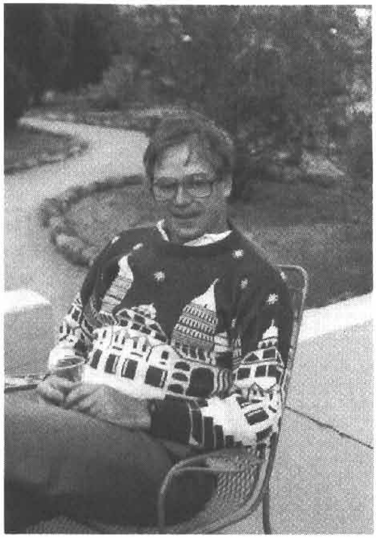
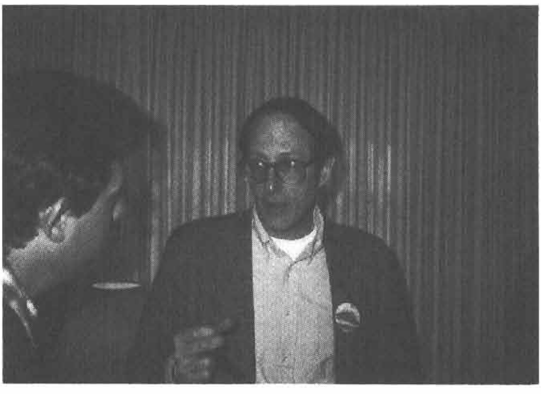
AUTOMATIC SMALL TELESCOPES





Clockwise from top left: (1) Andrea Dupree and Trigger. Andrea won the "Best Horseperson" award. (2) David Latham contemplates the galactic halo. He won the "Best Sweater" award. (3) Douglas Hall discusses a few fine points of differential photometry. He won the "New Astronomy Look" award for shaving off his beard.

Top to Bottom: (1) Tonto and the Lone Ranger—would you believe two desperados from across the nearby border—how about Sallie Baliunas and Scott Butler incognito? (2) Scott Butler, Sallie Baliunas, and Richard Radick discuss investment banking. In the background, David Latham talks to a medical doctor (his wife). (3) Sallie Baliunas demonstrates the yodel (to be used in global network communications) while David Crawford and Russell Genet listen with a critical attitude. E. P. (Lee) Belserene's head is in the lower right (expression unknown). In the background, Edward Horine (the Smithsonian's 60–inch telescope operator) talks with Andrea Dupree about big holes in the universe.

Figure 2. AutoScope mount for 0.5–meter telescopes. Shown with 0.25–meter optics—one of three with these smaller optics built for the Jet Propulsion Laboratory. The mount employs 24–inch diameter friction driven disks in both RA and Dec for the final drive, and two stages of precision Berg–belt reduction. This allows very smooth, totally backlash free operation without preloading—ideal for computerized control.

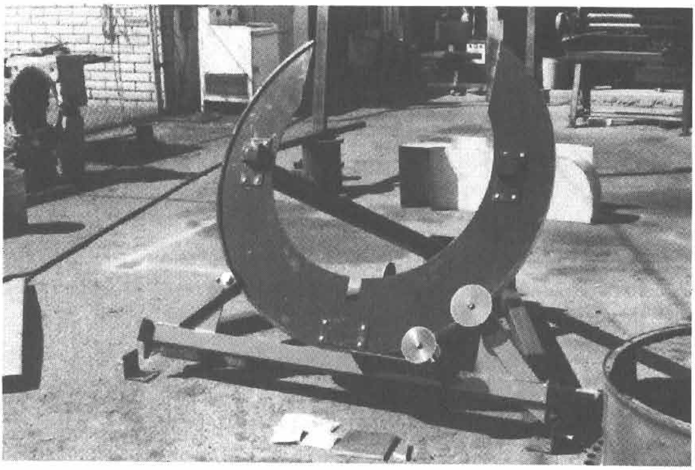


Figure 3. AutoScope mount for 0.75–meter telescopes. This compact horseshoe design allows a larger telescope to be placed in a small space at low cost. This mount was built for the Lawrence Berkeley Laboratory, and will be used in their automated supernova search program.

Both telescopes have friction drives in the final reduction stage and precision belt drives in the other reduction stages to provide the positive, zero–backlash control (without unbalanced preloading) that is required for high–speed fully automatic operation. The telescope mounts are extremely sturdy, are intended for nightly exposure to adverse environments, and are open–framework structures designed for ease of maintenance and modification.

The heart of the telescope control system is a PC/AT and a custom AutoScope printed circuit card that plugs into the PC/AT. The output of this card controls two microstep drivers for quiet, smooth, fast, positive control of all telescope motions. The telescope control software is all written in Turbo Pascal, and is fully compatible with the ATIS standards. Source code is provided and it is not copy–protected.

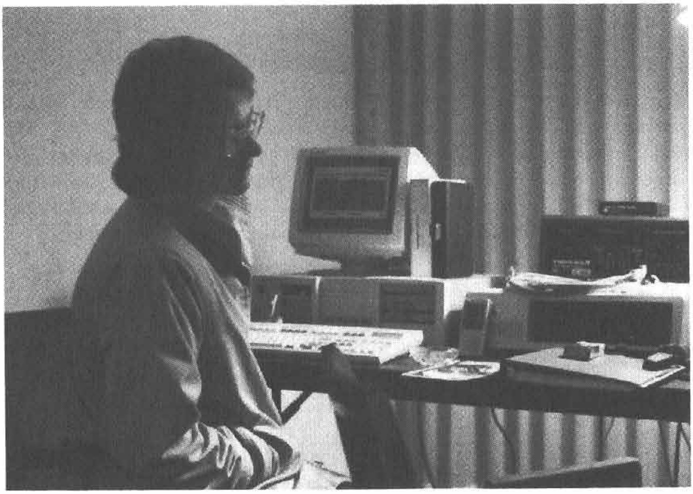


Figure 4. AutoScope telescope control system. It is PC–based, with software written in Turbo Pascal. The microstep drivers provide rapid, yet whisper quiet operation.

b) Instrumentation

A typical full set of instrumentation consists of the four–port instrument selector and its control and four permanently–attached instruments. For a 0.5–meter telescope intended for both instructional and research duties, the four ports might be occupied by a photometer, a CCD camera, a 35–mm camera, and an eyepiece. The instrument selector allows individual focusing of each instrument. The selection of an instrument is under computer control. Currently, the Optec SSP–3 VRI photometer and Optec SSP–5 UBV/uvby/H–beta photometer are fully supported, and the software supports fully–automated photometry. It is expected that in the future other fully–automatic instruments such as polarimeters, spectrometers, and spectrophotometers will also be supported. As with all other AutoScope software, the instrument control software is written in Turbo Pascal, and source code is provided.

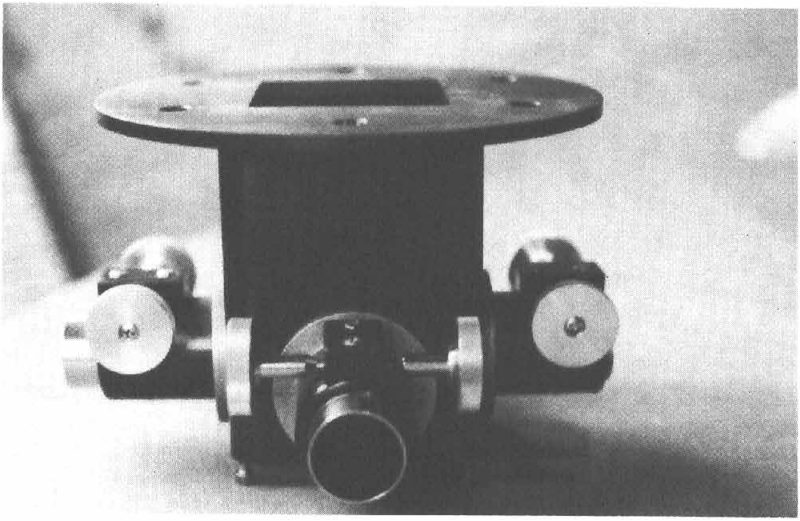


Figure 5. The computer–controlled instrument selector switches the light path to one of four ports. Shown is an instrument selector built by AutoScope for the University of Nevada, Las Vegas. One of the four ports contains a ten–position filter wheel for use with a CCD camera for imaging photometry.

c) Observatory

For those desiring fully–automatic operation at an unattended site (or for those not desiring to place additional duties on busy personnel at an attended site) a fully–automatic observatory can be provided. A small weather station provides environmental information, while a radio/crystal–controlled clock provides highly accurate time.

The observatory enclosure has a computer–controlled, motorized roll–off roof and tilt–down southern "door" that allows rapid access to all portions of the sky. While compact, the enclosure provides room for several astronomers and the environmentally–controlled electronic equipment housed in the telescope pier. An uninterruptable power supply

(UPS) keeps the system in operation even if there should be momentary power interruptions.

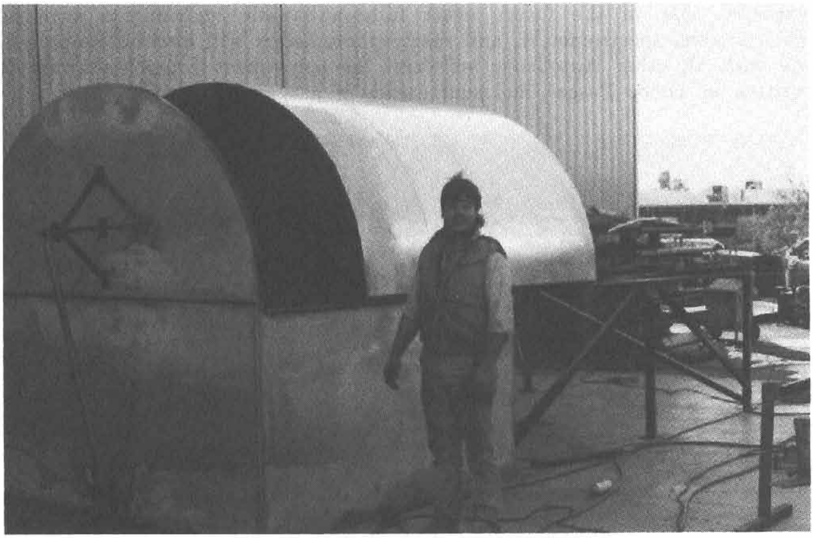


Figure 6. AutoScope observatory enclosure for the 0.5–meter systems. Designed for either manned or unmanned automatic operation, this sturdy structure can withstand mountaintop environments. The roll–off design allows a full view of the sky, and accommodates the rapid telescope movements possible in fully automatic operation.

REFERENCES

Boyd, L. J., Genet, R. M. and Hayes, D. S. 1988 in *Automatic Small Telescopes*, ed. D. S. Hayes and R. M. Genet, (Mesa: Fairborn Press), p. 35.

Crawford, D. L., Genet, R. M. and Hayes, D. S. 1988 in *Automatic Small Telescopes*, ed. D. S. Hayes and R. M. Genet, (Mesa: Fairborn Press), p. 115.

Hayes, D. S., Genet, R. M., Boyd, L. J. and Crawford, D. L. 1987 in *New Generation Small Telescopes*, ed. D. S. Hayes, R. M. Genet and D. R. Genet, (Mesa: Fairborn Press), p. 19.

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1904). The Cooke triplet was state of the art for wide-angle work until supplanted by Ross and Schmidt designs. It continues to serve the Maria Mitchell Observatory well. Exposures of 30-60 minutes show images of stars as faint as photographic magnitude 15-17. There are typically a half million images in the 14x17 degree fields imaged on an 8x10-inch plate.

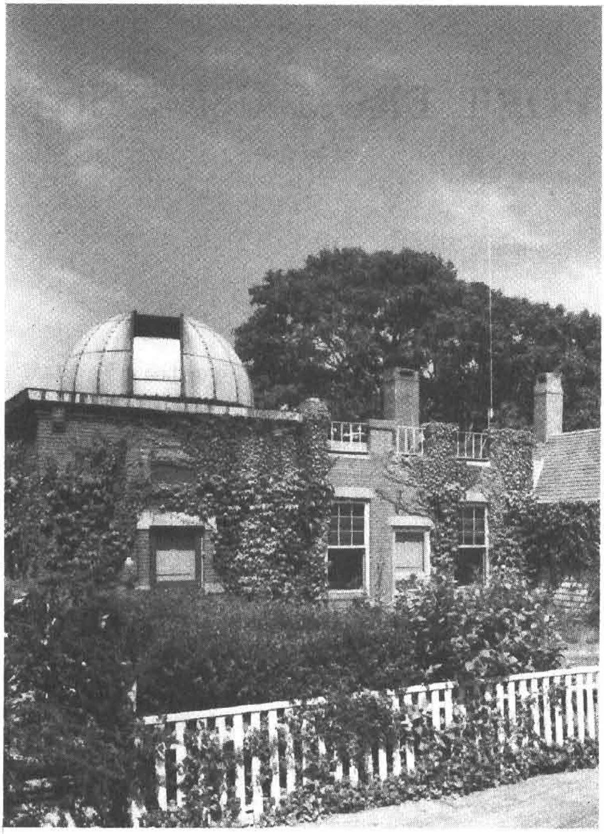
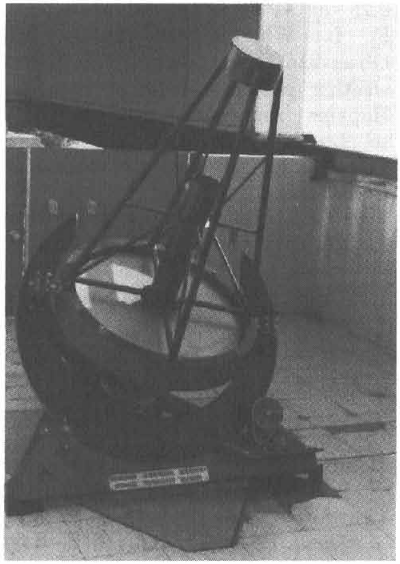


Figure 1. The Maria Mitchell Observatory.

The guide telescope is a 5-inch refractor by Alvan Clark and Sons, dating to 1858, when a committee calling itself "The Women of America" gave it to Maria Mitchell in honor of her discovery of a telescopic comet (1847VI). The Clarks had been making telescopes for about ten years. Alvan Clark, the father, had not yet given up his portrait painting business to devote himself exclusively to optics. Deborah Warner (1968)

Sallie Baliunas and the Smithsonian Institution's 30–inch APT. In the background is Rick Wasson and Saul Adelman and the MMT.



Clockwise from top left: (1) First row: Sallie Baliunas discusses K–line photometry. 2nd row: Robert Dukes, Rick Wasson, Craig Smith, and Saul Adelman relax in the sun. Backdrop: APT Service building and the MMT. (2) Smithsonian Institution 30–inch APT. (3) Everyone listens as Sallie Baliunas gets going on her talk. In the far background is Mexico.

software program written in *Ada* (tm). The interfaces to the display terminal are handled by *Graphics Kernel System* (GKS) subroutines. The OASIS system has database tables that generically describe the system to be controlled and monitored. Each table had to be tailored for the Sommers–Bausch application. On–line help is available through files edited directly by the user. The OASIS system allows the users to send commands to the telescope via the Apple control computer and to monitor data from the telescope. Commanding can be controlled by the user through screen menu picks and keyboard entries and procedures. Commands to the Apple include all of the functions available at the Apple computer as well as commands that have been added to enhance interactive remote operations. The telescope track rates can be controlled and all of the functions of the hand paddle have been reproduced on the OASIS screens. Data from the telescope includes the right ascension (RA) and declination (DEC) position, SIDEREAL TIME and the output of the PHOTOMETER in counts per unit time. Specification of all commands and telemetry is contained in the database tables and can be modified as the capabilities of the Apple develop. The database tables contain a total of 800 entries. This determines the complete user interface including displays and menus. Appendix A includes a list of commands available from OASIS and the telemetry that is sent from the Apple.

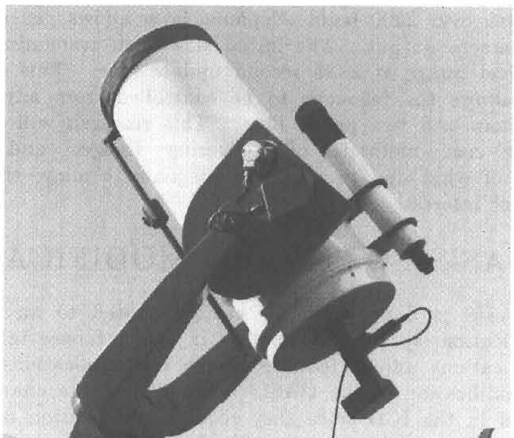


Figure 1. The remotely–controlled 16–inch telescope of the Sommers–Bausch Observatory of the University of Colorado at Boulder.

Donald S. Hayes was born and raised in southern California. A graduate of Pomona College (Astronomy), and the University of California, Los Angeles (MA and PhD in Astronomy), he has been on the faculty of Rensselaer Polytechnic Institute and Arizona State University, and on the staff of Kitt Peak National Observatory. Don is a Fairborn Observatory staff scientist and a free-lance writer/editor. His memberships include the AAS, the ASP, the IAPPP, and the IAU.

Russell M. Genet was also born and raised in southern California. He is a graduate of the University of Oklahoma (Electrical Engineering) and the Air Force Institute of Technology (MS), and is an instrument-rated pilot and instructor. Russ has worked for the US Air Force for the past 32 years, and develops simulators for training fighter pilots. He is co-director of the Fairborn Observatory and President of AutoScope Corporation. Russ is a member of the AAS, ASP (Board of Directors), IAPPP, and the IAU.

Front Cover: Sallie L. Baliuans and the Fairborn 10 automatic small telescope.