

MAN IN SPACE

An Apollo Telescope Mount (ATM) will point telescope up to 3 meters in length at the Sun with a precision of about 5 sec of arc. In some experiments, astronomers will need to achieve a resolution of 1 sec of arc, and eventually 0'.1' 0".0' or better. Not only must telescopes be pointed with that precision, but more significantly, considerably larger telescopes are required, as well as corresponding refinement of component specifications, alignment, etc. Two consequences of this desired high-resolution performance of space telescopes are of special importance to the question of man's potential role. First, the data collection rate of large telescopes may be greater than that of small telescopes. Second, those telescopes and their accessories must be specialized as to functions, wavelength of operation, etc., so that versatility is achieved only by major subsystem interchange or adjustment. All of these factors must be considered as part of the question of man's usefulness in performing astronomical observations from a satellite.

It is clear that men can perform many useful functions in connection with the assembly and operation of large instruments in space. Perhaps other advantages of manned operation will appear as man gains experience in space work. In the operation of large telescopes, man has several potential functions. First, he can perform major configuration changes—for example, converting a spectrograph into a spectroheliograph, altering the wavelength setting of a solar monochromator, inter-changing gratings of different rulings, etc. During individual observational projects, man provides the ability to perform rapid analysis of the output data in order to modify the subsequent observations. An example would be to monitor an active region, and to start a series of high-rate spectral or cine observations at the inception of a flare. Automatic equipment to do the job accurately and reliably probably cannot compete with human judgment, since the complex activities of time correlation, field search and event localization, and very sensitive threshold judgments must be made simultaneously, and both accurately and quickly sometimes under conditions of low signal-to-noise ratio.

SPACE OBSERVATIONS AND SENSING

As a matter of convenience, oftentimes dictated by the types of detection equipment employed, it might be well to divide the total electromagnetic spectrum into a number of wavelength intervals. The names of these intervals, as tabulated below, are generally accepted; the boundaries of these intervals, however, vary from one investigation to another. If man's environmental and biological history had been quite different, perhaps wavelength intervals of a completely different character would have resulted.

1. Gamma Rays	Shorter than 1.0 A
2. X-rays	1.0 A to 100A
3. Ultra-Violet (UV)	100A to 3000A
4. Visible	3000A to 7000A
	or 0.3 μ to 0.7 μ
5. Infrared (IR)	0.7 to 100
6. Microwave	100 to 10,000
	or 0.01 cm to 1.0 cm
7. Radio	1.0 m to 10.0 km and greater
8. "Radio Window"	0.1 cm to 10 m

All except the visible range of wavelengths correspond to five or more octaves of frequencies. The amount of light which we see through the Earth's atmosphere covers a little bit more than one octave of the electromagnetic spectrum. When we add the narrower slots in the optical window and the somewhat larger radio window, the coverage from the ground still does not cover some very important regions of the total spectrum which NASA should cover in order to obtain a satisfactory knowledge of the universe.

The series of spectrum wavelengths, then, gives us one of the important parameters for making observations in outer space, and beyond the turbulent and absorbing layers of the Earth's blanketing atmosphere. Another parameter is the intensity of this radiation, and another is its variation with time for particular coordinates. Inasmuch as it is, perhaps, an impossible task to cover each and