Voyager 2

Encounter with Saturn

Press Kit

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CONTENTS

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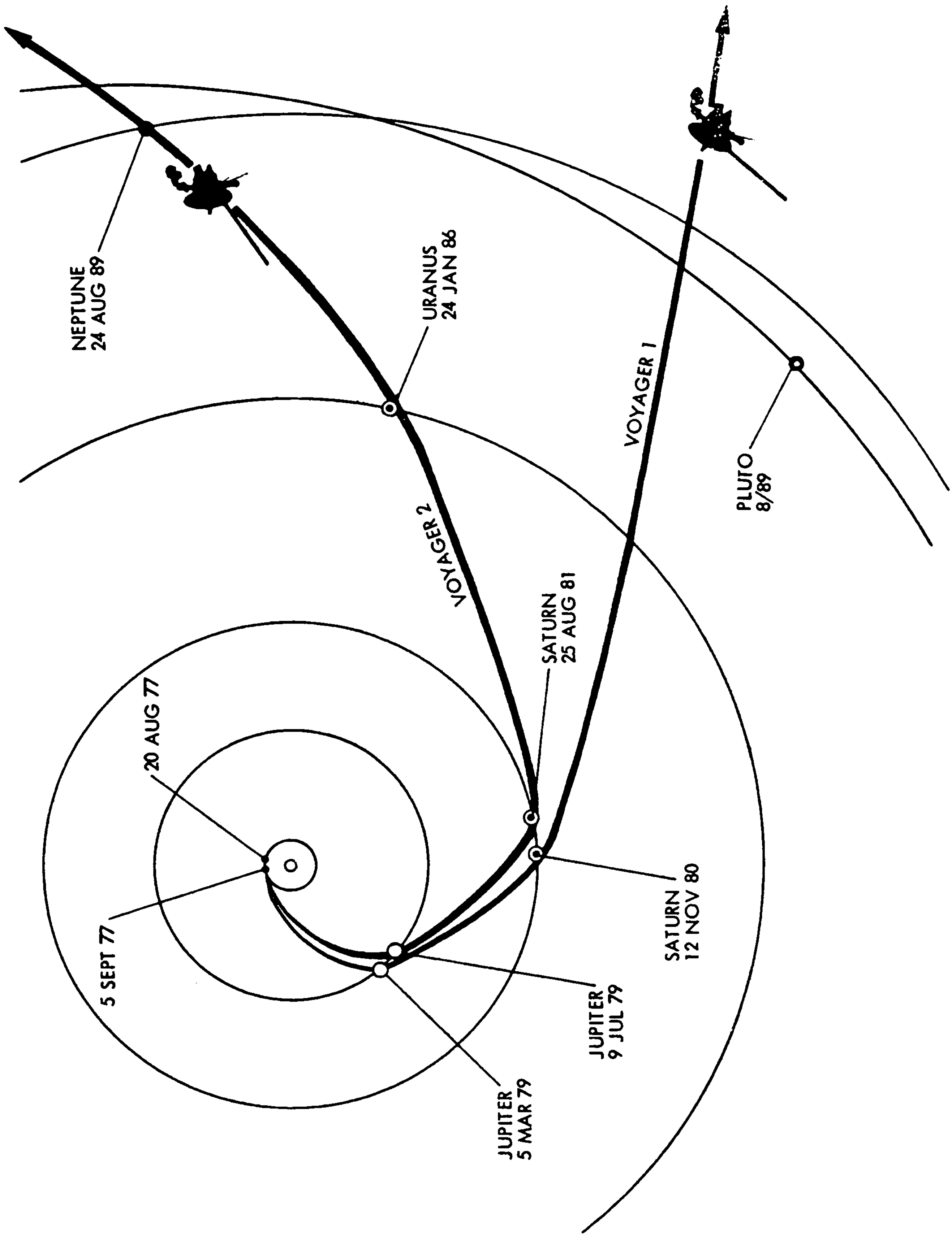
VOYAGER 2 TO MAKE CLOSEST ENCOUNTER WITH SATURN IN AUGUST

NASA's Voyager 2 will reach Saturn Aug. 25, 1981, with closest approach occurring at 8:25 p.m. PDT, as it passes 101,000 kilometers (63,000 miles) above the planet's cloud tops.

Voyager 1 flew past Saturn Nov. 12, 1980, and is moving out of the ecliptic plane of the solar system, searching for the heliopause, the limit of the solar wind. Barring any serious spacecraft subsystem failure, Voyager 1 could continue to return scientific data into the next century.

Voyager 2, launched Aug. 20, 1977 from Cape Canaveral, Fla., will travel another 2.84 billion km (1.76 billion mi.) to a Uranus encounter in January 1986, then on to a rendezvous with Neptune in August 1989.

July 29, 1981


NEPTUNE
24 AUG 89
URANUS
24 JAN 86
VOYAGER 1
PLUTO
8/89
VOYAGER 2
SATURN
25 AUG 81
20 AUG 77
SATURN
12 NOV 80
5 SEPT 77
JUPITER
9 JUL 79
JUPITER
5 MAR 79

Before Voyager 1's Saturn encounter, project officials planned that Voyager 2's studies of Saturn, developed over two years, would be revised based on scientific data returned by the first spacecraft. So many unexpected and unexplained phenomena were observed by Voyager 1 in the Saturnian system that Voyager 2 was extensively reprogrammed in flight to tailor its encounter to further explore the results from the first Voyager.

Saturn's rings, for example, unparalleled in the solar system, were found by Voyager 1 to be even more complex in their structure and dynamics than previously believed. Voyager 2 will pinpoint areas of the ring system to be extensively studied. Conversely, science objectives for Voyager 1's study of the large satellite Titan were achieved, so time that might have been devoted to further photographic coverage of Titan by Voyager 2 will instead be used on new images of the rings, planet and other satellites. Additional remote sensing of Titan, however, is planned.

More than 18,500 photos of Saturn, its rings and satellites will be taken by Voyager 2. When the post-encounter period ends Sept. 28, 1981, both Voyagers will have returned more than 70,000 photographs of Jupiter, Saturn, their rings and satellites.

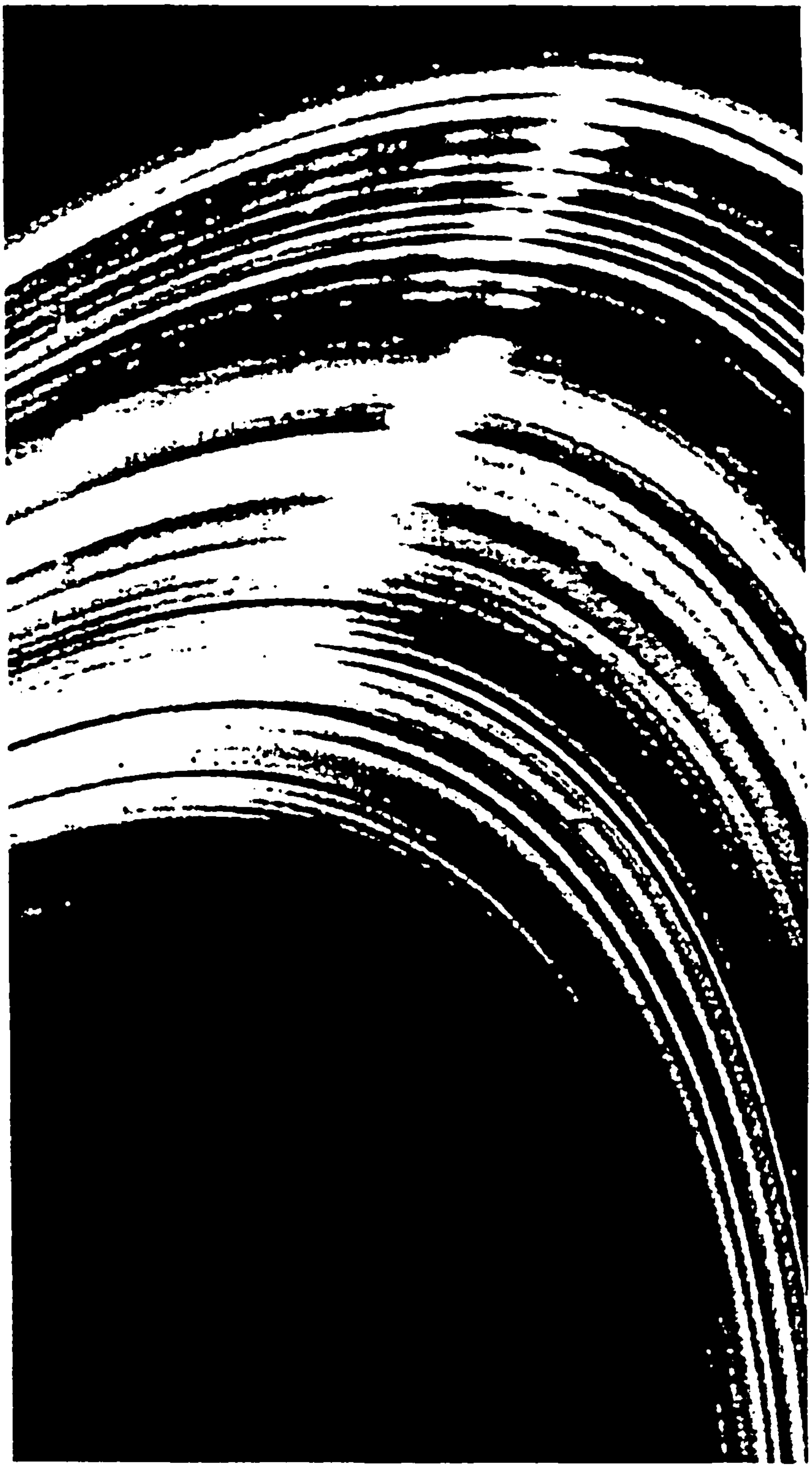
During Voyager 2's flight over Saturn's ring plane on Aug. 25, the spacecraft's photopolarimeter (located on the movable scan platform) will be aimed at the star Delta Scorpii, on the opposite side of the rings and more than 989 light years away.

Measuring the star's light as it flashes through the ring material could provide the best data so far on the number of ringlets, their densities and widths, and the widths of the gaps between them. The experiment will occur from 4:42 p.m. to 7 p.m. PDT and cover 70,000 km (43,000 mi.) of the rings from the limb of the planet to the F-ring.

The second occultation of the star by the rings will occur about nine hours after Voyager 2 has passed Saturn. As the spacecraft looks back at the planet, the star Beta Taurii, 180 light years away will be tracked by the photopolarimeter for about 40 minutes, as the star flashes through the F- and outer A-rings. The photopolarimeter will resolve ring material as small as 100 m (328 ft.).

A different radio occultation of Saturn is expected from Voyager 2 than Voyager 1. Voyager 2's radio signals will not penetrate to deeper cloud layers, but the spacecraft will fly across a more constant latitude (from about 20 degrees north to 20 degrees south), providing a more even sampling of the planet's atmosphere.

Voyager 2 will closely study the spokelike features of the B-ring discovered by Voyager 1. The spokes emerge from the planet's shadow and seem to dissipate after a few hours. They may be the product of fine ring material suspended above the ring plane, possibly a result of electrostatic charges. The spacecraft's cameras will photograph the spokes as they move about the planet.



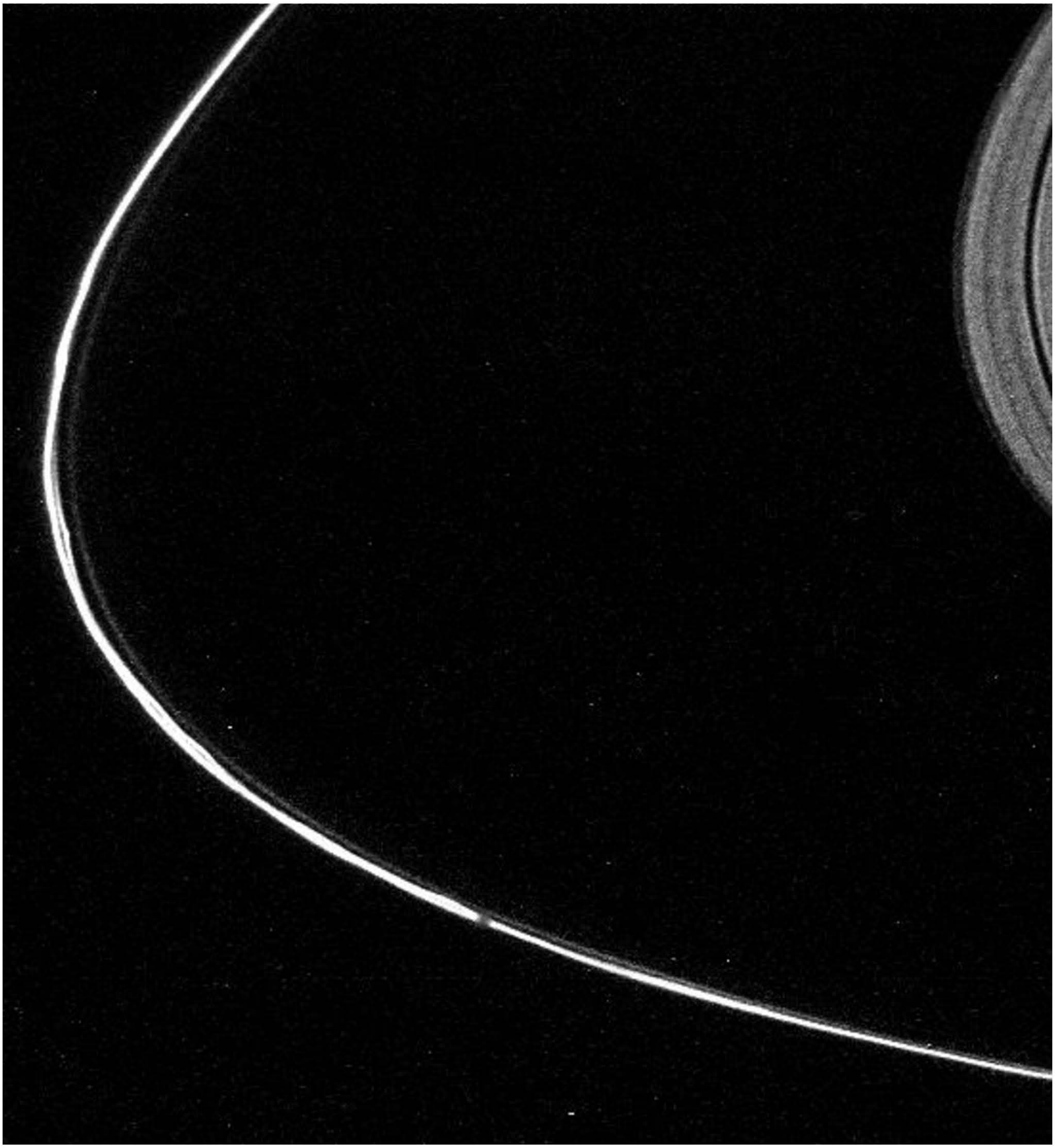
Spokelike features in Saturn's rings are bright areas in this image taken by Voyager 1 on Nov. 13, 1980. In this view, concentric structure in the B-ring increases contrast and accentuates hundreds of ringlets.

As the spacecraft moves through the ring plane, the cameras will photograph the rings edge-on, searching for signs of possible clouds of small particles elevated above the rings. The planetary radio astronomy experiment will search for electrical emissions originating near the spokes.

The apparent twisted and clumped appearance of two of the three visible strands of the F-ring will be the subject for pseudo-stereo imaging, in which photographs taken from different angles will be combined for a three-dimensional view of the ring. Sequences of images should reveal whether the structure of the F-ring changes with time.

As Saturn was the final planetary encounter for Voyager 1, its trajectory was designed to maximize the science return from the encounters with little regard to where the spacecraft would travel after Saturn. For Voyager 2, the aim point at Saturn was defined solely by the requirement to continue the trajectory to Uranus. The arrival time at Saturn, however, was selected to allow closer approaches to several moons viewed more remotely from Voyager 1.

Voyager 2 crosses the potentially hazardous ring plane only on its outbound leg (Voyager 1 crossed the ring plane at different distances both inbound and outbound) at about 111,800 km (69,500 mi.) from the cloud tops, just 1,200 km (745 mi) outside the orbit of the G-ring which is only approximately located by a single Voyager 1 photograph. (Voyager engineers expect the spacecraft to clear the G-ring by 1,200 km or 745 mi.)



Visible in this image, taken by Voyager 1 on Nov. 12, 1980, is the braided and clumpy appearance of Saturn's F-ring, due possibly to the gravitational effects of the two nearby satellites.

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The ring plane crossing occurs while the spacecraft is blocked from Earth view, so reacquisition of communications after occultation will signal the safe crossing through the plane.

Voyager 2 will pass 23,000 km (14,300 mi.) closer to Saturn than did Voyager 1. In addition, the spacecraft will make closer approaches to the satellites Enceladus, Tethys, Hyperion, Iapetus and Phoebe.

Both Voyagers used Jupiter's gravity to change their flight paths in order to fly on to Saturn. More significantly, spacecraft velocity was increased by approximately 56,300 km per hour (35,000 miles per hour). A similar gravity-assist swingby of Saturn is required for Voyager 2 to fly to Uranus. In turn, the Uranus gravity boost will direct the spacecraft toward Neptune.

The velocity increases shorten flight times, making it possible to send spacecraft beyond Jupiter within reasonable time frames. For example, a direct flight to Saturn could take eight years. Gravity assist makes the trip possible in half that time.

Saturn is the sixth planet from the Sun and the second largest in the solar system. Like Jupiter, it is a giant sphere of gas -- mostly hydrogen and helium with a small core of molten rocky material. But unlike Jupiter, Saturn's dark belts and light zones are muted by a thick haze layer above the planet's visible cloud tops.

Saturn generates almost two-and-a-half times the amount of heat it receives from the Sun, a phenomenon which is probably due to gravitational separation of helium (which accounts for about 11 percent of the upper atmosphere) and hydrogen.

Winds as high as 1,800 km (1,100 mi.) an hour blow eastward at Saturn's equator. The velocity decreases to near zero at about 35 degrees latitude north and south.

The planet takes 29.46 years to complete one orbit around the Sun, which is approximately 1.42 billion km (886 million mi.) away. A day on Saturn lasts 10 hours, 39 minutes, 26 seconds (as determined by Voyager 1 last year).

Until four years ago, Saturn was believed to be the only planet encircled by rings. But both Jupiter and Uranus were discovered to have thin, barely visible rings. (The Jovian ring was discovered by Voyager 1.) Saturn's rings, however, are much richer in material, mostly chunks of ice and rock ranging in size from dust grains to huge boulders many tens of meters in diameter.

Before Voyager 1's arrival at Saturn last year and the discovery of several hundred "ringlets," the rings were thought to consist of perhaps six individual rings; from the planet outward, they are the D-, C-, B-, A-, F- and E-rings. The dusty G-ring, which was first photographed by Voyager 1, is the innermost ring orbiting about 109,000 km (68,000 mi.) above Saturn's cloud tops.

The Cassini and Encke Divisions visible in Earth-based telescopes were thought to be empty of material, but Pioneer 11 detected material within the gaps, which Voyager 1 discovered to be ringlets. Voyager 2 will study the detailed ringlets within the Cassini Division to see if their structure has changed in the nine months since Voyager 1's visit.

Saturn is now known to have at least 17 satellites. Three were discovered by Voyager 1, and two were discovered in ground-based observations since Voyager 1's encounter.

The innermost satellite, discovered by Voyager 1, is temporarily designated 1980S28,(i.e., the 28th observation of a Saturnian satellite in 1980), and is about 40 by 20 km (25 by 12 mi.) in diameter. It orbits within 76,970 km (47,800 mi.) of the cloud tops just outside the A-ring.

The next two satellites, also discovered by Voyager 1, are 1980S27 and 1980S26. These serve as shepherding moons, maintaining the edges of the braided F-ring. They are both approximately 200 km (124 mi.) in diameter and orbit 79,070 km (49,130 mi.) and 81,370 km (50,560 mi.), respectively, from Saturn's cloud tops.

Two small moons, 1980S3 and 1980S1 share an orbit about 91,120 km (56,600 mi.) from the cloud tops. 1980S3 is 90 by 40 km (55 by 25 mi.) in diameter; 1980S1 is 100 by 90 km (60 by 55 mi.).

A satellite sharing the orbit of Dione is 1980S6, about 160 km (100 mi.) in diameter. It orbits about 60 degrees ahead of Dione at a distance of 318,270 km (197,760 mi.) above the cloud tops.

The two satellites discovered in ground-based observations occupy Tethys' orbit; 1980S25 orbits about 60 degrees behind Tethys, while 1980S13 orbits about 60 degrees ahead. They appear to be about 30 to 40 km (20 to 25 mi.) in diameter.

Nine satellites whose existences have been known for some time are (from the planet outward) Mimas, Enceladus, Tethys, Dione, Rhea, Titan, Hyperion, Iapetus and Phoebe.

Each Voyager uses 10 instruments and the spacecraft's radio system to study the planets, their satellites, rings, the magnetic and radiation regions surrounding the planets, and the interplanetary medium.

Each Voyager carries telescope-equipped television cameras, a cosmic ray detector, an infrared interferometer spectrometer, a low-energy charged-particle detector, magnetometers, a photopolarimeter, a planetary radio astronomy receiver, a plasma detector, plasma-wave instrument and ultraviolet spectrometer. Each spacecraft is comprised of 65,000 individual parts.

Voyager 2 was launched Aug. 20, 1977, from Cape Canaveral, Fla., aboard a Titan-Centaur rocket combination. Two weeks later, on Sept. 5, Voyager 1 was launched on a faster, shorter trajectory and sped past its twin before the end of the year.

By the time Voyager 2 reaches Saturn, it will have traveled more than 2 billion km (1.24 billion mi.) and will have consumed about 15,000 kilowatt hours of power supplied by an array of three radioisotope thermoelectric generators.

The Voyager 2 Uranus and Neptune encounters are dependent upon the condition of the spacecraft subsystems.

Voyager 2's primary radio receiver, with which the spacecraft receives commands and data to update its on-board computers from Earth, failed April 5, 1978; continuation of the Voyager mission depends upon the health of the remaining backup radio receiver on the spacecraft.

Should the backup receiver fail, a sequence of commands (backup mission load or BML) sufficient to operate the spacecraft for four years on the Uranus leg and through a minimal encounter science sequence will be stored in the spacecraft's computer command subsytem after completion of the Saturn encounter.

Both Voyagers will escape the solar system at velocities of nearly 59,550 km/hr (37,000 mph). The two spacecraft may reach the heliopause within 10 years. Even at these speeds, however, more than 40,000 years will pass before Voyager 1 flies within 1.6 light years of the star AC+793888 near the constellation Ursa Minor; in 358,000 years, Voyager 2 will pass within 0.8 light years of Sirius, now the brightest star in the heavens.

Both spacecraft were designed and built by the Jet Propulsion Laboratory, Pasadena, Calif., a NASA-owned facility operated for the space agency by the California Institute of Technology. The Jet Propulsion Laboratory manages the Voyager project for NASA.

NASA program manager is Frank A. Carr, and Dr. Milton A. Mitz is NASA program scientist. The Voyager project manager is Esker K. Davis, JPL, and Dr. Edward C. Stone, California Institute of Technology, Pasadena, is project scientist.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

VOYAGER 2 SATURN MISSION PROFILE

Voyager 2 will make its closest approach to Saturn -- 101,000 kilometers (63,000 miles) above the planet's cloud tops -- at 8:25 p.m. PDT, Aug. 25, 1981.

More than 18,500 photos of Saturn, the rings and the satellites will be taken during the encounter period.

The spacecraft will take higher-resolution photographs of five satellites and the planet's rings than its predecessor, Voyager 1.

All event times listed in this summary are Pacific Daylight Time, at the time they occur at the spacecraft; one-way light time from the spacecraft to Earth at closest approach to Saturn will be 1 hour, 26 minutes, 35 seconds.

Voyager 2 began its Saturn encounter June 5, 1981. The Near-Encounter phase begins at 4:43 a.m. Aug. 25, and ends at 12:02 a.m., Aug. 27. The Saturn encounter will end Sept. 28.

One of Voyager 2's most important observations will be the occultation of the star Delta Scorpii by Saturn's rings. For 2 hours, 18 minutes on Aug. 25 -- from 4:42 p.m. to 7 p.m. -- the photopolarimeter will be aimed so that the star's light passes through Saturn's rings enroute to the instrument.

As the ring material makes the star appear to alternately blink on and off, the instrument is expected to count with high precision the number of ringlets, their widths, and the widths of the gaps between them. The star traverses the portion of the rings that is in Saturn's shadow, so scientists expect little interference from scattered sunlight.

The sequence is expected to give high radial resolution (about 300 meters or 1,000 feet) of the ring structure across the entire 70,000-km (43,500-mi.) radial extent of the rings. Mission controllers will use a special 7,200-bit-per-second data mode from the spacecraft that permits time resolution down to 1/100th second, compared with 6/10ths of a second in standard data modes. Photopolarimeter observations of the rings are also expected to define the light-scattering characteristics of the ring particles.

The spacecraft will make the following close approaches to these Saturnian satellites:

o Iapetus: 6:30 p.m., Aug. 22; 900,000 km (560,000 mi.);

o Hyperion: 6:27 p.m., Aug. 24; 480,000 km (300,000 mi.);

o Titan: 2:38 a.m., Aug. 25; 665,000 km (413,000 mi.);

o Dione: 6:05 p.m., Aug. 25; 502,000 km (312,000 mi.);

o Mimas: 7:34 p.m., Aug. 25; 310,000 km (193,000 mi.);

o Enceladus: 8:45 p.m., Aug. 25; 87,000 km (54,000 mi.);

o Tethys: 11:12 p.m., Aug. 25; 93,000 km (58,000 mi.);

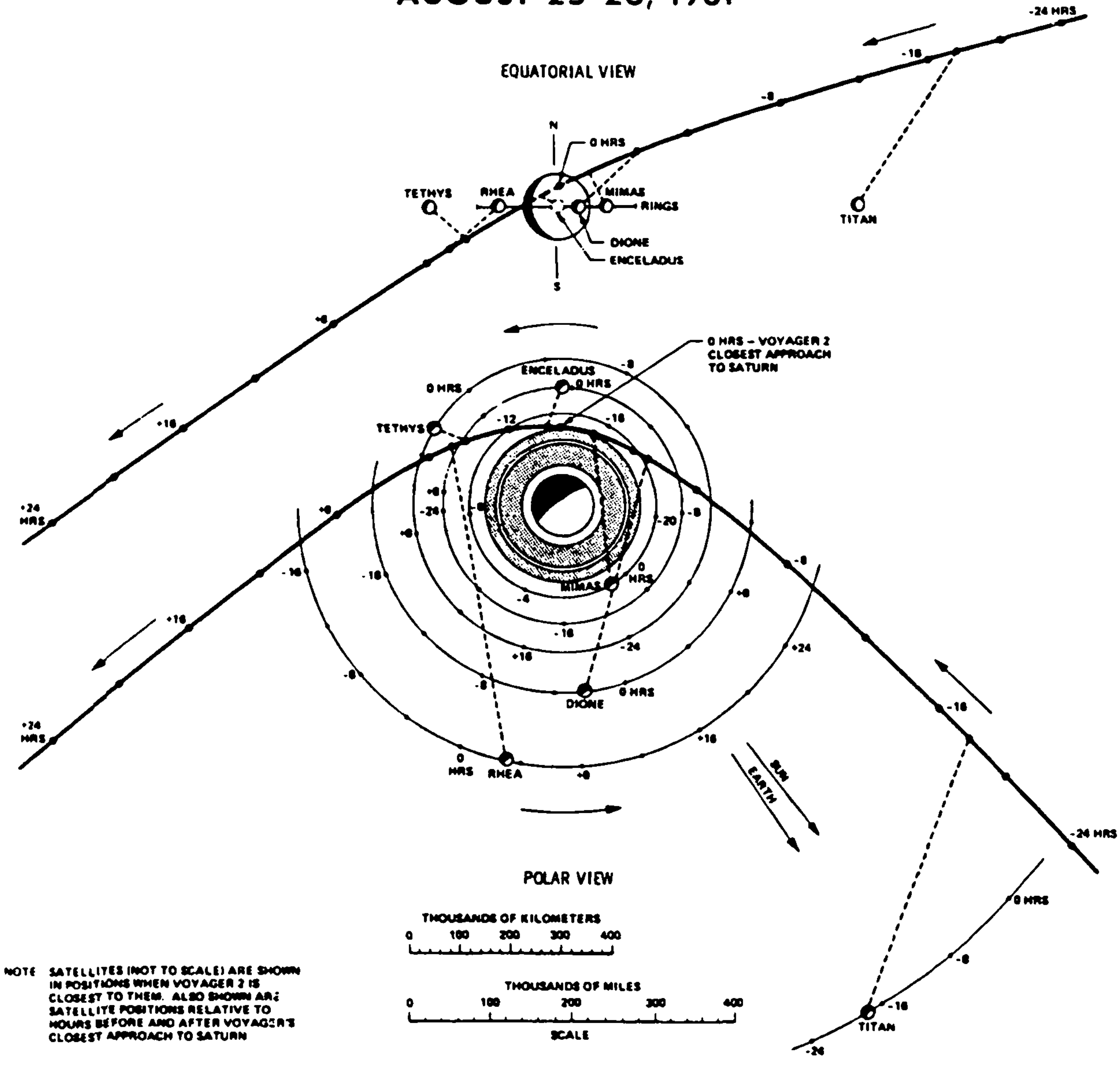
o Rhea: 11:29 p.m., Aug. 25; 645,000 km (401,000 mi.); and

o Phoebe: 6:30 p.m., Sept. 4; 2,080,000 km (1,290,000 mi.). (Voyager 1 did not attempt to take pictures of Phoebe because of its great distance from the moon at closest approach.)

Voyager 2 will also take high-resolution photos of seven of Saturn's newly discovered satellites: 1980S26 and 1980S27, the pair that shepherds Saturn's F-ring; 1980S6, the satellite that occupies Dione's orbit; 1980S1 and 1980S3, the two moons that share an orbit occupies Dione's orbit; and 1980S25 and 1980S13, the two satellites discovered recently in Earth observations; they orbit Saturn about 60 degrees behind and ahead of Tethys.

Voyager 2 will approach Saturn from above the ring plane, with the Sun behind the spacecraft. Observations of the rings during approach will be entirely of their sunlit side, while outbound observations will be of the unlit side. The spacecraft crosses the ring plane only once -- in a downward direction -- before departing for Uranus.

TWO VIEWS OF VOYAGER 2 FLIGHT PATH PAST SATURN AUGUST 25-26, 1981



Crossing will occur about 54 minutes after closest approach, while the spacecraft is out of sight of Earth. Voyager 2's crossing will be 112,000 km (69,500 mi.) above the clouds. (The G-ring orbits about 109,000 km (68,000 mi.) above the clouds.) Pioneer 11 flew safely through the same general region in 1979, as a pathfinder for Voyager 2. The region is Voyager 2's "Uranus aim point," required to bend its flight path and place it on a trajectory to Uranus.

Voyager 2 will disappear behind Saturn (Earth occultation) at 9 p.m., Aug. 25, and will reappear at 10:35 p.m. (Note: This is spacecraft event time; for the time of signal arrival at Earth, add one hour, 27 minutes to all times.)

During Voyager 2's encounter, scientists will concentrate on selected targets rather than on a repeat of Voyager 1's sweeping look at the entire Saturnian system. Selections are based on knowledge gained from Voyager 1's encounter last fall and the flight path necessary to continue on to Uranus.

Photography of Titan, for example, has been largely replaced with additional high-resolution photography of the rings.

Voyager 2 is expected to get better-resolution IRIS (infrared interferometer spectrometer) maps of Saturn.

There should be additional information on Saturn's auroras (they are similar to Earth's northern lights).

Spatial and temporal studies of the braided F-ring, including pseudo-stereo photographs, are planned.

The photopolarimeter is expected to measure microstructure of the satellite surfaces and to observe aerosols and dust in Titan's and Saturn's atmosphere. (The photopolarimeter on Voyager 1 failed shortly after the spacecraft's Jupiter encounter and the instrument was not used at Saturn.)

There will be studies of Saturn's eccentric (non-circular) ringlets -- one in the C-ring and one in the Cassini Division -- to define their shapes and details of their motions. The questions scientists want to answer are these: Are they truly elliptical? If so, why? Measurements of the eccentric rings' ellipticity and their precession rate (how quickly the major axis of the ellipse rotates about the planet) should tell whether the satellite Mimas interacts with the ring material to produce the eccentricity, or if some other cause is responsible.

The planetary radio astronomy and plasma-wave instruments will obtain more high-resolution data within Saturn's magnetic field than Voyager 1 collected to characterize the rapidly varying emissions noted by Voyager 1.

There will be high-resolution photography of Enceladus, (about five times better than Voyager 1) in an attempt to determine why its surface looks so smooth and uncratered in Voyager 1 pictures. Some process may have warmed the satellite's surface -- in effect, erasing it clean of craters and other features within geologically recent times.

High-resolution photos (about 3 km or 2 mi.) will also be taken of Tethys. The satellite appears to be almost entirely water ice, according to Voyager 1 data, with only 10 to 20 percent denser material. Improved mass determination measurements of Tethys should be possible with Voyager 2 because it will approach the satellite so much more closely than Voyager 1 did.

Voyager 2 will photograph the opposite hemispheres of Hyperion and Iapetus from those photographed by Voyager 1, with resolution about four times better.

The infrared interferometer spectrometer (IRIS) will obtain higher spatial resolution data of Saturn's temperature structure at different latitudes than Voyager 1, by making its north-south map at closer range than sequences in Voyager 1's encounter.

Fields-and-particles experiments will measure deeper inside Saturn's magnetosphere than Voyager 1's instruments, because Voyager 2 will fly inside the orbits of Enceladus and Mimas, allowing observations in regions not penetrated by Voyager 1.

As Voyager 2 approaches Saturn, and perhaps after it leaves the planet, it may see signs of the presence of Jupiter. The plasma wave instrument saw evidence as early as January 1981 that Jupiter's magnetotail reaches almost to Saturn, and scientists have predicted that the tail, in fact, reaches even beyond Saturn. If that is true, Voyager 2 may be able to measure the effects on Saturn's magnetic field of the most distant portion of Jupiter's magnetic field.

The planetary radio astronomy instrument will obtain high-resolution data near the rings in an attempt to determine the origin of the electrical discharge signals recorded by Voyager 1.

About three and one-half days before closest approach to Saturn, Voyager 2's cameras will take a series of narrow-angle pictures of the B-ring. The cameras will concentrate on Saturn's B-ring and the radial, spoke-like features recorded by Voyager 1. One picture will be taken every 3.2 minutes for 13.5 hours covering about one and one-fourth full rotations of the B-ring.

At ring-plane crossing, the wide-angle camera will take a series of pictures of the B-ring in an attempt to observe material that may be elevated above the main ring structure, as current theories predict that the spoke material may be elevated above the rings.