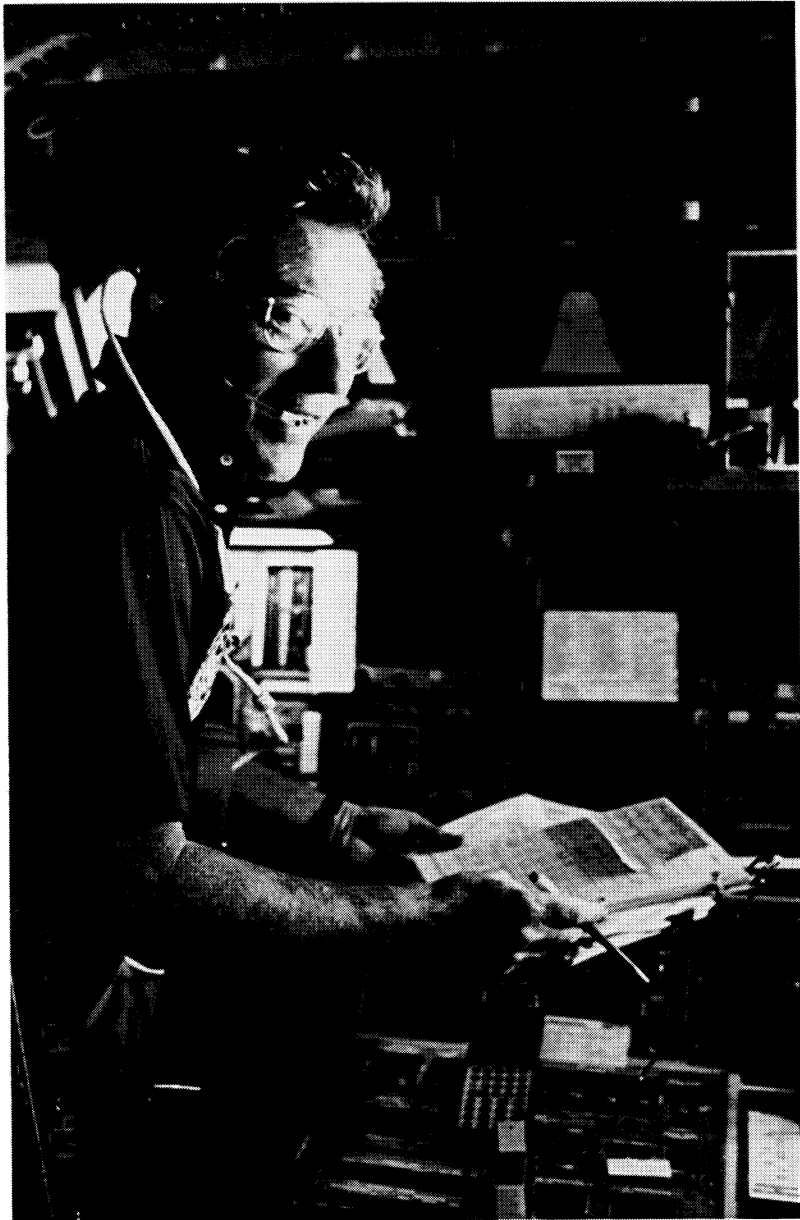In November 1983, NASA flew a nine-day Space Shuttle mission that marked the initial use of the Spacelab orbital laboratory and several other "firsts." Little noticed in reports of that highly successful flight was another first: the space debut of a remarkable high performance navigation monitoring computer known to NASA as SPOC, for Shuttle Portable On-board Computer. SPOC's debut was as successful as the rest of the mission and the small but highly capable computer is now used regularly on Shuttle flights. The photo at left shows a part of the Orbiter *Columbia's* flight deck with SPOC in use by astronaut John W. Young, commander of the Shuttle/Spacelab 1 mission.

SPOC was not a specially-developed system but an adaptation of a commercial computer called GRiD Compass, produced by GRiD Systems Corporation, Mountain View, California. Hardware had to be modified and new software developed to meet space requirements, which led to changes in commercial models that benefited the company's competitive position.

Since the Shuttle Orbiter's primary computers must handle a multitude of processing functions, NASA wanted a separate computer to provide reliable monitoring of the spacecraft's orbital path and a visual display of the Orbiter's position at any time. Since weight and space are vital considerations in Shuttle operations, the computer had to be small and light; nonetheless, it had to have graphic display capability, a large memory storage capacity, high processing speed and a degree of ruggedness sufficient to withstand launch vibration. After evaluating a number of small computers, NASA selected GRiD Compass.

The principal modification needed was a fan to cool the computer; GRiD computers are normally cooled by convection, or heat transfer by circulation, but that process does not work in weightless space. NASA also

wanted a larger electroluminescent screen and an improvement—for failsafe operation—to the lithium battery that powers the important internal clock. The power cord was modified to tap the Orbiter's power supply and Velcro strips were added to keep SPOC from floating. The fan was later incorporated into the larger screen models of the new Compass II line.

In Shuttle operations, SPOC automatically computes and displays the Orbiter's ground position, predicts the paths of the next two orbits, identifies locations where the Orbiter has line-of-sight communication with Earth stations, determines points for certain location-dependent Earth observations and continuously displays mission elapsed time. These demanding requirements necessitated a highly sophisticated operating and control system, one of the major considerations in NASA's selection of the GRiD Compass. Nonetheless, NASA and GRiD software engineers had to spend many hours writing, testing, and rewriting source code. This process, the company reports, ultimately benefited GRiD and its commercial clients, since it helped fine tune the GRiD Operating System and common code documentation.

Shown at left, the GRiD Compass computer weighs only 10 pounds, measures 15 inches in its longest dimension and is two inches thick when the screen is folded down; it slips easily into a standard briefcase. GRiD computers are manufactured in nine models using 17 integrated software packages. Widely used for office (above) and conference (upper right) work, the computers can also be used, with an optional battery pack for power, for field work (lower right); they have found special application among oil and natural gas companies for on-site drilling and production calculations, offering time and monetary savings over sending information gathered at a wellsite back to headquarters for computer analysis. For similar reasons, GRiD equipment is used by the U.S. Army as part of a field communications system. It is also used by AT&T Communications and Bell operating companies for on-site development of the detailed equipment layout plans for new or existing telephone buildings. Although the company is only five years old, it has already built a strong market base; GRiD Systems reports installations in more than 25 percent of the Fortune 1000 companies and in many government agencies. In addition, the GRiD computer's role in space flight is growing as NASA continues to expand the functions of SPOC.