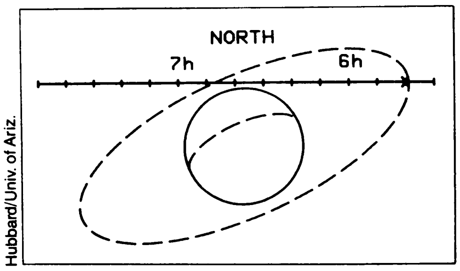
Signs of a puzzling ring around Neptune

Combined observations from two observatories have yielded strong evidence of a ring around the planet Neptune, the only one of the solar system's four giant worlds for which no ring has heretofore been confirmed. "But if it's a real ring," says James L. Elliot of Massachusetts Institute of Technology, one of the discoverers of the rings of Uranus, "it's not like any other one we've seen so far."

Last July 22, Neptune passed near the star SAO 186001 (as seen from earth), and a number of astronomers arranged to observe the event. At such times in the past, blockages, or occultations, of a star's light have revealed rings (such as Uranus's) and previously unsuspected satellites, as well as providing precise measurements of a known planet's size. SAO 186001 did not pass behind Neptune itself, but Patrice Bouchet and colleagues at the European Southern Observatory in Chile, observing for Andre Brahic of the University of Paris, did note one brief occultation, lasting barely a second and reducing the star's light by only about 35 percent. About 100 kilometers away at the Chilean Cerro Tololo observatory, Faith Vilas from the University of Arizona in Tucson got an almost identical result.



Hubbard/Univ. of Ariz.

Apparent path of star SAO 186001 beyond Neptune on July 22, 1984, actually represents two parallel tracks about 90 kilometers apart (indistinguishable at this scale). Brief blockage of the starlight for a similar period along both tracks (dot with X) suggests occultation at two points along a ring, though neither track showed an occultation where the ring should have crossed it again. (The dashed line is three Neptune radii distant from the planet's center.)

Two such findings for the same location in space, both supported by precise recordings of their data, would normally be taken as evidence of a satellite. But the two Chilean observations, says William Hubbard of the University of Arizona, were of locations about 90 km apart, while the duration of the occultations indicates that the starlight was being blocked in each case by an object only 10 to 20 km wide — hardly the likely dimensions of a moon. The likeliest inference, according to Hubbard and Brahic, is that the star passed behind a Neptunian ring, which kept its light from reaching either observatory.

A mystery, however, is that neither group detected any occultation where the other side of the ring should also have blocked out the star. Could the ring be somehow broken or incomplete? (There are signs of a "partial" ring in Voyager photos of the Saturn ring system's Encke division, Brahic notes.) Could part of it be "kinked" out of the way or otherwise distorted by the presence of satellites or other factors? Or might part of it be so wide that its density gets too low to cause an occultation — or so narrow that it simply did not show? "There is more diversity in the solar system," says Brahic, "than in the brains of bright theorists."

— J. Eberhart

West Coast shuttle delay

The first West Coast launching of the space shuttle, which had been tentatively scheduled for Oct. 15 (SN: 1/12/85, p. 28), has been postponed until no earlier than Jan. 29, 1986. Planned as the second classified Defense Department shuttle mission (the first has been set for next week), it is to take off from Vandenberg Air Force Base in California, enabling the craft to enter its first near-polar orbit. The delay is attributed to problems with thermal-protection tiles on the shuttlecraft Challenger, and to the need for additional time to ready the flight's payload. □

Quasicrystals: A new ordered structure

For decades, crystallographers have assumed that the solid state was an orderly place where crystals were made up of atoms arranged in neat patterns that repeated themselves at regular intervals. Successive steps of the right length along any given direction within this lattice would take a microscopic traveler to new locations indistinguishable from the starting point. The conventional wisdom was that crystals must have this kind of periodic structure. This complacency was shattered recently when a group of researchers discovered a material that doesn't fit the traditional rules of crystallography.

The new material, a metallic solid discovered by Daniel Shechtman of the Israel Institute of Technology while he was working at the National Bureau of Standards (NBS) in Gaithersburg, Md., is an alloy of aluminum and manganese. When a beam of electrons bombards this solid, the electrons scatter to form a set of sharp spots indicating that the material's atoms are highly ordered. At the same time, however, the pattern created by the spots implies that the crystal's atoms can't be arranged within a regularly repeating, or periodic, framework.

The result was so surprising that "we stalled for a good long time" before publishing details, says NBS materials scientist John W. Cahn. "All my training had been with this assumption that crystals are strictly periodic." More than a year after the discovery, their report appeared in the Nov. 12 Physical Review Letters. The researchers plan to present additional findings at a meeting in March.

The alloy discovered at NBS may be an example of a new class of structures that "sit somewhere between the crystal and glass state," says Paul J. Steinhardt, a physicist at the University of Pennsylvania in Philadelphia. Several years earlier, Steinhardt and a colleague had been studying the structure of glasses by simulating on a computer what happens to atoms in a liquid as it cools below its melting point. These studies led him to look for a "quasicrystalline" structure that was highly ordered but not periodic. He found such an example in two dimensions in the work of British mathematical physicist Roger Penrose, who looked at ways of laying tiles of particular shapes to cover a floor without creating a repeating pattern — the kind of problem mathematicians explore just for fun.

Steinhardt extended one Penrose tiling scheme to three dimensions, coming up with two shapes, both looking like squashed cubes or rhombohedra. Groups of these shapes fitted together to fill space in a pattern that showed the same symmetry as an icosahedron (a 20-sided solid with triangular faces) but was "quasiperiodic" instead of periodic. Last fall, just after he had calculated what an electron diffraction pattern for that structure would look like, he saw the NBS paper and its diffraction pattern.

"It was quite exciting," says Steinhardt. "There the two were, sitting right next to each other, the result of completely disconnected pieces of work." The two patterns were very similar. Steinhardt and Dov Levine quickly reported the possible existence of "quasicrystals" in the Dec. 24 Physical Review Letters.

"This model looks very promising," says Cahn. Because periodicity was built into so much of the study of the properties and nature of solids, "almost everything has to be reexamined," he says. Various groups throughout the world have already started to look at how the properties of such a material would be different from those of an ordinary crystal. Others are trying to find different combinations of metals that cool to form larger and more pure quasicrystal samples.

"It's not every day that one comes across a new kind of atomic structure," says Steinhardt. "There's the obvious hope that something really interesting will come from it."

— I. Peterson