Electronic Camera: Cheap Starlight

by Ann Ewing

The stars never shine as deep and bright as astronomers would like. The pinpoints of light peppering the night sky intrigued and puzzled man long before history was recorded.

Stars were first catalogued according to brightness in the 1st century B.C., when the human eye was the only available instrument. After the telescope was invented, the thousands of visible stars became millions.

But until photographic film was developed, there was no way of recording the stars seen through a telescope.

During the 20th century, however, astronomers became convinced that photographic film was not the most efficient way of collecting starlight. They have now put into routine use electronic cameras, the end-product of some 30 years of research aimed at gathering more light from a source in the heavens in less time than photography takes.

The 13 observatories already equipped with an image tube converter have at their disposal a device making their telescopes the equivalent of instruments with nearly three times the diameter. This means that a 60-inch telescope can equal a 180-inch one in light-gathering power when its stellar photographs are taken electronically rather than directly on photographic plates.

The aim once was to make a 20-inch telescope do the job now accomplished only by the 200-inch giant atop Mt. Palomar in California. Now scientists are not so sure such a large increase can be achieved electronically, but they are very happy to have the boost of up to three times, hoping that the original goal will be reached in the future.

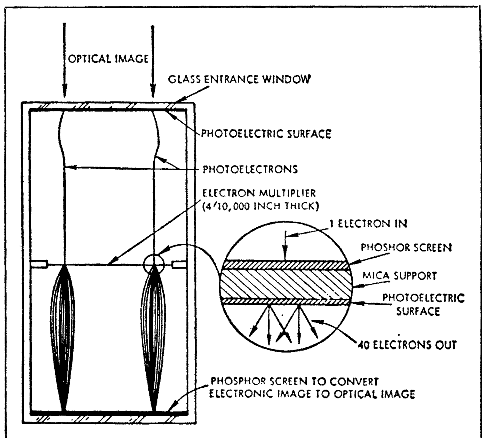
The only clue astronomers have concerning how stars—including the sun—are stoked, how they are born and how they die, indeed to the whole cosmos, is from the radiation they send spaceward. Although this radiation is now known to come in many wavelengths, the most extensively studied by far is the visible or near-visible light that can be photographed.

Development of a practical electronic image tube and its routine use—tripling the power of any telescope—promises a revolution in astronomy. Considering the discoveries already made with the 200-inch Hale telescope, including the optical identification of the puzzling quasars, operational use of the image tube could well bring a spate of discoveries revising man's theory of how the universe was born and is evolving.

The image tubes are in much demand. Since the supply is limited, they are being doled out by a joint committee of Carnegie Institution of Washington and the National Science Foundation. Committee members are Dr. John Hall, director of the Lowell Observatory, Flagstaff, Ariz., Dr. William A. Baum, also of Lowell Observatory, and Drs. Harold H. Lane and Gerard F. W. Mulders of the National Science Foundation.

Among large telescopes equipped with the image tubes are the U.S. Naval Observatory's Flagstaff Station, the University of Texas' McDonald Observatory, the Australian National University's Mt. Stromlo Observatory, the Dominion Astrophysical Observatory in Victoria, British Columbia, and Mt. Wilson and Palomar Observatories. Besides the 13 already distributed, the four-member allocations committee is now in the process of selecting a dozen observatories to be allotted the 1967 supply of image tubes.

The devices were developed after some 14 years of work by the Carnegie Image Tube Committee, a joint effort of Carnegie's Department of Terrestrial Magnetism, Mt. Wilson and Palomar Observatories, Lowell Observatory, the U.S. Naval Observatory and the National Bureau of Standards. Drs. Hall and Baum were original members of this committee, headed then as now by Dr. Merle Tuve, director of Carnegie's Department of Terrestrial Magnetism.



Electronic camera

The device does its work by intensifying starlight internally by electronic means, with the receiving end of the image tube being attached to the focus of the telescope's optical system. The display at the other end, a new and much brighter image, can be photographed by conventional means.

The image tube known as the "cascaded image intensifier" and being distributed to the 25 observatories is particularly useful in the blue part of light's spectrum, the range most frequently used by astronomers. Another, called the "mica-window converter," is also suited for infrared work.

The difference between the two occurs toward the end of the electronic processing. In the image tube, or intensifier, light going through the photocathode releases one electron for each 10 or 15 of the light bundles, called photons, hitting the first thin film. These electrons are then cascaded, or accelerated, several times, finally falling on the plate where they create a latent image that is then photographed in the normal manner. The important point, and the one now so delighting astronomers, is that this system gives the highest efficiency ever known for recording the faint light of a star or other heavenly object on a photographic plate.

In the mica-window converter, the electrons resulting from light photons falling on a thin film are accelerated in much the same manner. However, instead of hitting a photographic plate directly, they end up bombarding a phosphor, or TV-like screen and that image is then photographed. Tests so far have indicated to astronomers that this system may be more efficient in the infrared, which is of interest to the military, but that the image tube is more of an all-around method satisfactory for day-to-day operation at many observatories.

The cascaded image tubes are made to very rigid specifications and cost about $5,000 each, although this cost is expected to drop as more of them are produced by Radio Corporation of America. Nevertheless, $5,000 is a very small price for a device that triples the effective power of a $750,000 telescope and also lasts for several years. Image tubes are completely sealed and self-contained, and tests have shown they are reliable and stable under actual observing conditions.

The pioneer in the investigation of image tubes was Dr. Andre Lallemand of the Paris Observatory, who was one of the first to point out the potential advantages of such a device.

Besides their application in astronomy and by the military, image tubes have promise in locating of malformations inside the body and in the study of the internal structure of atomic nuclei.