ASTRONOMY

Out from under

Large space telescopes would clear the view from the planets to the edge of the universe

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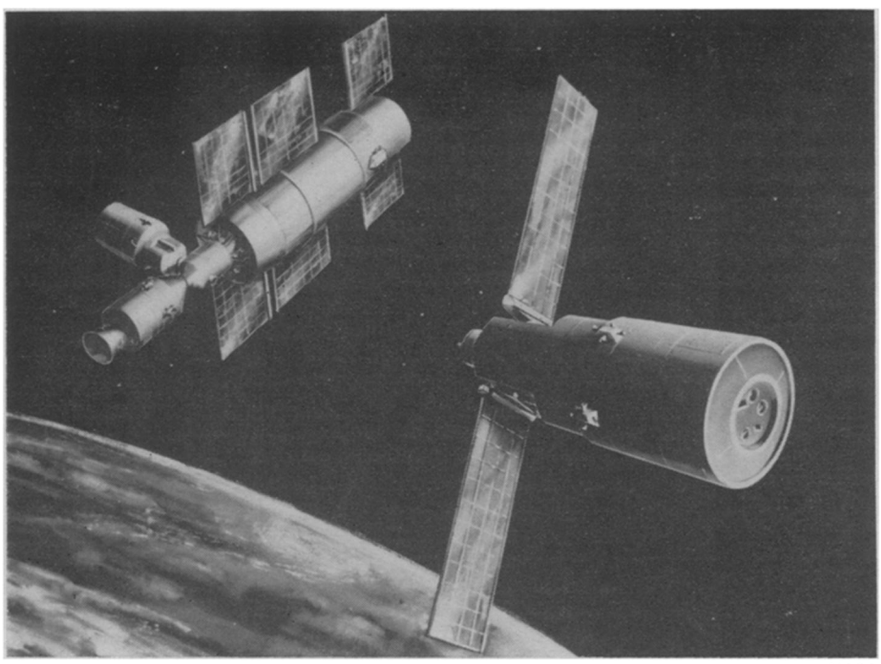

NASA

An astronomy module like this one could carry a large orbiting space telescope.

The larger a telescope is, the more light it collects and the fainter are the objects it can see. The larger a telescope is, the greater is its potential resolving power, its ability to distinguish small objects.

The earth's atmosphere sets limits on the improvements that are possible by increasing the size of telescopes. Light rays passing through layers of air at different temperatures are bent and distorted so that focusing a sharp image is no longer possible. The phenomenon, called twinkling, is visible to the naked eye, and the practical resolution limit of one second of arc for long photographic exposures is reached in quite small telescopes.

The largest earth-based telescopes, such as the 200-inch Hale telescope located on Mt. Palomar, also approach a limit of faint seeing. The atoms of the air give off a faint light, the so-called airglow, which is invisible to the eye, but which provides a background glow strong enough to wash out stars fainter than 23rd magnitude.

Astronomers are therefore very eager to have a large telescope in space, and construction of such an instrument has been recommended in recent weeks by two of the Government's scientific advisory groups, one a committee of the Space Sciences Board of the National Academy of Sciences, and the other the Astronomy Missions Board of the National Aeronautics and Space Administration (SN: 11/15, p. 447).

The telescope would be at least 120 inches in diameter and would be located either in orbit around the earth or on the surface of the moon. Its resolution would be about 0.04 of a second of arc. Space is a darker environment than the atmosphere, and objects as faint as 29th magnitude would be visible to the telescope. Since each magnitude represents a factor of 10 in increasing faintness, 29th magnitude is one millionth as bright as the 23rd magnitude now barely visible to the Hale telescope.

As a further bonus, the absence of the atmosphere and its absorptions means that the same mirror can be used for ultraviolet and infrared ranges invisible to viewers on the earth.

A large space telescope would be a help in almost all the outstanding problems of astronomy, but the Space Sciences Board committee lays special emphasis on the nearest and farthest problems, cosmology and the solar system.

Most astronomers agree that the universe is expanding, but they have never been able to get an accurate measure of the rate of that expansion, the so-called Hubble constant (SN: 12/7/68, p. 575). Studies of galaxies farther away than the present outer limit of about six billion light years could increase the accuracy of the Hubble constant from the present figure of 50 percent and could determine whether it is the same everywhere or whether it changes from place to place. The amount of such a change would determine the curvature of the universe.

Another half-century-old puzzle is the question of the universe's missing matter. Calculations based on current theories and measurements ("if they can be trusted," as the National Academy committee puts it) lead to a conclusion that between 90 and 99 percent of the matter in the universe has not yet been detected. A space telescope's ability to see more distant and fainter objects may help find some of the missing matter.

Closer to home, atmospheric twinkle also affects the images of the planets, making surface details shimmer, jump, and appear and disappear in front of the observer's eyes. It has always been hard to get different astronomers to agree on what they have seen on the surface of a planet. The controversy over the supposed canals of Mars that has been running for 70 years is only one of the most spectacular examples.

A large space telescope would be able to see the planetary surfaces clearly. The Academy of Sciences committee acknowledges that it would not be able to see them as closely as space probes, but it would be able to watch them continuously. The telescope could distinguish features 8 kilometers wide on the visible disc of Venus, 11 kilometers wide on the surface of Mars, 120 kilometers wide on Jupiter and 1,100 kilometers wide on Pluto. Such distinction would allow spectroscopic study of selected regions and determination of local temperature profiles for Mars and Venus.

Putting up such a telescope is within the capabilities of present technology. A NASA spokesman says the question of doing it in an era of tight budgets depends on how much Congress and the space agency are willing to spend on it and how many people can be assigned to it. □