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ULTIMATE CATALOG

STARS

By Marcia Bartusiak

All I ask is a tall ship and a star to steer her by," wrote the British poet John Masefield in 1902. If Masefield were to comment on today's methods of celestial navigation, he would find things a bit more complicated.

To be able to aim the long-awaited Hubble Space Telescope (HST) at diverse targets around the sky, astronomers, computer scientists, and engineers at Baltimore's Space Telescope Science Institute are cataloging more than 20 million celestial objects, the largest undertaking of its kind in astronomical history.

Tracking a star or a faraway galaxy with an earthbound telescope is a relatively easy operation. With the earth as a reference frame, a telescope can be pointed to a specific "longitude" and "latitude" on the celestial sphere.

Some 300 miles out in space, however, the 12-ton observatory will have no such bearings to rely on. Instead, astronomers will have to use a different orientation system. To aim the HST they must first pinpoint the precise position and brightness of a pair of stars in the target's vicinity.

Guidance sensors on the telescope will lock onto these "guide stars" and keep the 2.4-meter mirror fixed on the target with hair-fine precision—within two millionths of a degree—for 24 hours.

Such accuracy is absolutely necessary if earthbound observers are to take full advantage of the telescope's ability to resolve objects ten times more sharply than ground-based optical telescopes. Once the telescope is up, guide stars will be chosen from a computerized catalog and their locations periodically radioed to the HST's onboard computers.

The billion-dollar telescope will whip around the earth once every 100 minutes, and achieving such accuracy at that speed "is a scary proposition," admits Helmut Jenkner, project leader for the Guide Star Election System.

"When the catalog was first conceived several years ago," he continues, "it was thought that a handful of people could get the job done. But the difficulty in pinpointing the location of millions of guide stars was vastly underestimated. Assembling the Guide Star Catalog turned out to be one of

the most difficult tasks to be completed before the telescope's launch."

Today, at the institute's modern glass-and-concrete edifice on the Johns Hopkins University campus, about 30 people work in around-the-clock shifts to complete the project. They start with some 1,500 photographic plates of the celestial sphere. Each plate covers a region of the sky about as large as that occupied by the Big Dipper's bowl. First a laser scanner will "read" each plate, translating its regions of light and dark into a series of numbers.

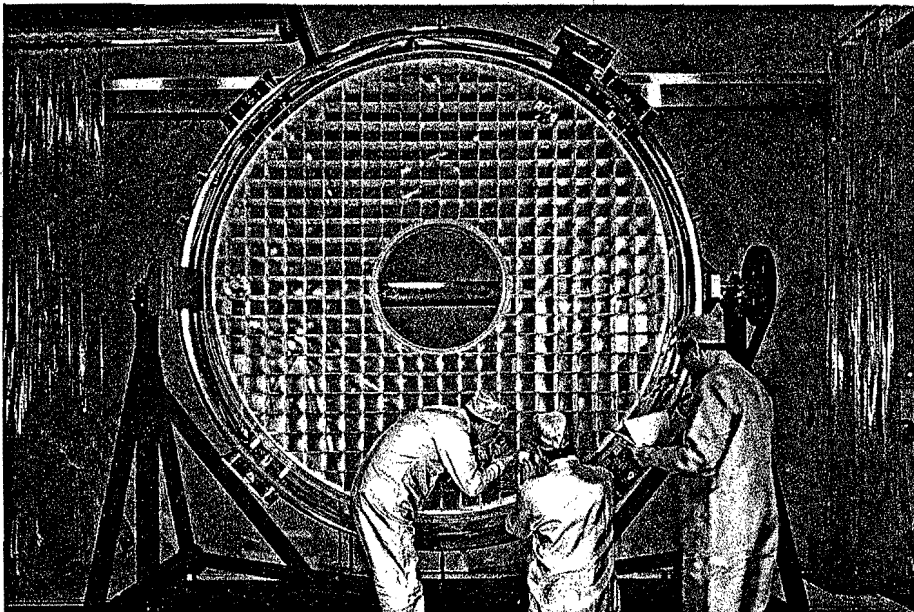
A specially designed computer program then takes each digitized image and automatically records every star, every galaxy, and every nebula as faint as the fifteenth magnitude (a class of objects 4,000 times too faint to be visible to the naked eye). From the library of 4,500 tapes that will eventually be processed, the astronomers will construct the catalog.

The best guide stars are the sharpest, most pointlike objects, which will be recorded in the catalog. Also listed will be more fuzzy objects, so they can be avoided. Jenkner calls them "spoilers" because their lack of definition could confuse the telescope's guidance systems.

When the first edition of the catalog is completed this fall, Jenkner estimates it will list the positions and magnitudes of between 20 million and 40 million sky objects. The compendium will be 100 times larger than the four-volume *Smithsonian Astrophysical Observatory* star catalog, currently astronomy's most extensive listing of stars. "Ours will be the astronomical reference catalog for years to come," says the Austrian astronomer.

One daunting feature of this undertaking is that once begun, it will never really be finished. Since stars are continually moving in our galaxy, "errors in the positions of the stars will start to creep in a few years after the telescope launch," notes Jenkner. But as new photographic surveys are done, the catalog will be updated periodically.

For the moment the project leader has a more pressing concern: to complete the first edition. "From now until launch day we have to catalog about one star a second to meet our deadline." **□□**



How many stars are there in the sky, and where are they? The Space Telescope has to know.