Voyager reveals a turbulent Neptune

by Marsha Freeman

After a twelve-year journey the Voyager 2 spacecraft came within a little more than 3,000 miles of the cloudtops of Neptune on Aug. 24, giving scientists their first close look at the giant planet. Neptune is Voyager's final planetary encounter, after a magnificent series of discoveries at Jupiter, Saturn, and Uranus.

Neptune is so far from Earth, nearly 3 billion miles, that ground-based telescope observations are very tenuous. So little was known about the eighth planet, that scientists knew that whatever Voyager found there would be a surprise. When Voyager began to reveal that this cold and dark world had huge Jupiter-like storms, fast-moving and changing cloud systems, and Saturn-like irregular rings, scientists knew that Neptune would turn out to be a considerably more exciting planet than the virtually featureless Uranus.

Neptune is the first planet discovered by theoretical calculation, and only later found through telescopic observation, due to its distance from the Earth, and its distance from the Sun which makes the light intensity there about half that at Uranus. Due to its long period of revolution around the Sun, 165 years, Neptune has not completed a full year since it was discovered in 1846.

As Voyager came closer to Neptune, a huge dark spot in the center of the planet became visible. As the spacecraft moved toward closest encounter, it was revealed that this dark spot has above it streamers of white, whispy clouds, traveling at a higher altitude and different speed than the probably violent weather system underneath.

As imaging scientists tried to determine the speed of rotation of these atmospheric phenomena, their task was made more difficult by the fact that the white clouds were forming, and breaking up and disappearing within hours. Images of the same area taken merely two and a quarter hours apart were so drastically different, it was impossible to track any single feature.

Scientists could not tell whether new clouds had formed while others had disappeared, or whether clouds had just quickly moved to other regions above the great dark spot. This has, so far, hampered the effort to more precisely determine the rate of rotation of the clouds, as compared to the 18-hour rotation of the surface of the planet.

One of the mysteries which will probably be solved by more thorough analysis of the Voyager data received in the last week of August, will be Neptune's rings. Since 1984, ground-based observations indicated there were as many as six ring arcs, or partial rings, around Neptune. When Voyager came closer, it found one complete ring closer to the planet than the ring arcs, which had never been imaged on Earth at all. On Aug. 22 imaging team leader Dr. Bradford Smith announced that Voyager had found the first complete ring around Neptune.

He also announced that more material was being seen in the incomplete ring. Scientists now have matched three of the six ground-observed ring segments or arcs to one single ring which initially did look like only a partial structure. On the following day, Voyager project scientist Dr. Ed Stone explained that it is possible that other ground observations were of the small moons of Jupiter, and not material from a ring.

The most detailed data about the rings will be produced from information Voyager collects for the two days after the closest encounter at the planet, as the spacecraft looks back toward Neptune, on the other side of the Sun, using its photopolarimeter to measure the light of a distant star through material in the rings.

Triton

The second moon in the Solar System to have an atmosphere, Triton, has also proved to be an exciting object. Days before its close encounter, Voyager had revealed a moon with a sharp difference between its northern and southern hemispheres. Because of the angle at which Voyager was approaching Triton, the southern hemisphere was most visible, and had a mottled, clouded look to it.

In the northern half above the equator was a darker region, and there appeared to be a bluish fringe between the two. Nothing blue has been observed at any other body in the Solar System. Scientists have proposed that the same atmospheric light-scattering that produces Earth's blue sky, may be responsible for the color on Triton. Because the atmosphere contains methane, the light at the red end of the spectrum is being absorbed, leaving the bluer color.

On Aug. 25, after the close-up images of Triton had started to reach Earth, craters, volcanic calderas, flow patterns, frozen lakes, and other possible surface features were revealed. Dr. Larry Soderblom summarized what had been revealed so far of the Neptunian system, by saying that it is like having Jupiter orbited by Mars.

Over the next days and weeks, scientists will be poring over the wealth of new data Voyager's instruments have collected. Many of the most exciting discoveries cannot be made within minutes of the real-time images being received on Earth, because the moons are so small, the rings so tenuous, the atmospheres of the planet and Triton so active, and the lighting at the planet and signal from Voyager so faint, that the most sophisticated technology in existence has to be applied to coax discoveries from the data.