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 childrens' 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-

ance in the laboratory situation.

But they add that many important questions remain unanswered. For instance, why were first-born infants most susceptible to maternal absences, and why did half the substitute-care infants show secure attachment to their mothers? Also, it is not known whether infants form secure attachments to nonmaternal caregivers. Clarification of these issues hinges on studies of larger samples and long-term follow-ups of securely and insecurely attached infants, says Barglow.

– B. Bower

Asbestos subpoena quashed

A New York State judge has turned down a subpoena request by the R.J. Reynolds Tobacco Co. of Winston-Salem, N.C., that had asked for access to the raw data representing two decades of a scientist's research on asbestos. Judge Ethel B. Danzig ruled that compliance with the subpoena would "place an unreasonable burden upon the medical and scientific institutions involved and would unduly disrupt [their] ongoing research." She also said a subpoena might have denied the researcher his right to first release of his yet-unpublished data.

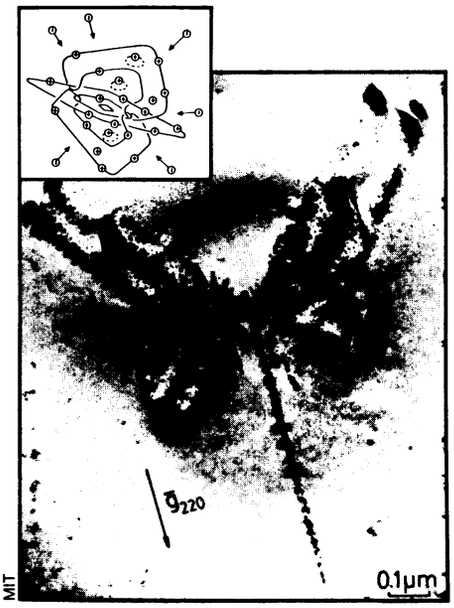
Reynolds is a defendant in a lawsuit, now pending in California, that contends combined exposure to asbestos and smoking was responsible for the death of the plaintiff's husband. While preparing for the case, Reynolds's lawyers learned that the plaintiff intends to use expert witnesses whose testimony will rely on published research by Irving J. Selikoff, a renowned asbestos researcher at Mount Sinai School of Medicine in New York City. Since Selikoff refused to appear as a witness in the case, the Reynolds lawyers didn't know how they could probe the validity of Selikoff's published findings short of subpoenaing the raw data behind them: some 324 linear feet of material stored in 97 file-cabinet drawers and 250 bound volumes, according to Mount Sinai.

Collected over more than 20 years and still actively used, the data result from studies involving 18,170 individuals. Selikoff estimated that to ensure the study participants' confidentiality, it would take thousands of hours to purge their identities from his files. As a result, Mount Sinai, with the American Cancer Society's help, decided to fight the subpoena.

But the story isn't over. James Fyock, a spokesman for Reynolds, says the company plans to appeal the ruling. In addition, a similar subpoena request for Selikoff's data, filed with a U.S. District Court, was stayed pending resolution of this request, and may now be resolved.

– J. Raloff

Magic butterfly cleans up chips



MIT

Osamu Ueda is a renowned collector of real-life butterflies. But among those likely to gain him the most fame is this microscopic one, discovered while he was visiting the Massachusetts Institute of Technology. The expert electron microscopist, who works for Fujitsu Laboratories in Kawasaki, Japan, found the butterfly and others like it in the silicon wafers used to make integrated-circuit chips while he was working with MIT's Kris Nauka and Mark Goorski.

The "butterfly" is actually a beneficial defect that Ueda found had formed during the high-temperature annealing of crystalline silicon in the processing of wafers to make chips. What makes it so special is that it removes metal impurities from the top 100 microns of a wafer – where they could alter the performance of any integrated circuits or devices eventually placed there – and locks them deep within the silicon.

Many techniques have been engineered to gather up and channel detrimental impurities, introduced during chip making, away from the regions where chip devices will operate. But such "gettering" processes can take 16 or more hours – far too long to be useful with the rapid thermal annealing techniques being developed for the processing of much smaller, very-large-scale-integration chips, according to MIT materials scientist Jacek Lagowski. Since the discovery, the researchers have developed a way to produce the butterfly intentionally. "We believe this butterfly is the only gettering process which can work in times on the order of seconds," says Lagowski.

As the inset diagram shows, the roughly 1-micron defect results from a three-dimensional deformation of the lattice structure of crystalline silicon. The butterfly pattern emerges only when the deformation is viewed at one of several select angles.

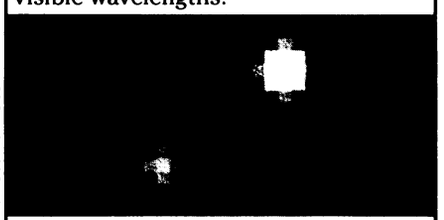
– J. Raloff

As of '87, he's Proteus Man

Neurofibromatosis, the genetic disorder that has come to be known as Elephant Man disease (SN: 6/6/87, p.359), was probably not the cause of the Elephant Man's deformities. That is the conclusion of a National Institutes of Health panel, which last week released its final report on the incurable disease. The report doesn't address directly the case of Joseph Merrick – the 19th-century "Elephant Man" who later became the subject of a popular movie and play. But according to panel chairman David A. Stumpf, it was the group's consensus that Merrick actually suffered from an extremely rare disease known as the Proteus syndrome. The updated diagnosis is of more than historical interest, as it may help to free neurofibromatosis victims from the fear of the severe deformation that is more properly associated with the Proteus syndrome. The experts recommend areas for further research, and one panelist predicts that the neurofibromatosis-causing gene will be definitively identified in the next year or two – a critical step in the development of a treatment or cure. □

Seeing double

Astronomers have found what they think is the first known pair of quasars, sitting neatly together some 12 billion light-years away in the direction of the constellation Crater. Only one of the two quasars, which are 4.2 arc seconds apart, registers in radio wavelengths, while both can be seen in the visible range. This rules out the possibility that the quasar is imaged through a gravitational lens, which would split the image of one quasar into two and cause both to be recorded identically in radio and visible wavelengths.


Eur. Southern Obs.

The spectra of the quasars, which could be circling one another or members of passing galaxies, also showed subtle differences in their physical makeup. Although a quasar has been known to exist in that region, December observations were first to uncover its binary nature. The study, led by the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., will be published in an upcoming issue of Astrophysical Journal Letters. □