Voyager Bulletin

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Voyager 1 Wins Space Award

The Veterans of Foreign Wars of the United States have awarded their National Space Award Gold Medal and citation to the Voyager Project for the success of Voyager 1 at Jupiter last March. Accepting the award at the VFW annual convention in New Orleans was Mission Director Dick Laeser, standing in for R. J. Parks, project manager at the time of Voyager 1's Jupiter encounter. The text of the citation reads:

> *"A brilliant effort teaming professional knowledge, technology, and man's urge to conquer the unknown will lead to vehicles of human design to complete the initial reconnaissance of all the planets of the solar system in the first half century of the Space Age."*

Quiet Period Near an End

A six-week "quiet period" coinciding with the spacecraft's solar occultations is nearing an end. Due to the position of the Sun between Earth and the spacecraft, data reception from both ships has been poor, but the radio science team has taken this opportunity to study the effects of the Sun on the signals.

Voyager Watches Pioneer 11 and Saturn

"Come on through – the rings are great!"
(Pioneer 11 to Voyager)

A. Thomas Young
Deputy Director
NASA/Ames Research Center

As the world awaited word of its fate on September 1, Pioneer 11 swooped down past the outer edges of Saturn's rings, below the rings, past Saturn's cloud tops, and up again, out into deep space, with hardly a jolt to its systems.

Voyager 2 will take nearly the same path when it reaches the planet in August, 1981, crossing the ring plane at approximately the same point as Pioneer 11's inbound ring crossing.

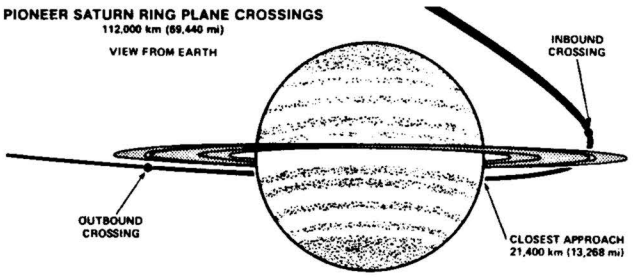
Many of Pioneer's findings will heavily influence detailed planning now underway for the Voyager flybys of Saturn. Of particular interest are the intensity of trapped radiation near the planet, the ring composition and density, rotation rates of material at various latitudes, and interesting weather features.

Ground-based telescopic observations have identified three or possibly four rings around Saturn, the second largest planet in our solar system and sixth in distance from the Sun. But the content of the rings has been the subject of much scientific debate – whether the particles are totally water ice or icy-coated rocks, how large, and how dense. Initial results from Pioneer 11 indicate that the rings may consist of many layers of snowball-sized particles which contain more water ice than rock.

In addition, Pioneer 11's imaging photopolarimeter detected a narrow ring of particles, the "F ring", outside the A ring, while the charged particle detectors reported a broader area, the "G ring", even farther from the planet. Unable to detect two other suspected rings (an outer E ring and inner D ring) from Pioneer, astronomers will study Saturn through telescopes this fall and winter when the rings will be edge-on to Earth.

When Pioneers 10 and 11 were rocked by sizzling and turbulent radiation along Jupiter's far-reaching magnetic field lines, the Voyager spacecraft were in the assembly stage. Parts were exchanged for more radiation-tolerant parts, electronic circuits were modified, additional radiation shielding was added to each spacecraft, and both Voyagers survived their passages near Jupiter with little damage.

The extent of Saturn's radiation was unknown until Pioneer 11's flyby. As the spacecraft passed below the



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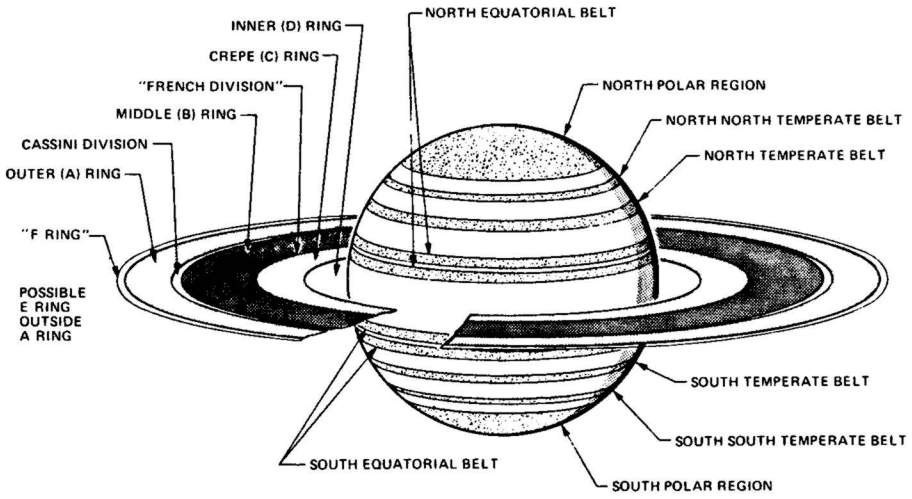

	km	mi
SATURN DIAMETER	119,000	74,000
FROM SATURN TO –		
C RING	12,570	7,810
B RING	31,730	19,720
CASSINI DIVISION	56,870	35,340
A RING	61,660	38,320
OUTER EDGE OF A RING	77,250	48,000
F RING	80,470	50,000

rings, the radiation intensity readings dropped dramatically, indicating radiation absorption by the rings.

Until Pioneer 11 crossed Saturn's bow shock on August 31 at a distance of about 1.4 million km (895,000 mi) from the planet, it was uncertain if Saturn even possessed a magnetic field. The bow shock is the line at which supersonic particles streaming from the sun are slowed to subsonic speeds near a planet's magnetic field boundaries. A planet's magnetic field tends to trap radiation particles and sweep them around in space with the planet's rotation.

Saturn's magnetic pole may be offset from its spin axis by as little as 1°, making it unique among planets. Most of the planets thus far studied have an offset of about 10°, causing a wobble in their rotating magnetic fields and allowing definition of precise longitudinal lines for mapping and tracking features.

Dynamo currents of magnetic fields are thought to exist in the metallic hydrogen below the outer gaseous atmosphere. Saturn's field source is deeper within the planet than at Jupiter, resulting in a more regular magnetic field.

The regular magnetosphere and low radiation levels bode well for the oncoming Voyagers.

Like Jupiter, Saturn has no solid surface and ground-based observations have revealed bandedness in its atmosphere similar to Jupiter's belts and zones. Pioneer images suggest there may be twice as many belts and zones on Saturn. Preliminary analysis shows a scalloped region suggestive of a jet stream below the north polar region, and another scallop at the northern edge of the equatorial zone, suggestive of an upwelling feature.

Already a focal point for Voyager's explorations because of its methane atmosphere, Saturn's largest satellite Titan has become even more interesting as it is sometimes inside, sometimes outside, Saturn's magnetosphere, due to varying pressure of the solar wind.

Ten minutes after crossing the ring plane on its inbound journey, Pioneer 11's charged particle instruments detected the deep shadow of a body with a radius of about 100 to 300 km at about 150,000 km (93,200 mi) from the planet's cloud tops. The spacecraft was about 2500 km (1550 mi) below the ring plane. This body may be the same as a body detected by the imaging system a few days earlier, and both may be sightings of Janus, the innermost and smallest of Saturn's ten known satellites.

Launched on April 5, 1973, Pioneer 11 was never intended to see Saturn. It was the second man-made object to successfully traverse the then-unknown region of the asteroid belt between the orbits of Mars and Jupiter, and also the second spacecraft to observe Jupiter, in December 1974. However, at that point, a decision was made to slingshot the sturdy craft 167 degrees back across the solar system to its bonus encounter with Saturn. In six years, Pioneer 11 has crossed two billion miles of space. Now it will head out of the solar system and toward the stars, in almost exactly the opposite direction of Pioneer 10, which encountered Jupiter in December 1973 and has already crossed the orbit of Uranus.

Weighing 258 kilograms (568 pounds) at launch, Pioneer 11 carries 12 instruments and conducts 14 investigations. Spinning constantly for stabilization (at a rate of 7.8 revolutions per minute at Saturn), Pioneer is powered by two radioisotope thermoelectric generators and carries a 9-foot-diameter dish antenna which points toward Earth to send and receive signals through the Deep Space Network.

The Pioneer missions are managed and controlled for NASA by Ames Research Center, Mountain View, California. The spacecraft was built by the Space Systems Division of TRW, Redondo Beach, California.

Pioneer 11's success strengthens Voyager 2's prospects of encountering Uranus in January, 1986. Voyager 2 is currently on a trajectory which will take it to Uranus after its Saturn Encounter in August 1981, but its flight path could be changed should Voyager 1 fail to meets its objectives at Saturn for any reason – including damage from radiation or ring particles, which now appears unlikely. Voyager 1's trajectory was chosen specifically to observe Titan at close range, while Voyager 2's flight path was specifically chosen to allow a flyby of Uranus.