the Davis experiment within the last six months."

Protection bill failed

Barrick officials originally planned to let the mine flood when it was shut down in 2002, but kept it dry through the first few months of 2003 as negotiations proceeded. Last year, a bill in the US Senate gave Barrick protection against future claims of environmental damage stemming from past operations of the mine. The congressional efforts failed, however, when Barrick wasn't satisfied with changes made in the House version of the bill. While Congress failed, the NSF review is moving forward.

David Stonner, head of congressional affairs for NSF, said that after reviewing the underground laboratory proposals a panel of experts will pick the most promising site by early June. Then studies will get under way to determine what the actual cost of developing a deep lab would be. The ultimate cost for developing Soudan, Homestake, or San Jacinto is estimated to be between $200 million and $250 million.

"Roughly a year from this summer, we'll get back the cost information and then make a formal proposal to the National Science Board," Stonner said. "We will do things in an orderly fashion, although I understand that in South Dakota, things can't go quickly enough." Homestake has been a powerful economic engine in western South Dakota for much of the state's history, and state leaders are anxious to keep the mine operating, even if it is producing scientific research instead of gold. The earliest that serious money could be available for developing Homestake or one of the other sites would be fiscal year 2006.

Vince Borg, vice president for corporate communications at Barrick, explained that beyond the long-term liability issues that have to be resolved, the day-to-day operation of the pumps in the mine creates an immediate problem for the company. "If we continue pumping, it requires our crews to do the pumping. It is a safety issue, and we will be responsible for those on the site. Without the indemnification worked out, we don't want to invest in that." He also said that Barrick engineers don't believe that letting the mine flood would have a detrimental effect on its eventual use as a science laboratory. The rock will remain in good condition, he said, and the antiquated equipment that would be flooded is inconsequential. For Barrick, Borg said, flooding is a "non-issue."

Borg said Barrick intends to keep the pumps running for, at most, a few more weeks. "NSF has to decide on the site, then go through its own process and engineering work. If [conversion of Homestake to a science laboratory] could come to pass, that would be wonderful for Lead. But, despite some of the local expectations, the lab has never been just around the corner."

Although several mining experts have said that flooding technically won't damage the mine, Mann noted that, "from the scientist's point of view, it would be so discouraging that we shouldn't allow it to happen without trying to educate Barrick and the politicians about the value of the mine for science. We ought to object as scientists." That is why Mann led the charge in Lead in April. **Jim Dawson**

New Mexico Plans Optical Interferometer and Fast-Slewing Telescope

Thanks to pork-barrel funding, a small university in New Mexico is building an observatory with scientific, educational, and military applications.

How does a minor university land a major observatory? In New Mexico Tech's case, it helped that the university has access to a high, dark site, that the Magdalena Ridge Observatory (MRO) will have national security applications, and that the project has allies in Congress.

"We had a coalition of universities looking for an observatory," says Van Romero, vice president for research at New Mexico Tech (officially the New Mexico Institute of Mining and Technology), which has around 1800 students and 110 faculty members. New Mexico Tech and its partners—New Mexico State University, New Mexico Highlands University, and the University of Puerto Rico—learned that the US Army's neighboring White Sands Missile Range wanted better missile tracking capability and the Air Force Research Laboratory in Albuquerque was interested in developing adaptive optics. "We seemed to have a critical mass—universities, along with more than one military user," says Romero. Representative Joe Skeen and Senator Pete Domenici, both New Mexico Republicans, supported creating the MRO because the potential for education outreach, adaptive optics research, and world-class astronomy "all came together in a happy confluence of ideas," says Stephen Traver, a legislative fellow in Domenici's office who used to work for the now retired Skeen. Domenici led the way in winning a congressional markup for the $48 million observatory.

The observatory's future home is on a ridge in the Magdalena mountains near Socorro, about 130 kilometers south of Albuquerque. Besides the clear skies and roughly 3200-meter-high perch, the site's advantages include that it is near both White Sands and New Mexico Tech, it has room for the observatory to expand, and it has a road and other infrastructure already serving ecological and atmospheric studies and the university's lightning lab (see box).

The MRO will consist of an optical–infrared interferometer with eight to ten 1.4-meter telescopes in a reconfigurable Y-shaped array up to 400 meters long plus a single 2.4-meter telescope. Groundbreaking is scheduled for 20 October.

Stars and scuds

The MRO array will have a larger number of bigger elements distrib-

SEAWEST ENTERPRISES

Magdalena ridge in New Mexico is the future site of a multipurpose observatory.

uted over a wider range of baselines than any other optical interferometer in the works, says Chris Haniff, whose University of Cambridge group is involved in the project. MRO's angular resolution, he adds, "will be a factor of a hundred higher than the Hubble Space Telescope. That means that for any class of astronomical object, you can see more detail."

"One of the exciting things we think we will be able to do is to look at the central engines of active galactic nuclei," says David Westpfahl, project scientist for the MRO interferometer. "All the models have a massive object at the center, such as a black hole, and an accretion disk and polar outflow, but the detailed shape and arrangement of these things are still being worked on. We hope to be able to resolve several of these objects and decide among the models." The MRO interferometer will also be used to deduce the relative rotational axes of stars in clusters, which could shed light on the importance of turbulence in star formation, and to study other aspects of star birth, as well as star aging and planet formation.

Fast slewing is the special feature of MRO's single telescope. It will be able to zip to a particular part of the sky at 10° per second. The slewing was initially incorporated to accom-

Not All in a Flash

After 40 years of near solitude, New Mexico Tech's Langmuir Laboratory for Atmospheric Research may have to adjust a bit when the Magdalena Ridge Observatory sets up nearby (see accompanying story). In particular, says Langmuir Director Bill Winn, balloons and rockets from thunderstorm research could land on the MRO telescopes, and radio noise from the MRO could interfere with Langmuir measurements. "We can live together—we just have to sort things out," Winn says.

BILL WINN/LANGMUIR LABS

The Langmuir lab is rare in that thunderstorms play out in their entirety right there, so researchers don't have to chase storms, the more common approach. Research at Langmuir spans ground- and balloon-based measurements of lightning and thunderstorms, applications such as lightning rod safety, and instrument development. The lab's flashy new tool is the Lightning Mapping Array, a set of ground-based radio antennas that use the global positioning system to determine the time-of-arrival of radio frequency signals, from which the path and time development of lightning can be worked out. "Our main interest is to learn more about lightning—how thunderstorms become charged, where the charge is located, how lightning propagates," says the lab's Bill Rison, one of the instrument's developers. "The eternal question is, Why do thunderstorms produce lightning? How do they develop a charge strong enough?"

Toni Feder

modate the US Army. The MRO offers a good look at target missiles fired from Fort Wingate in western New Mexico, says Tomas C. Chavez, chief of test technology at White Sands. "We could collect phenomenology data during the target's boost and coast phases to help home in on the target with an interceptor." Adds Romero, "This is a match made in heaven. The army wants to use [the telescope] during the day and early morning, we want to use it at night." The 2.4-meter mirror was donated by the air force. Originally intended for classified space-based research, it has hardware added to keep it from sagging in Earth's gravitational field.

Astronomers will take advantage of the fast slewing, too. "One big use of the telescope will be 'alert response to transient astrophysical phenomena,' " says project scientist Eileen Ryan. "An example would be to find the optical counterpart of gamma-ray bursts." For that, the telescope would automatically interrupt other observations when it receives signals from Swift, a satellite NASA is supposed to launch in December. The MRO telescope, Ryan adds, will be bigger and will slew faster than other ground-based telescopes currently hunting for GRBs (see PHYSICS TODAY, July 2002, pages 24 and 25).

Mostly, though, the 2.4-meter telescope will be devoted to studying "small Solar System bodies—asteroids, comets, and Kuiper Belt objects," says Ryan. "We want to use the telescope to ask how fast asteroids are spinning. How big are they? What are their shapes?"

Possible with pork

What with the MRO being funded directly by Congress, the project often gets labeled as pork. Says Romero, "Without this type of funding, we would not be able to build it. But we think this is a facility that funding agencies like NASA and NSF will take the opportunity to fund research at." And, unusual for a federally funded project, New Mexico Tech and its partners will foot the running costs, estimated at $2 million a year.

If all goes as planned, the single telescope would see first light in 2005, and the interferometer could be up and running a couple years later.

Toni Feder

Astronomers Save Historic Plates

When astronomer Elizabeth Griffin attended the annual International Astronomical Union meeting three years ago in Manchester, England, she issued a challenge to the assembly: Rescue photographic observations. For nearly a century, until digital detectors became common in the late 1980s, star spectra were routinely recorded on photographic plates. But the three million or so plates across the globe are at risk of disappearing owing to neglect and natural disasters. Griffin's challenge is now under the auspices of an IAU working group and the World Spectra Heritage, a nonprofit organization that is attempting to raise $1.5 million to digitize spectrographic plates.

ONDREJOV OBSERVATORY

Spectroscopic plates (inset) from the 2-meter telescope at Ondrejov Observatory in the Czech Republic will be digitized by the World Spectra Heritage.

Because of the "astronomical" number of plates involved, says Griffin, who chairs the new working group and is a visiting scientist at the Herzberg Institute of Astrophysics near Victoria, British Columbia, Canada, "we select plates that can be scientifically useful." Some 35 observatories are known to have plate collections and many have agreed to ship the plates to the institute's Dominion Astrophysical Observatory for scanning. The processed observations will form the basis for a new Spectroscopic Virtual Observatory (SVO).

The photographic observations are invaluable for understanding stellar phenomena that change slowly over time, such as stars undergoing minor explosions, eclipsing binary stars, pulsating stars, and even stellar evolution. For her part, Griffin is using 100-year-old plates to study details of Earth's atmospheric ozone concentrations accidentally captured on the plates.

Under ideal conditions, plates can survive for 350 years, according to the Eastman Kodak Co, which manufactured most of the plates. In practice, however, many plates have been lost or damaged. For example, plates from a deserted 1920s observatory on Mt. Brukkaros, in what is now Namibia, are being used by local villagers as windows. Last year, a frantic group of volunteers rescued 50 years' worth of photographic plates thrown out by the University of Michigan to make room for a new laboratory. And photographic plates narrowly survived the 1997 earthquake that rocked the Cerro Tololo Inter-American Observatory near La Serena, Chile, and the wildfire that earlier this year ravaged Mt. Stromlo Observatory near Canberra, Australia (see PHYSICS TODAY, March 2003, page 29). Collections also dwindle when borrowed plates are not returned. "These incidents highlight the risk to historic scientific information if there are no digital backups," says Griffin.

At the same time that collections are degrading, the demand for them is falling. The main users of plates are retiring and the equipment for scanning them is becoming obsolete. Young astronomers, says Mike Bessell of Mt. Stromlo Observatory, tend to be more interested in new instruments and "not that particularly interested in time-sensitive phenomena." It doesn't help that researchers typically have to physically look through the plate collections to determine what observations they contain. "If the information is online, then research could happen much more quickly," says Griffin.

Fewer companies are now making the specialized scanners required for digitizing plates. Petr Skoda, an astronomer in the Czech Republic, got a grant to digitize the Ondrejov Observatory's collection but his scanner was broken. "Because of the collapse of the Soviet Union," he says, "the Hungarian company that made [the scanner] has vanished." Funds to replace the machine do not exist, he adds.

The SVO project will officially start when $100 000 is raised for equipment costs. The money will go toward upgrading four scanners donated to the project. Even then, Griffin estimates it will take five years to digitize 50 000 plates. The results will help rescue a small part of astronomical history. Says Skoda, "We should try to save the heritage of the epoch of photographic astronomy as well as the data from the current electronic era."

Paul Guinnessy