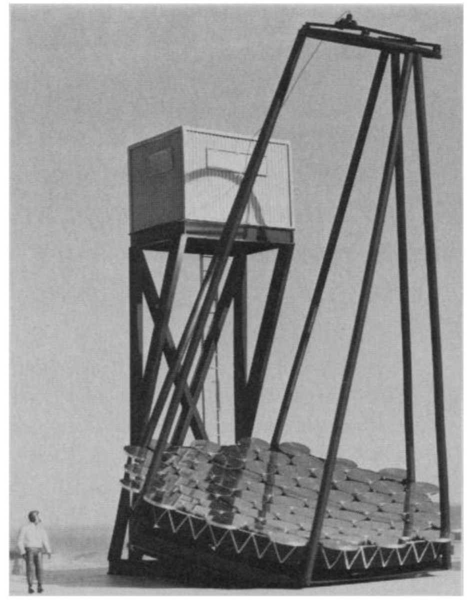
The New Eye of Texas Is Soon to Be Upon Us

This recently proposed telescope promises twice the light-gathering power of any existing instrument at a strikingly low cost; the key is an innovative, albeit specialized, design



The Spectroscopic Survey Telescope. *The model pictured here shows all its essential features—most notably the multimirror reflecting surface and the lack of any conventional mount.*

If there were a Nobel Prize for creative simplicity, then a top contender would surely be the Spectroscopic Survey Telescope (SST), now being proposed by the University of Texas and the Pennsylvania State University for a site at Texas' McDonald Observatory. Not only will the SST have more than twice the light-gathering power of any current generation telescope, but it will cost less than one-fourth as much as any of the new technology telescopes that are now on the drawing boards. Indeed, its estimated cost of $6 million seems so manageable that the two universities plan to raise the entire amount from private donations.

The SST was conceived several years ago by Penn State astronomers Daniel W. Weedman and Lawrence W. Ramsey, who took an aggressively back to basics approach. For nearly a decade now, astronomers all over the world have been pushing for new technology telescopes having diameters of 8 meters or more. Probably the most notable example is the 10-meter, $85-million Keck Telescope, which is now being built atop Hawaii's Mauna Kea by the University of California and the California Institute of Technology. However, Weedman and Ramsey reasoned that one of the chief aims in building these new technology telescopes is to collect more light for doing spectroscopy on faint objects, such as quasars and distant galaxies. (A mirror 8 meters in diameter would have more than twice the light-collecting area of the 5-meter Hale Telescope on Mount Palomar.) So why not throw out all the expensive bells and whistles needed to support a general-purpose telescope, and instead build an instrument that does nothing *but* spectroscopy?

The result was the SST. At first glance, its most obviously unconventional feature is the reflecting surface. Instead of using one large 8-meter mirror, the SST will achieve the somewhat larger light-gathering area with a mosaic of 85 1-meter mirrors mounted on an open framework of steel rods. The idea is that mass-producing dozens of relatively small mirrors will be much easier and cheaper than trying to produce a single 8-meter monolith. (A technical point of great practical importance is that the mirror surfaces will actually be spherically curved, instead of being sections of a paraboloid. Although this does mean that SST images will be slightly blurred—which does not significantly degrade the spectroscopy in any case—it has the advantage that all the mirrors can be identical.)

Less obvious, however, and yet to professional astronomers much more startling, is the way the SST will be mounted. It will be permanently offset from the vertical direction by 30°, and it will only be able to pivot around the vertical axis. In particular, it will be unlike any other major optical telescope in that it will not try to track the stars across the sky. Once the SST has been pirouetted into position and pointed toward a given object, it will remain fixed in place while the earth's rotation carries that object across its field of view.

Although this approach clearly has its drawbacks, as the designers admit, they are not as serious as they might seem at first. By a combination of pivoting the telescope and choosing the right time of night, for example, observers at the SST will be able to scan most of the available sky; the only exceptions will be the southernmost stars visible from McDonald, which are too near the horizon for optimal viewing anyway, and a relatively small patch around the north celestial pole.

Meanwhile, the observers will be able to obtain exposure times of up to 1 hour by means of the light-gathering device visible at the top of the telescope, which will track the moving image by sliding along a linear rail. (The device is not a detector so much as a funnel: it will pipe the incoming light through fiber optic cables down to a variety of spectrographs waiting on the ground.) If a second moving device were added—and there is room—observers could independently track objects up to 12° apart.

The biggest payoff of the SST design, however, is that it represents a vast simplification in the mechanical engineering problem. As in any other telescope, the SST will have to keep its optical surfaces aligned to within a tenth of a micrometer. Otherwise it will never be able to form a worthwhile image at all. But because the SST will not have to tilt and scan across the sky, the gravitational stresses on the mirrors will be constant. Moreover, since gravity always pulls straight downward, pivoting the telescope around the vertical axis will do nothing to change those forces. The upshot is that the mirrors' supporting framework can be lightweight, strong, and simple.

Compare that with the Keck Telescope, which will also use a multitude of smaller mirrors. The Keck will be far more versatile than the SST because it will follow the stars. But it will also cost more than ten times as much, not least because its optical surfaces will constantly be fighting the shifting forces of gravity. Indeed, the only way it will be able to keep its alignment at all is through a constellation of computer-controlled actuators that will link the mirror segments, and that will automatically adjust their positioning as the telescope moves.

Weedman, Ramsey, and their colleagues at Penn State joined forces with the Texans in 1985, shortly after the McDonald Observatory lost out in its bid for state funding of a 300-inch (7.7-meter) "Eye of Texas" telescope. Several years of development and refinement of the SST concept followed. And now, according to observatory director Harlan J. Smith, the SST design is far enough along that the two universities have started to approach individuals and foundations for construction funds. "I'm always an optimist about timetables," he says, "but realistically, we could have first light on a partially completed telescope in 1990." ■

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