
Telescope tunes in to the guiding light

Since the days of Isaac Newton, optical astronomers have had to live with ground-bound telescopes and be satisfied with cursing the turbulent atmosphere that caused their images to blur.

Even today, with recent advances in imaging that have improved resolution, anything short of a telescope sent into space is unable to obtain a resolution at visible wavelengths of more than about 1 arc second. Certain kinds of telescopes that can measure and adapt to the irregularities in the earth's atmosphere are one solution, but they, too, face their own set of demons: Such telescopes require a bright source to correct for turbulence, and most deep-sky viewing is without such sources.

Now Laird A. Thompson of the University of Hawaii at Manoa and Chester S. Gardner of the University of Illinois at Urbana-Champaign have taken the first step to solve that problem by using a laser to create an artificial guide star. Although successful in creating the star, Thompson still refers to the image—which measured some 1 to 2 arc minutes across—more as a “blob” than a real point source. “We have a long way to go to actually make a usable star,” he told *SCIENCE NEWS*.

But the incentive to succeed is there. If adaptive telescopes with electrically deformable mirrors and artificial guide stars can work together to overcome the problems of atmospheric turbulence, resolution could improve to 1/10 of an arc second, Thompson says, the same resolution promised by the Hubble Space Telescope scheduled for launch in 1988.

Thompson's experiment, reported in the July 16 *NATURE*, builds on the work of French researchers R. Foy and Antoine Labeyrie, who first suggested that lasers might be used to create artificial stars for adaptive imaging systems. In general, such imaging systems are equipped with sensors that constantly monitor the atmosphere and then feed the information to a computer, which alters the shape of the mirror or makes slight changes in orientation of other optics (SN: 1/3/87, p.10). But to do that, these telescopes need a reference source at least as bright as a 10th-magnitude star, Thompson says, which is too faint to be seen with the naked eye but is more than bright enough by an astronomer's standards.

Last January, Thompson and Gardner became the first to turn Foy and Labeyrie's theory into data by shining a flashlamp-pumped dye laser 60 miles high into the sodium layer of the earth's mesosphere. Tuned to the same wavelength as the sodium, 5,890 angstroms, the laser scattered the alkali metal in such a way as to create a light source. Researchers then used the University of Hawaii's 2.2-meter telescope at the

Mauna Kea Observatory to measure and photograph the predicted return flux from the artificial source. “We just wanted to make sure we knew how much light was going to come back,” Thompson says. The light they measured corresponded with what they expected from the laser guide star.

Once it is honed to look like a real star, the purpose of the reference point would be to lie directly in front of the star being imaged. Astronomers would then accommodate for the light being emitted from

the reference point. To save energy, the laser would be pulsed so that it would go on for 10 to 20 microseconds 200 times every second, which is how often the atmosphere can vary. Thompson and Gardner also are considering other types of lasers and scattering methods, such as Rayleigh scattering, in their effort to create an artificial star.

Even if the right laser and method are found, though, researchers still have to make sure that the transmission of the energetic source itself won't distort the image and that the guide star behaves as a normal star would. After that, the rest is written in the stars. —K. Hartley

Quality day-care and social growth

When day breaks, more than half of all U.S. mothers with infants are off to work and must place their children in some form of nonmaternal care. By 1995, as many as two-thirds of all preschool youngsters in the United States will have working mothers, according to organizations involved in child-care services.

Yet carefully controlled research on the social development of children in nonmaternal care is in its infancy. Contrasting perspectives on the effects of child care are offered by two new studies that reflect an ongoing debate among child development researchers. One indicates that the quality of a day-care program is of key importance to children's social growth, perhaps even more than their family background. The other study, however, suggests that even if the care is in the child's own home, daily separations during the first year of life are a “risk factor” for the development of a disturbed mother-infant relationship.

The former study, conducted by psychologist Deborah Phillips of Yale University and her colleagues, finds that children fare better in programs in which children and adult caregivers frequently engage in conversation. High levels of verbal interaction with other children appear to interfere with social development, report the investigators in the July *DEVELOPMENTAL PSYCHOLOGY*.

In centers with higher amounts of adult-child conversation, parents and caregivers alike rated the children as more considerate; caregivers also rated them as more sociable, intelligent and able to concentrate on specific tasks. Centers rated higher on overall quality—as measured by observations of the day-care environment, verbal interactions between adults and children and interviews with program directors—were similarly associated with better social development. The researchers statistically controlled for the effects of the children's age, family background and length of day-care attendance.

The sample consisted of 166 children attending one of nine day-care centers in

Bermuda, where about 85 percent of the children spend most of their day in some form of nonmaternal care by 2 years of age. The centers vary widely in quality and consist of eight private programs and one government-run facility serving predominantly low-income families.

The children were 3 years of age or older at the time of the study, and their average age of entry into day-care was 19 months.

The data, says Phillips, suggest that specific features of child-care programs, such as staff-child ratios and staff training, can be regulated to promote positive interactions among caregivers and children. Day-care quality in the United States is regulated at the state level, observe the researchers, where the emphasis is on minimum standards for health and safety rather than guidelines to promote social development.

But a note of caution on early child care is sounded by psychiatrist Peter Barglow of Michael Reese Hospital and Medical Center in Chicago and his colleagues. They studied 110 infants of affluent parents; half of the children were cared for full-time by the mother, and half had in-home day-care provided by someone other than the mother because both parents worked full-time. Substitute care began at 8 months of age or earlier.

At 12 to 13 months of age, infants were videotaped during a laboratory exercise in which the mother leaves her baby with an experimenter for several short separations. Infant behavior on being reunited with the mother was scored by a researcher unaware of the mother's work status.

There was an increased incidence of “avoidant attachment” among first-born infants of working mothers, report the researchers in the August *CHILD DEVELOPMENT*. This is marked by ignoring the mother's return, turning away from her and refusing to communicate with her. Many infants of working mothers may experience repeated, daily separations from the mother as rejection by her, suggest the scientists, leading to avoid-