What's Going on at Neptune?

Just when astronomers thought they might have shown that Neptune has no rings detectable from Earth, along comes last summer's occultation of a star by an apparent ring. Apparent because the evidence is so strong but the implications so odd—even for the bizarre world of planetary rings. If a ring did briefly obscure that star, it was like no other ring known or imagined.

Last summer's occultation has met all the requirements for credibility demanded of it by astronomers. The key is that the observations were made at different sites through different telescopes having filters of different colors. On 22 July, Patrice Bouchet of the European Southern Observatory in Chile and colleagues were using both the observatory's 1- and 0.5-meter telescopes to observe the star for André Brahic of the University of Paris. The star dimmed in both telescopes. That ruled out instrument error.

One hundred kilometers to the south, an observing team headed by William Hubbard of the University of Arizona also recorded the dimming through the 0.5-meter telescope at the Cerro Tololo Inter-American Observatory. That ruled out a cloud or another relatively nearby obstruction. Hubbard's group was observing the bluish planet and the reddish star at three different wavelengths so that Hubbard can state with confidence that only the star was occulted. Only something in the vicinity of Neptune would be likely to block the light from the star and not the light from the planet.

Other characteristics of the occultation leave little doubt that both groups of observers saw the same, real event. It occurred about 0.1 second later in the south than in the north, as would be expected for a true ring occultation. When Hubbard and Brahic first compared their occultation records in detail last month, they found that their profiles of varying light intensity are "virtually identical." Both are V-shaped, about 0.8 second wide at half depth, and equivalent to a loss of about 35 percent of the star's light. That would correspond to a ring about 10 to 15 kilometers wide and about 70,000 to 80,000 kilometers (3 Neptune radii) from the planet's center.

But then there are the oddities. Where both groups should have seen a second occultation as the star passed to the outside of the ring farther around its circumference, they saw nothing like the earlier event. Conceivably, only a fragment of a ring might have been responsible. And the occultation places the apparent ring so far from the planet that only the most accommodating theory would allow ring particles to avoid agglomerating into a satellite.

"I'm willing to accept that they saw part of a ring," says Harold Reitsema of the Ball Corporation in Boulder who is an experienced occultation observer, "but that creates real problems because I don't understand how you get parts of rings." He is not alone. Theory requires that the particles spread to form a complete ring or coalesce into a satellite. Two narrow rings in Saturn's Encke gap do seem to be undetectable in about half of the close-up Voyager images, but in view of all of the negative reports from Neptune observations of the past few years (*Science*, 21 October 1983, p. 311), Hubbard estimates that this "ring" must be undetectable nine times out of ten that a star passes behind it. Perhaps a ring could broaden and thus thin out rapidly enough to render it undetectable a short distance farther around its circumference, but everyone finds that hard to accept.

There may be other strange things going on. In 1981 Reitsema and his colleagues observed another solitary occultation near Neptune, also at a distance of roughly 3 Neptune radii. Because the star's obstruction appeared to be complete and two nearby telescopes recorded it while a third did not, it seemed reasonable that a satellite at least 180 kilometers in diameter had blocked the star. A small satellite is not so odd, but catching one occulting a star was a 1000 to 1 shot, unless there is a whole belt of them. Elsewhere small, inner satellites and rings go hand in hand.

The latest occultation has reinvigorated the search for Neptunian rings, but astronomers are still mostly mystified—such strong evidence and such confusing implications. Galileo must have felt the same way. He died decades before Huygens figured out that Galileo's discovery of Saturnian "companions" is actually a system of rings.—RICHARD A. KERR

garding T-cell recognition of antigen. The T-cell receptor can only be activated by a foreign antigen when it is presented on a cell surface in conjunction with an appropriate histocompatibility molecule. After arguing for many years, most immunologists have come to the view that the same T-cell receptor recognizes the foreign antigen and the histocompatibility molecule together. (The opposing view is that there is one receptor for the antigen and a separate one for the histocompatibility molecule.)

Davis proposes that the β-chain may be the one that interacts with the histocompatibility molecule. He finds them to be distinctly more variable in amino acid sequence than are α-chains. "There is quite a lot of variability," he says of the β-chains. "Moreover, you find it in places where you don't find it in immunoglobulins [antibodies]." In his view, the extra regions of high variability might form the recognition site for the histocompatibility molecule. The remaining hypervariable regions, which are comparable to those of antibody proteins, would then bind antigen.

Hood, who has also compared amino acid differences among β-chains, does not think that the data provide convincing evidence for the existence of the extra hypervariable regions, however. In addition, he points out that recent studies have shown that antigen contacts with antibody may extend beyond the antibody's three hypervariable regions. If the T-cell receptor is similar, then its antigen-binding region might extend into the postulated histocompatibility-recognizing areas.

However the T-cell receptor binds antigen and histocompatibility molecule, one immediate consequence, according to Lawrence Samelson, who works with Ronald Schwartz at the National Institute of Allergy and Infectious Diseases, is the addition of a phosphate group to a 20-kilodalton protein that is closely associated with the receptor in mouse T cells. The finding suggests that the T-cell receptor may be on the same footing as numerous other receptors, including those for growth factors, hormones, and neurotransmitters, in which activation results in a phosphorylation event. Moreover, the 20-kilodalton protein may be the murine analog of the "T3" molecule that participates in the activity of the human T-cell receptor.

Another consequence of T-cell receptor activation, as shown in several laboratories, is a flow of calcium ions into the cell and a stimulation of the production of interleukin-2, which is also called T-cell growth factor, and its receptor. As a