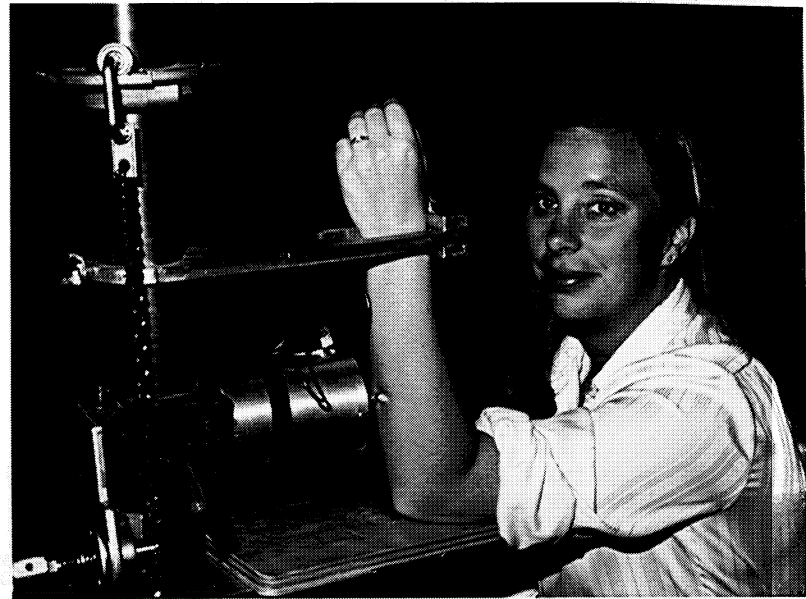
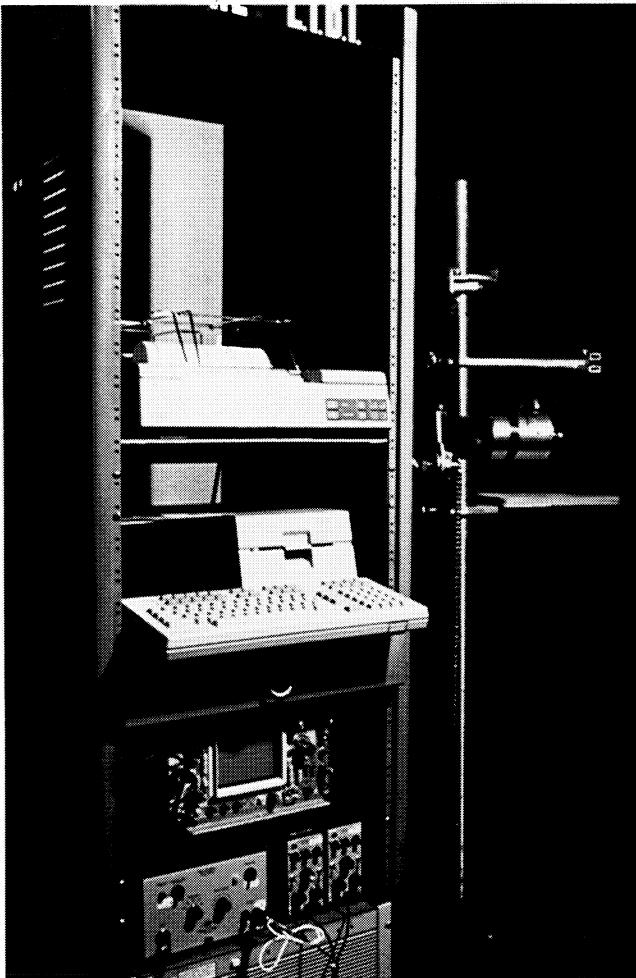


Bone Analyzer

One of the dangers of long-duration space flight is disuse osteoporosis, a form of bone deterioration induced by astronaut inactivity under weightless conditions. However, the crew of the Skylab 4 interim space station demonstrated, on an 84-day mission in 1973, that adequate food and exercise can reduce bone loss. Contemplating future manned missions that might run two years or more, NASA sought a practical, inexpensive, noninvasive way of making quantitative measurements of bone stiffness and mass, a system sensitive enough to monitor and evaluate small changes. This would enable comprehensive studies of the effects of nutrition and exercise, toward developing food/exercise programs to prevent astronaut bone loss. Since bone deterioration affects a substantial portion of the U.S. population, it would also meet a need—in hospitals, clinics and convalescence homes—as a tool for diagnosis of bone abnormalities caused by disease, aging and disuse, and a means of evaluating fracture healing.



Such a system is now in final development status after a decade of effort by the Biomedical Research Division of Ames Research Center, which funded and teamed with Dr. Charles R. Steele, Professor of Applied Mechanics at Stanford University's Department of Aeronautics and Astronautics. In 1977, the Ames/Stanford team developed a prototype microprocessor-controlled bone probe system; built by Oxbridge Associates, Sunnyvale, California, it was known as SOBSA (Steele-Oxbridge Bone Stiffness Analyzer). Tests with human subjects indicated that SOBSA could be used clinically but it had certain limitations with respect to accuracy, sensitivity and operator training requirements. Through its Technology Utilization Program, NASA funded construction of an advanced SOBSA-2 featuring improvements in those areas.

SOBSA-2 is a computer-controlled impedance probe system in which bone stiffness is determined quantitatively by measuring responses to an electromagnetic shaker. The subject's bone is constrained at each end (above), the shaker applies vibration and the probe measures the resulting impedance (electrical resistance), providing a basis for computer analysis and determination of bone stiffness; the data acquisition and analysis module is shown at left. Such information can be used by physicians to detect the presence of bone disease, to measure the extent of deterioration, and to aid in prescribing therapy.

SOBSA-2 has been further refined and it is now undergoing clinical testing at Stanford University Orthopedic Clinic, performing measurements on patients before and after total hip, knee, shoulder and elbow replacements. The latest model has a more powerful controller, permitting extensive data collection and analysis in a short time. By the end of 1985, it is expected that the system will have demonstrated the desired accuracy and repeatability over a wide range of subjects.