NEPTUNE ORBIT OBSERVATORY

■ All modern astronomy rests on an inadequate, and rather shaky foundation—the Earth. The fact that astrophysics and astronomy are, necessarily, observational sciences—until, at least, we are able to put together stars and planets ourselves—makes the observational equipment the very essence of the science.

Necessarily, to date, astronomy must use the Earth and its movements as the basis from which all of its work extends. The distance to the Moon is measured by triangulation, using the surveyed diameter of the Earth as a base line. For a 230,000 mile distance, an 8,000 mile base line is reasonably satisfactory. (Ideal would, of course, be a base line about the same order of length as the distance to be measured.) But for measuring the 93,000,000-odd miles to the Sun, or even the 23,000,000-odd to Venus, it's an inadequate base line.

The base line for measuring the distance to the nearest stars is even less adequate—the 186,000,000 mile diameter of Earth's orbit. First, of course, we don't know that base line accurately, because we have to measure it by using our 8,000-mile Earth base line. Second, even if we knew it accurately, the distances to be measured are light-years, and our base line is in light-minutes. Almost exactly 1,000 light-seconds, which isn't a very adequate base for measuring even the nearest stars.

Space satellites—manned space satellites—will allow us to use enormously better instruments, without the problems of atmospheric interference. But that won't give us an adequate base line for measurements . . . unless the space satellites are at enormously greater distances, and positioned with precisely known accuracy.

Neptune is 2,800,000,000 miles from the Sun; it has an orbit that is very nearly perfectly circular, and with very low inclination to the plane of the ecliptic. (Unlike Pluto, which has a highly eccentric, and highly inclined orbit.) In the year 2011, Neptune will have completed one complete orbit under astronomical observation. The accuracy with which its orbit is known far exceeds anything that could be arranged for an independently orbiting space satellite; Neptune's orbit has been surveyed with meticulous accuracy for more than a century.

Further, the orbit of any space satellite would be unstable; as supplies are brought to it, and men and materials taken away, the mass of the satellite would be continually undergoing small, but significant changes.

Neptune's immense mass wouldn't be subject to such variations. But, unfortunately, Neptune is anything but an hospitable environment; if domes could be built and maintained there, we'd have our instruments sunk in a turbulent atmosphere again anyway.

Space observatories in orbit about Neptune, however, would be tied to Neptune's precisely known positions by simple, highly accurate survey. Neptune's 3,000-mile diameter moon, Triton, moreover, could serve as a location for a fixed base-camp serving the space observatories. It's not going to be desirable to have heavy machine tools mounted in the observatory stations; they vibrate things. Since Triton, too, has been observed over many decades, Triton's orbit also is known with high precision, and the angular relationship Sun-Neptune-Triton can be calculated at any time, with accuracy greater than it could be measured, because many decades of precision observation have smoothed out instrumental errors.

Neptune is almost thirty times as far from the Sun as Earth; not only is the Sun's light and heat decreased by the inverse square law to about 1/900th of what it is at Earth—so are the intensities of solar radio emission, magnetic fields, and particle radiation—the Sun's own super-van-Allen belt system.

The Crab Nebula has been identified as the remains of a supernova that exploded about 1050 A.D.—and also as one of the most intense radio-emission sources in the galaxy. And there is indication that it's also a source of extremely high-energy cosmic rays. Calculations of the white dwarf stellar remains from the supernova blast indicate it has a diameter of about 17,000 miles, and is *still* radiating—despite that minute size! *—at a rate 30,000 times our Sun's!* Surface temperature has been estimated at 500,000°—at which temperature, naturally, almost no light—relatively speaking—is emitted. The star is radiating nearly all of its output in the most extreme ultraviolet and X-ray regions.

Neither of those radiations can pass through an atmosphere; we badly need X ray, cosmic ray, and ultraviolet telescopes, as well as radio telescopes to cover the spectrum we're now missing, or barely detecting.

The Neptune Orbit Observatory would be far better than Earth-satellite observatories not only because of escaping the Sun's flood of similar radiation—but because Earth itself would be a shrieking, howling bedlam of radio transmissions.

Mount Wilson Observatory has had steadily increasing difficulty as Pasadena increased in size, and Pasadena's use of electric lighting increased per capita. Any Earth-satellite observatory could expect a similar problem.

The use of the diameter of Neptune's orbit for triangulating stellar distances would be ideal—within the Solar System, at least, it's the best possible—except for one slight difficulty. It takes too long—one hundred sixty-five years—to get from one end of the orbit to the other.

However, using plates made at Neptune, and plates made at an asteroid observatory, or at a Jupiter satellite observatory, we would have the necessary two-position readings of angles, and would have a base line some 3,000,000,000 miles long.

Incidentally, the materials used in building the space-observatory instruments involve certain problems we've never before had to consider. The difficulties experienced in our space probes have shown us that, in space, you can't just use any handy metal! Where Earth's atmosphere makes the ultra-light metals lithium and sodium unusable due to chemical attack—in space, the lack of atmosphere makes them unusable due to their vapor pressure! They simply sublime away into space.

Even more common metals such as aluminum, copper, zinc, and lead are unusable—they give off a continuous, contaminating cloud of vapor that will condense on anything in the vicinity. The usable metals are the ones you'll find in regular use in high-vacuum devices that are designed to maintain a vacuum, while running hot—nickel, tantalum, tungsten, zirconium, and the quasi-metallic graphite, all of which are used in high-power radio transmitter tubes where both temperature and high vacuum conditions are imposed. ■

In times to come

Next month our cover will be done by a new artist, Lloyd Birmingham, who's done a nice job of presenting a familiar scene . . . under unfamiliar circumstances. Some one of these days, the polar glaciers are going to melt, you know . . . and that white stuff on Greenland alone is up to a mile thick.

H. Beam Piper has the feature novelette, "Naudsonse," which is a nonsense word referring to what nonsense words seem to be . . . when your method of listening to words happens to be a bit different.

The Editor