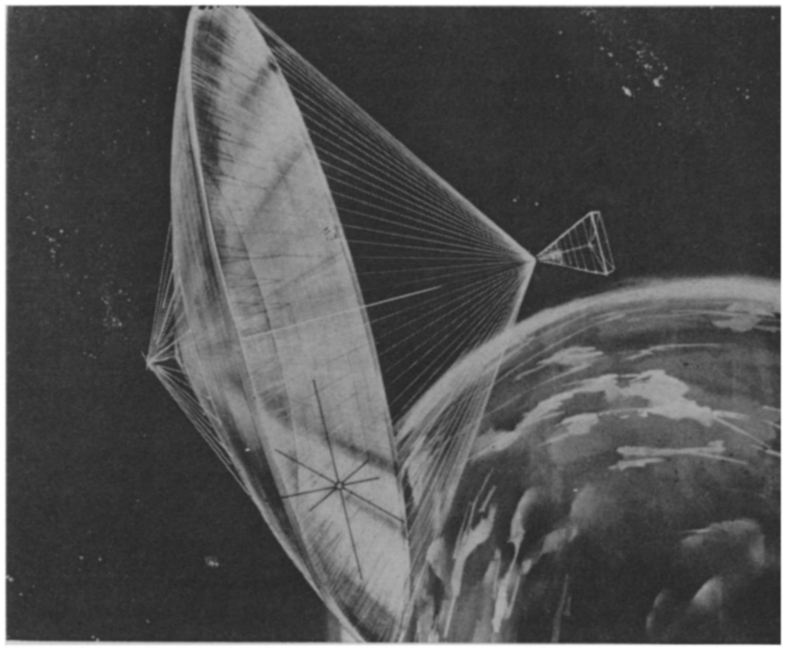


NASA

Radio sources will be measured by 1,500-meter rig.

Covering the spectrum in space

Advanced telescopes in both the radio and optical ranges are still alive at NASA

by Dietrick E. Thomsen

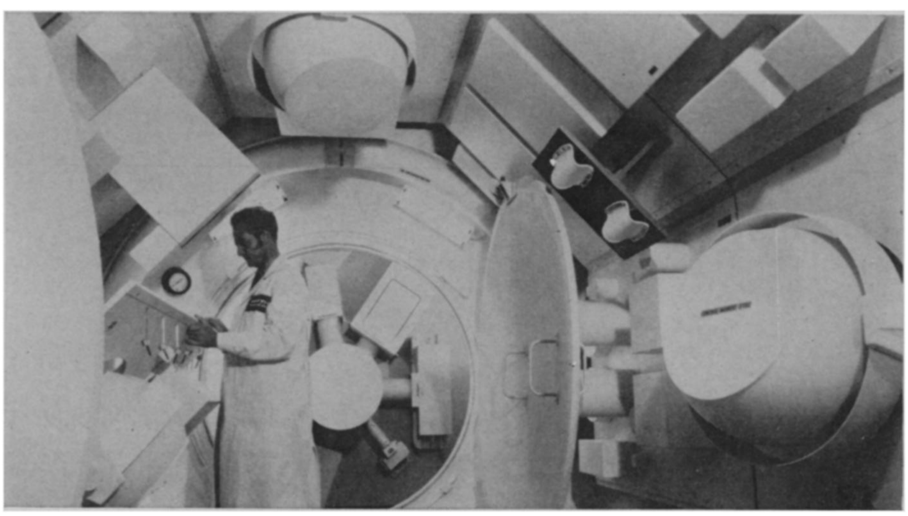
The National Aeronautics and Space Administration has sometimes been criticized for neglecting science and spending most of its effort on spectaculars. Yet in its present financial crisis, in which it faces budget cuts of hundreds of millions of dollars, two significant astronomical projects may stay alive while other parts of the agency's plans go overboard wholesale.

The projects involve orbiting an optical telescope of two or three meters diameter and a radio telescope of about 1,500 meters diameter. At the moment both projects are moving forward in spite of NASA's money crisis.

Of the radio project, called LOFT for Low-frequency Radio Telescope, Dr. Robert G. Stone of NASA's Goddard Space Flight Center in Greenbelt, Md., says, "We are trying to keep some life in it." The life that it has at present is a design study contract awarded to Cornell Aeronautical Laboratory, Inc. of Buffalo, N.Y. Cornell engineers will analyze the design of the reflector grid, antenna feed and antenna radio frequency characteristics of a flight test model one-fifteenth the size of the proposed telescope. This step will follow a five-meter test model that Cornell now has ready for flight to see how well it holds its shape in space.

If the project continues to survive, LOFT could be flying by the end of the decade. Dr. Stone sees it as a kind of orbiting national laboratory.

LOFT would be designed for observation at frequencies between 0.5 and 10 megahertz, a range that is reflected by the ionosphere and cannot be observed from the ground. The same range is now being studied by the first radio telescope in the sky, the Radio Astronomy Explorer (RAE). Success with RAE has made radio astronomers eager to put up a bigger and better telescope.



Martin-Marietta

Optical telescope would operate automatically, be serviced by spacemen.

The main purpose of RAE was to find out whether there were astronomical emissions in this range. There was no particular reason to suspect that there weren't, but until they were observed it was not certain that they existed. The explorer is fitted with dipole and V antennas to sense the background radio signal, and one of its major functions is to compile a contour map of radio brightness in this low-frequency range. According to Dr. Stone the map is nearly complete.

After finding out what parts of the sky contribute bright emission in this frequency range, the next step is to identify and study individual sources. RAE's antennas were not designed to resolve discrete sources; nevertheless, says Dr. Stone, before the map is finished "we may get one or two sources."

Discrete sources in this frequency are one of the main things LOFT is being designed for. It will attempt to find out what happens to the spectra of discrete sources, especially quasars, at the low-frequency end. Most astronomers expect less brightness than at higher frequencies, but the opposite has also been suggested.

Since wavelengths at these frequencies are measured in hundreds of meters, the signals will give information about large-scale movements of the sources. Waves of this length represent large motions of electrically charged bodies; light and higher frequency radio waves are usually generated by processes that go on inside atoms and molecules.

LOFT will also be used to study planetary atmospheres. RAE has already produced two interesting bits of planetary information: that the earth's ionosphere broadcasts waves of LOFT's range (SN: 5/3/69, p. 423) and that Jupiter apparently does not (SN: 8/29, p. 186). Further study with a high-resolution telescope that can pinpoint sources, as RAE cannot, is indicated.

The length of waves in this range means that LOFT can be a spidery parabola that would be spun out of a capsule made fairly small for launching. To reflect radio waves one needs a wire mesh whose threads are separated by about one-twentieth of the smallest wavelength desired. For a 100-meter wave (3 megahertz) this would be 5 meters.

The project for a large optical telescope in space is also showing life, a whole bargeful. The bargeload is a mock-up of a module segment to carry controls and sensing equipment for a two- or three-meter reflecting telescope. The segment was designed at Martin Marietta Corporation's space center near Denver, and the barge brought it to the Marshall Space Flight Center at Huntsville, Ala., where it will be tested in connection with NASA's feasibility studies of a manned orbiting laboratory.

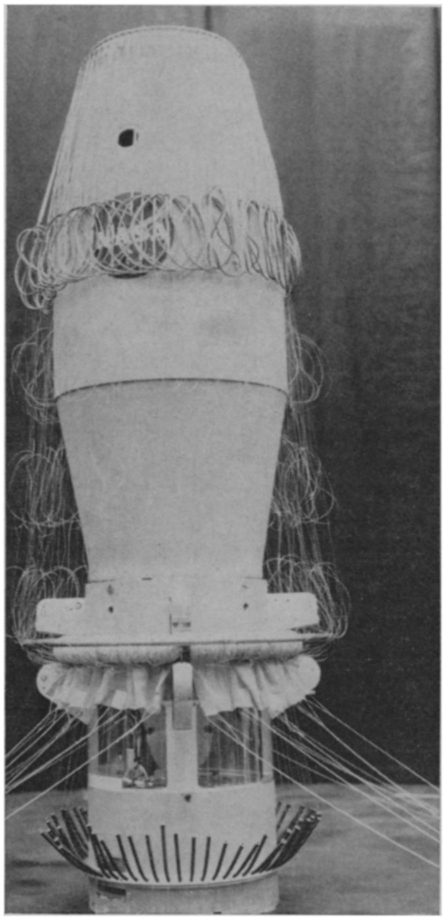
The Martin Marietta mock-up represents 26 feet of the 60-foot length of a module to carry the whole telescope. The telescope would be designed for independent flight and automated operation, but would return periodically to the manned orbiting station for maintenance and adjustment.

A single mirror in space could reflect light from the ultraviolet at 900 angstroms to just into the infrared at 10,000 angstroms. Ground-based telescopes see from about 3,000 angstroms to about 7,000.

Even more important than wider range is the better resolution of a space telescope. Atmospheric turbulence limits earth-based telescopes to a resolution of about one minute of circular measure. A two-meter telescope in space, says Marc Aucremanne, NASA program manager for advanced progress and technology, could have a resolution of 0.07 seconds.

At this resolution it could distinguish many more individual stars in the nuclei of galaxies and more of the infant protostars in gaseous nebulosities than ground-based telescopes could. In such objects, says Aucremanne, it might be able to see structures as small as 50 astronomical units (450 million miles) across. Improved knowledge of the densities of stars in galactic nuclei, of the relationships between quasars and galactic nuclei and of the formation of stars in gaseous nebulae would be expected.

If all goes well and the project stays alive, the large optical telescope could also be flying by the end of the decade. □



NASA

Five-meter LOFT *(above) monitored by camera surveying unit (below).*

NASA