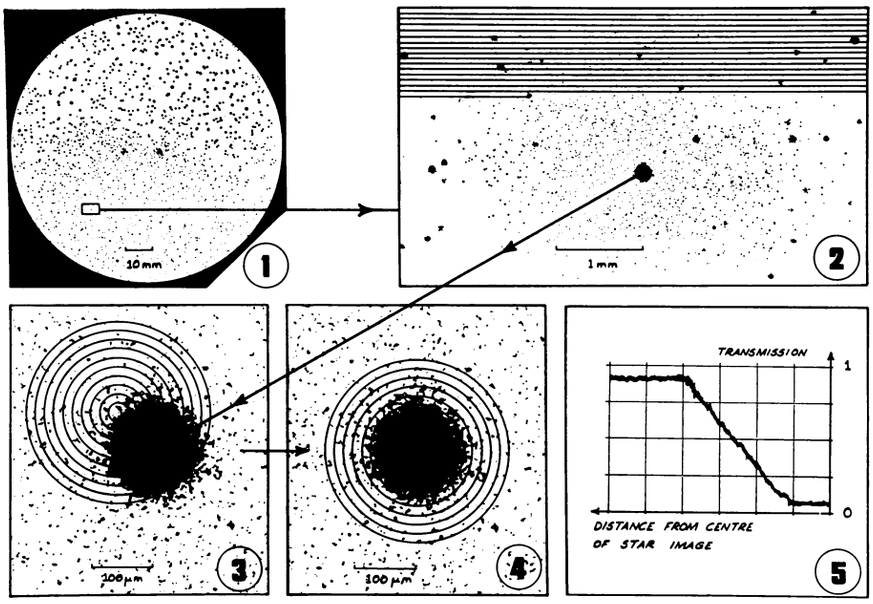
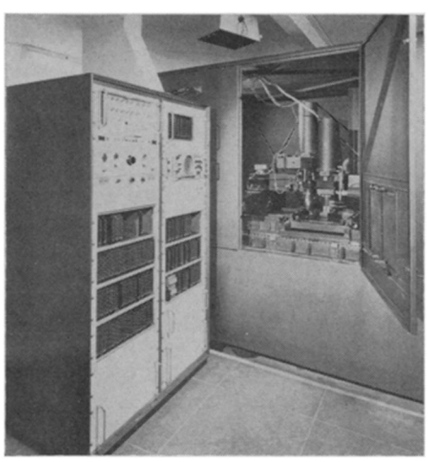


The Galaxy measuring machine searches a portion of a Schmidt plate (1 and 2) then by concentric circle scanning centers and measures the star image (3 and 4) and displays the profile of the star on an oscilloscope for a computer.

Automated optical astronomy

Help in cataloguing stars comes from a computer and an automatic plate-scanner

by F. C. Livingstone



Four tons to catalogue the heavens.

Poets have made the stars in the sky a cliché for infinity or uncountability, but astronomers find the thought more disturbing than artistic. A single plate from a Schmidt camera, the astronomer's special photographing telescope, can contain the images of tens of thousands of stars in an area a few times the size of the image of the moon.

Each of these images is of potential interest to astronomers, either because it may represent a previously unknown class of object or because it may add something to the statistics of known classes. But no one can look at them all. Astronomers usually concentrate on a few objects they happen to be studying, and then put the plate away in a file until someone else comes looking for a specific thing.

The world's collection of Schmidt camera plates contains a wealth of information waiting to be extracted and catalogued. Such a compendium would bear especially on the statistics concerning different classes of stars, and this is of particular importance in testing theories of the structure and history of the galaxy and of the life cycles of stars. But there has been neither the manpower nor the storage capacity available for the job.

Automation is beginning to help. If it is as successful as its proponents hope, and if it spreads to enough centers, it may provide new methods for cataloguing stars, compiling astronomical statistics and notifying astronomers of the existence of unusual objects.

Applying automation requires an automatic plate-scanning machine linked to a computer. One such machine, called Galaxy, is now working at the Royal Observatory in Edinburgh. Another is on order for the Royal Greenwich Observatory at Herstmonceux in England.

The design of Galaxy started in 1965 under the direction of Dr. V. C. Reddish of the Edinburgh observatory. The basic concept of the machine was the work of Dr. P. B. Fellgett, who is now professor of cybernetics and instrument physics at Reading University.

The specifications include a cathode-ray tube that could focus a beam of light onto a spot as small as one micron across, a mechanical carriage to hold and position the photographic plate to an accuracy of one micron, a system for measuring the carriage position to the same accuracy and an automated system to control the motions.

A contract was let in June 1966 to Paul Coradi Scotland Ltd. The machine was delivered in March 1969. Though the plates are small, the machine is large: 6 by 6 by 7 feet with a weight of 3.6 tons.

In more than 2,000 hours of running time so far, Galaxy has located over a quarter million stars and determined the brightness and color of 40,000.

The plates used are photographic negatives. A star image is a dark spot that can be from tens to hundreds of microns across. When the spots come under the light beam, less light gets through them than gets through the adjacent transparent portions of the plate, and the drop-off is sensed by a photoelectric sensor underneath.

Typically Galaxy will make a first pass with a beam about 16 microns wide and record the locations of the star images on the plate. In this way it can find and record 10,000 stars an hour.

When the image positions are known, the images can be brought under the beam one at a time and scanned with a one micron beam. This determines the structure of the image, which reflects the brightness and color of the star. Analyses of this kind can be done at the rate of 1,000 an hour.

So far the greatest problem has been programming the observatory's computer to handle the wealth of information generated by Galaxy.

One example of what Galaxy can do is a search for newly formed stars that the Scottish astronomers are making. These are found in interstellar gas clouds. There are many such stars per cloud and many such clouds scattered around the sky. By the old methods of examining Schmidt plates by hand and eye, systematic searches for newly formed stars could be made in only a few locations. Now they can be searched for and catalogued throughout the sky, and their statistics, which are important for theories of stellar evolutions, can be well determined. □