts that its national ranking as a recipient of NSF funds rose from 46th in 1977 to 28th by 1983.

Armed with such evidence, a coalition of EPSCoR states hired lobbyist Stewart Van Scoyoc in 1989 to convince Congress to expand the program. The effort, which included visits to congressional offices by dozens of EPSCoR scientists, quickly paid off. By 1991, NSF's EPSCoR budget had risen by 38% and Congress had given money to five federal agencies—the Department of Agriculture (USDA), the Department of Defense (DOD), the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the Environmental Protection Agency (EPA)—to launch their own programs. (The agencies did not request the money themselves.) The National Institutes of Health (NIH) signed on last year, and Van Scoyoc says his next target is the Department of Commerce.

Most states are delighted by this explosion of research funds, but some are having trouble digging into their own pockets to come up with matching funds. Idaho exemplifies this funding crunch. Environmental scientists at three Idaho universities want to find new ways to clean up two heavily polluted federal facilities, the Idaho National Engineering Laboratory and the Hanford Reservation in neighboring Washington. Last year, NSF approved the plans and awarded them a $1.5 million, 4-year EPSCoR grant to be matched by the state. Private companies and the universities contributed more than half, and officials expected state legislators to put up the rest. But legislators cut the $600,000 request by 25% in the course of balancing the state budget. It took a $150,000 carryover from last year to prevent the initiative from falling on its face, says Jean'ne Shreeve, vice provost for research at the University of Idaho and director of the state's EPSCoR program.

Idaho officials are now scrambling to find the money to pay the state's share of some $2 million worth of proposals that Idaho's EPSCoR committee wants to submit to four other agencies. "We'll have to take a serious look at whether we'll be able to compete," says Shreeve. "We're stretched as much as we can."

Idaho isn't alone. "You're beginning to see different classes of EPSCoR states, those that can come up with the match and those like us that are really struggling," says Terry Shehata, director of Maine's EPSCoR program. For example, for 3-year grants starting in 1992 or 1993, Alabama, Louisiana, and Mississippi have more than tripled NSF's contribution—$43 million vs. $11 million. Over the same period, seven states—Arkansas, Idaho, Kansas, Montana, Nebraska, Nevada, and West Virginia—have barely met the minimum dollar-for-dollar match.

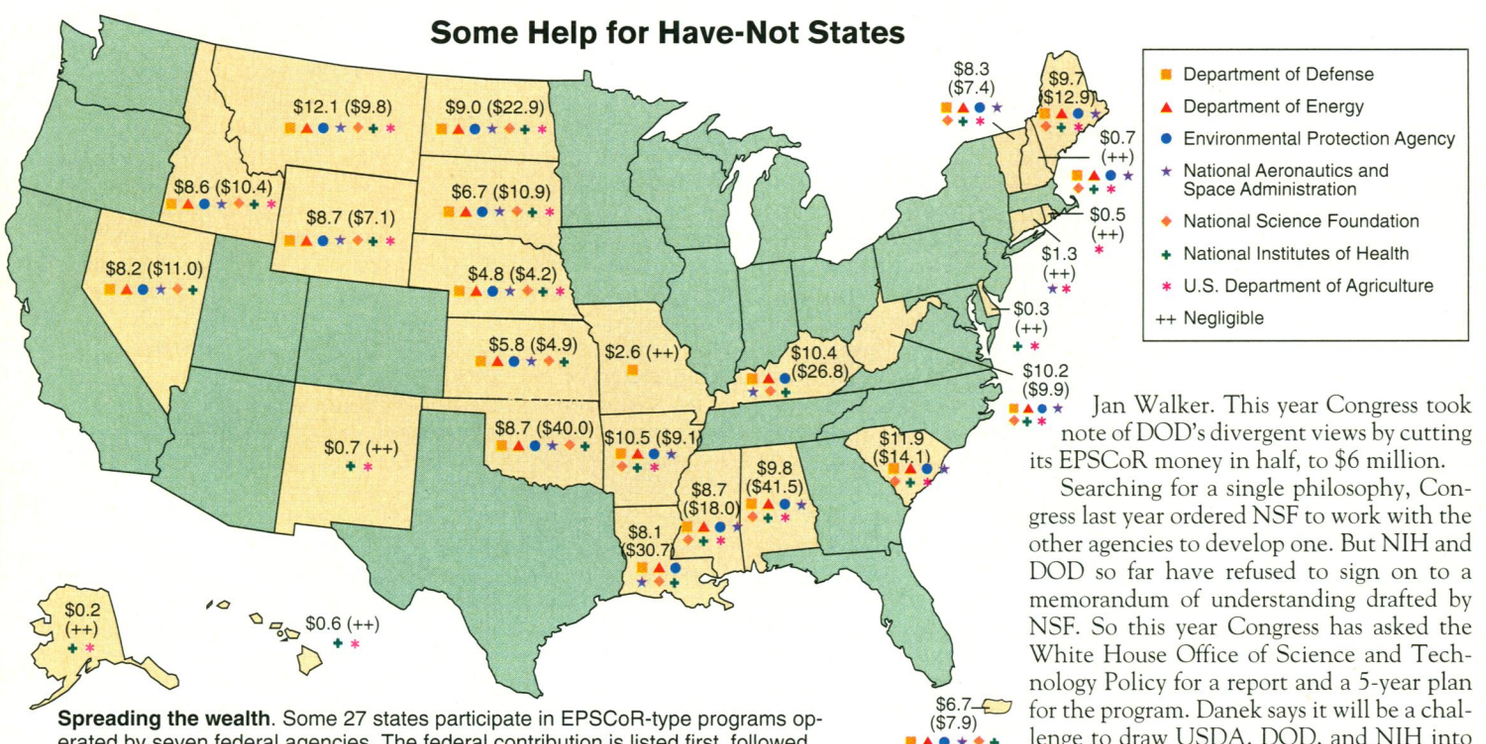
As the states hunt for dollars, the federal agencies are struggling to define how EPSCoR fits in with their missions. Not every agency understands self-improvement in quite the same way. DOE and NASA, for example, place a heavier emphasis on training students than on funding research projects. USDA prefers to fund specific research projects, in particular those proposals from EPSCoR states that just missed the cut in its regular grants competition. And DOD objects to spending money by region, preferring to put its EPSCoR funds into an existing program targeting universities with little past DOD support, regardless of geography. "We think that's more fair," says spokeswoman Jan Walker. This year Congress took note of DOD's divergent views by cutting its EPSCoR money in half, to $6 million.

Searching for a single philosophy, Congress last year ordered NSF to work with the other agencies to develop one. But NIH and DOD so far have refused to sign on to a memorandum of understanding drafted by NSF. So this year Congress has asked the White House Office of Science and Technology Policy for a report and a 5-year plan for the program. Danek says it will be a challenge to draw USDA, DOD, and NIH into the EPSCoR fold. "Unfortunately, some agencies don't feel as strongly as others that their mission includes the development of research capacity," Danek says.

Some states have persuaded mission-oriented agencies to be more flexible in their requirement for matching funds. "We realize state budgets have gone to hell, so we tell them to match any way they legally can," says Deran Pashayan, EPA's EPSCoR program manager. One such loophole is to count salaries as part of the state's matching contribution.

Danek, however, warns the states against taking shortcuts. "If states aren't willing to put in money, then maybe they shouldn't be part of EPSCoR," he says. The program's value, according to Danek, can be measured by the answer to a single question: "How much is a state willing to invest in its future?"

–Richard Stone



Spreading the wealth. Some 27 states participate in EPSCoR-type programs operated by seven federal agencies. The federal contribution is listed first, followed by state funding.