Neptune on the Horizon

By JONATHAN EBERHART

When NASA launched Voyager 2 in 1977, officials were unwilling to announce that going to Neptune – or even to less-distant Uranus – was part of the plan. Jupiter and Saturn were the only official goals. The spacecraft had to prove itself before planners risked publicly suggesting their vision of a 12-year grand tour of the solar system's four big outer worlds. For the first time in 175 years, a rare alignment of the planets stood to make the adventure possible, but the proposal made planners nervous because of its similarity to a previously considered mission – actually called the Grand Tour – that had been rejected after years of bitter budget and policy disputes.

Yet Voyager 2 survived and made it to Uranus, raising the number of the planet's known moons from five to 15, discovering its unexpectedly tilted magnetic field and photographing its thin rings in a single time exposure. Now the craft is closing in on Neptune for its Aug. 24 closest encounter, and early signs hint this flyby may prove one of the more fascinating.

In 1987, Alexander J. Dessler of Rice University in Houston, then editor of GEOPHYSICAL RESEARCH LETTERS, challenged scientists to venture predictions about the little-understood planet. "Successful predictions are so rare that they are usually regarded as compelling evidence of the underlying theory," he prodded, adding that even unsuccessful ones can help because they "expose defects in the theories, and they sometimes point the way to needed repairs."

The predictions appear in the journal's August issue, while scientists impatiently await the results of the first close study of what is now the solar system's most distant known world. (Ordinarily, Pluto lies farthest from the sun, but at the moment Pluto's eccentric orbit has carried it inside Neptune's.)

The strangest revelation of all may be Neptune's version of rings, suggested by some to be not rings but short arcs (SN: 8/5/89, p.87). According to a group led by Anthony R. Dobrovolskis of NASA's Ames Research Center in Mountain View, Calif., Neptune may also have rings that cross over its poles rather than around its equator. These researchers suggest the possible polar rings may be sustained by the gravity of Neptune's large satellite Triton, which travels nearly backward in its orbit and whose surface, bombarded by charged particles trapped in Neptune's magnetic field (if there is one), may in turn supply particles to the rings themselves.

Dessler's challenge raised numerous other issues. For instance, offers William J. Borucki of NASA Ames, "Neptune is predicted to have 1/19 the lightning flash rate [flashes per square kilometer per second] of Jupiter, and to display most of its lightning activity at high latitudes." This is one of many uncertainties, however, in this case based on the observation that most of Jupiter's lightning showed up in Voyager photos at a latitude of 49°N, more than halfway to the pole, although Saturn's was concentrated at only 9°N.

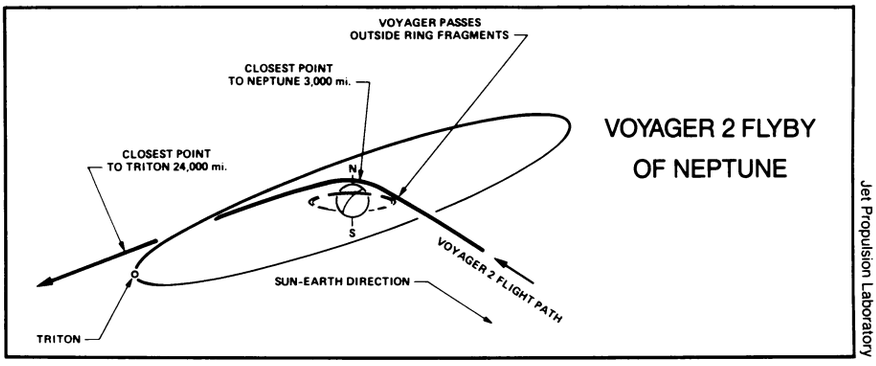
Two other researchers venture to calculate the density of Neptune's ionosphere, but they note that all the electron measurements made at Jupiter, Saturn and Uranus by the Pioneer and Voyager spacecraft turned out to be "considerably lower than the densities expected from the standard ionospheric theory."

Adds Dessler, "There's a mystery brewing about where the radio noise is." Radio signals would provide one of several signs that Neptune has a magnetic field, but although "Neptune is quiet, it's also dark," with the photos showing no indication yet of auroras or other phenomena such as the "electroglow" first discovered (and named) during the Uranus visit. In comparison, Dessler notes, Jupiter's radio emissions showed up as soon as Voyager's instruments were turned on, Saturn's appeared more than six months before the craft reached the planet, and Uranus' emerged with as much as three months to go, although scientists did not realize it until they reexamined their data well after the Uranus encounter.

As of Aug. 8, Neptune was still keeping its apparent radio silence, says Michael L. Kaiser of NASA's Goddard Space Flight Center in Greenbelt, Md. One explanation, says Andrew F. Cheng of the Johns Hopkins Applied Physics Laboratory in Laurel, Md., could be that even a conventionally shaped magnetic field may produce signals undetectable by Voyager 2 if Neptune's field is radically tilted like that of Uranus.

One of the most exciting Neptune findings in recent months – first observed from Earth (SN: 11/12/88, p.310) but now being monitored by Voyager 2 in increasing detail – is a huge circulation pattern in the atmosphere like Jupiter's famous Great Red Spot. Greeted with cheers by space scientists, who were elated that photos from the encounter may be less bland than those of haze-blanketed Uranus, it is but one intriguing aspect of Neptune's clouds.

The craft will fly across the Neptunian north polar cap at an altitude of barely 3,000 miles in the first Voyager encounter that can yield pictures sharp enough to show fluffy cumulus clouds, according to Carol R. Stoker and Owen B. Toon of NASA Ames. These scientists predict that at least 2,000 cumulus clouds per hour (if most are about 120 miles across) will penetrate the visible top of the atmosphere while Voyager 2 looks on.



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Triton may turn out to be another spectacle, its surface possibly ranging from yellow to orange to brown to almost black (if it is not hidden by stratospheric haze) due to a variety of organic sludges. Moreover, according to a group headed by Aaron P. Zent of NASA Ames, the Tritonian pole facing away from the sun may be covered by a thick, frozen nitrogen glaze made of molecules that migrate around from the warmer pole. Such a surface, Zent says, may look less like snow than like a hockey rink, formed of smooth grains each more than a yard long. On the other hand, Voyager may view Triton through dense nitrogen clouds in the atmosphere, with scattered light from smog and the cloud particles making the images even harder to understand.

But for all the fascinating possibilities posed by scientists on Earth, says Dessler, "Neptune is likely to come up with more." □