Astronomers Want New Optical Telescopes, but . . .

An NSF plan to build two new 8-meter instruments with some international financing has drawn astronomers' fire

FOR MORE THAN A DECADE, American astronomers have complained that they lack the optical telescopes needed to do their job. As new radio and space-based telescopes were built, astronomers were waiting in longer and longer lines to use existing national optical observatories. In fact, two-thirds of the astronomers seeking time on the National Optical Astronomy Observatories (NOAO) were turned down last year—a problem NOAO director Sidney Wolff calls "tragic."

At long last the National Science Foundation is preparing to do something about those long lines. For the first time in 15 years the NSF is seeking funds for the design of new optical instruments. The instruments in question are two optical/infrared telescopes, one in each hemisphere. This pair of powerful 8-meter telescopes would give astronomers a remarkably clear view of the entire sky.

But there's a catch: NSF says it won't commit to building the instruments until foreign governments promise to come up with half the total cost, estimated to be $176 million. This has a lot of U.S. astronomers grumbling because it would mean they would have to share precious observing time. That's not the only question in the project. Building the facilities would be a major technological feat, for their cutting-edge design calls for the largest mirrors ever cast in a single piece.

The NSF investment—if it comes through—is barely in the nick of time. Many astronomers fear they are about to lose their century-long lead in optical astronomy to the Europeans, who have committed $250 million for an array of four 8-meter telescopes in Chile. The Japanese also are expected to spend at least $100 million to build a 7.5-meter telescope in Hawaii.

It might be thought that the Hubble Space Telescope would grant the United States a comfortable lead over these scientific competitors. But it won't. Space Telescope will have little time to dwell on single objects of interest. Ground-based telescopes are essential, astronomers say, to make sense of those objects—to find out what they are made of and how they behave.

Yet the only new starts for ground-based optical astronomy in the United States have been launched by university consortia, who are in various stages of raising private funds to build their own observatories—and those telescopes won't be open to the general astronomical community. American astronomers had proposed in 1982 that a 15-meter optical telescope be built, but this so-called National New Technology Telescope (NNTT) was abandoned in favor of the two 8-meter telescopes because many thought it would be too difficult and too expensive to build. "We're hanging on by our fingernails in terms of keeping ahead of the Europeans," says University of Arizona astronomer Roger Angel. "Without some kind of federal commitment, we're not going to stay in that position."

NOAO

Twin peeks. *Sidney Wolff, director of the National Optical Astronomy Observatories (NOAO), helped shape NOAO's proposal to build twin 8-meter optical telescopes on Mauna Kea in Hawaii and on a mountain in Chile.*

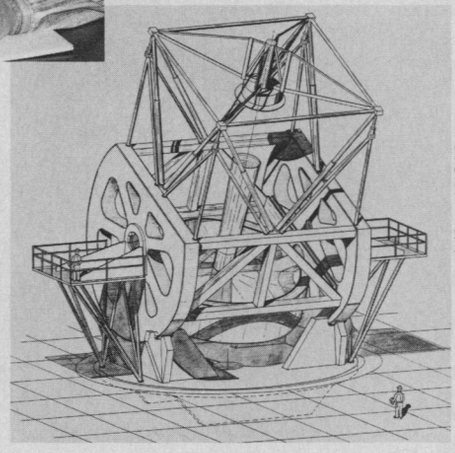
The NSF isn't seeking much yet—only $4 million in 1991 for design costs and buying glass for the mirrors. And even that investment needs approval from the National Science Board. But the budget request is enough that the NOAO astronomers who put together the proposal for the 8-meter telescopes sense a "genuine commitment," Wolff says.

The NOAO plan calls for the mirrors to be cast by Angel, who has a shop at the University of Arizona where he is building an innovative assembly line for casting 8-meter mirrors in a single piece. No one has ever cast a single-piece 8-meter mirror before, but everyone from the Japanese to the Europeans seems to think that's the right diameter for the 1990s.

Angel expects orders from NOAO and three U.S. university groups, but it won't be easy to cast those mirrors. "We're pushing the technology to the limit. It's challenging," admits Angel, who spin-casts his mirrors and their honeycomb support structure in one piece. So far, he has cast one 3.6-meter mirror and expects to complete a 6.5-meter mirror early next year, which should be the largest mirror ever cast.

The NSF has a lot invested in this technology—it's been supporting Angel's work at a rate of about $1 million a year for the past 5 years—and would be one of the first to try it out if funding comes through for the two 8-meter telescopes in 1991. When those observatories are complete, they should stand above the rest of the field, rivaled in size only by CalTech's and the University of California's Keck Telescope, which is made of a mosaic of 36 mirror segments.

By the time the two 8-meter telescopes are built, the demand for them may be reaching dramatic proportions. Requests for time on U.S. telescopes is growing rapidly—by 25% in the past 2 years at the NSF's optical facilities at Kitt Peak in Arizona, Sacramento Peak in New Mexico, and Cerro Tololo in Chile.



J. Keppel/NOAO

And no private group can meet that demand as the NSF can, because no private group has the resources to build telescopes in both hemispheres. The NOAO proposal makes a case for doing just that, giving astronomers a window on the entire sky. That will be important for following up the initial sightings of the Hubble Space Telescope, which is too small and busy to capture enough photons to do spectroscopy on objects of interest. The two 8-meter telescopes, however, will be large enough to study the spectra of those objects, probing their composition, temperature, and dynamic behavior.

To accomplish this, Wolff and her col-

leagues have set their sights on building the telescopes on two of the best mountaintops in the world—Mauna Kea in Hawaii and Cerro Pachon in Chile. With such remarkably clear views, the new larger 8-meter mirrors should produce images that are a factor of 4 to 16 times better than those produced by current ground-based telescopes, says Wolff.

NOAO astronomers feel so strongly about access to both hemispheres that when faced with limited funds of about $88 million, they decided it would be better to ask the NSF to pay for half of each telescope, rather than all of one. NSF director Erich Bloch then encouraged them to seek international partners to share the cost.

This proposal has led to complaints from the astronomical community, some of whom are calling Bloch "Mr. Internationalization," and who think the United States should be able to afford its own national observatories. The community is split over whether it is better to have one national observatory or half of two international telescopes. Some are worried that construction could be delayed by involving so many different groups and funding agencies.

"I think there's some disappointment in that it's already taken so long to arrange the funding for this," says Harvard University astronomer George Field, whose committee advised the National Research Council in 1982 to build the NNTT. "After all, the recommendation for funding for an optical telescope came out in 1982 and it's taken 8 years to even put it in a proposal." Most astronomers, however, seem to agree with CalTech physicist Ed Stone when he says, "Half a telescope is better than none."

The proposed international partnership is by no means a sure thing, however. The two main potential partners are the British and the Canadians. The British are expected to decide this summer whether to sign up with the United States or with other Europeans to build their own 8-meter telescope on La Palma in the Canary Islands—a site where they would get more viewing time for less money. The Canadian astronomical community likes the proposal but has budgetary hurdles of its own to overcome and won't make a decision until next year.

The NSF staff is reviewing the proposal now; it expects to give the National Science Board a recommendation by fall. How serious is the NSF? "I think you get a good sense of how serious we are by the fact that a significant start on it is in the (proposed) 1991 budget," says Laura Bautz, director of NSF's division of astronomical sciences. "In a sense, we have made an important decision to go forward with some kind of 8-meter telescope partnership." ■ ANN GIBBONS

Census Adjustment Battle Heats Up

Statisticians have methods to adjust—even supersede—the census count, but the decision to use them is a political matter

DEMOCRATIC POLITICIANS INSIST ON IT. Their Republican counterparts denounce it as a political manipulation of virgin data. Statisticians are divided as to its feasibility. But for the first time in history, the Census Bureau is gathering data for what may be the first statistical adjustment of its decennial count of the American population—one intended to account for the 3 to 5 million citizens the census is expected to miss this year.

Passions run high where the census is concerned. Census figures chart the ebb and flow of population movement and the legislative apportionments that result. More than $50 billion in federal revenue is distributed among the states according to census figures. With such political and economic resources at stake, it's hardly surprising that talk of manipulating the numbers is taken very seriously.

Indeed, the idea of an undercount already has a long history of heated tempers. Following a spate of lawsuits after the 1980 census, the Commerce Department, which oversees the Census Bureau, developed methods for correcting the undercount, which is concentrated among the poor and minority "underclass." In 1987, the department backtracked and announced that there would be no adjustment for the undercount. But now, in the face of further legal action and recent protests from congressional Democrats, Commerce is reconsidering.

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>
> – Vic Fazio (D-Calif.)

The census operates under a constitutional mandate to "enumerate" the population every 10 years, which it attempts to fulfill in the simplest possible manner: by counting every man, woman, and child in the country. Over the years, this effort has evolved into a two-step process. In the first phase, forms are mailed to every household on the Census Bureau's master list. Perhaps as a result of a declining sense of civic responsibility, or perhaps as a result of the growth of the underclass, this year only 64% of the forms distributed were mailed in.

That was the lowest response rate ever; the Census Bureau had expected 70%. The second phase of the census is designed to account for missed households and delinquent respondents. In phase two the bureau sends trained enumerators to every household that failed to return forms. This phase is now under way and is due for completion by 6 June. Visiting 37 million households, the enumerators may count as many as 50 million people.

Even when both phases work smoothly, the census invariably misses a fraction of the population. And that undercount isn't evenly distributed. In 1980 the census missed 1.4% of the total population, but considerably larger numbers of minority groups: blacks, for example, were undercounted by 5.9%. And the undercount will probably be even worse in the 1990 count. "Given the growth of the underclass over the past decade, I can't see how the undercount could be any smaller," says Stephen Fienberg, a professor of statistics and social science at Carnegie-Mellon.

The undercount is a particularly emotional issue for congressional and big city Democrats, since the low count is concentrated among the poor and urban areas in their constituencies. "It's obvious that the first phase of the census process was a failure," said Representative Vic Fazio (D–CA), one of several House Democrats who called for statistical adjustment during a recent hearing. Several months ago, Representative Charles Schumer (D–NY) criticized the Bush Administration in the *New York Times*, writing that "someone in Washington doesn't want an accurate count in largely Democratic urban areas." Republicans are quick to articulate their own political concerns; Representative Vin Weber (R–MN) calls the movement for adjustment "an attempt to use a statistical device to achieve political objectives."

The techniques that are now raising such