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Voyager Mission to Saturn

Voyager 1 made its closest approach to Saturn on 12 November 1980. On that day, the mission control center at Jet Propulsion Laboratory was the focus of intense worldwide attention. Interest in the Voyager mission to Saturn approached that accorded the first manned lunar landing. This issue contains the first set of scientific reports from the flyby of the planet, its many satellites, and its rings.

The Saturn system is a frigid mysterious world nearly 1.6 billion kilometers (1 billion miles) from Earth. Per unit area, it receives about 1 percent as much sunlight as does Earth. Spacecraft visiting it must be prepared to withstand extreme cold, to operate semi-autonomously, and to convey messages to and receive messages from Earth.

Saturn has a mass 95 times that of Earth. It has an atmosphere that consists mainly of hydrogen, with helium (approximately 11 percent) the next most abundant component. Methane, ammonia, ethane, ethylene, acetylene, and phosphine have also been detected. The temperature decreases from 150 K in the upper atmosphere to a minimum of about 85 K at a pressure of 100 millibars and then increases to about 160 K at 1.4 bars. The planet is obscured by clouds, which move at velocities that are a function of latitude. Eastward wind speeds near the equator as high as 480 meters per second (1100 miles per hour) were observed.

One of the major objectives of the Voyager mission was to gather information about Saturn's satellites. There are 15 of them, including three that were discovered during the flyby. Titan, the largest of the group, is the second largest satellite in the solar system (Jupiter's Ganymede is first) and the only one known to possess a substantial atmosphere. Although it is covered with clouds and haze, Voyager experimenters were able to determine its diameter (5140 kilometers). Using this datum and the mass, they calculated Titan's density to be 1.9, which corresponds to a 50:50 mix of rock and water ice. The atmospheric pressure at the surface of Titan is 1.6 bars and the temperature approximately 93 K. Nitrogen is the main constituent of the atmosphere, with methane next in abundance. At the conditions on the surface of Titan, gaseous, liquid, or solid methane might be present. The other satellites were not obscured by clouds. They were covered with water ice and in some cases are composed mainly of water ice. A striking feature of Mimas is a crater roughly 130 kilometers in diameter. Craters were also observed on most of the other satellites.

Saturn's rings were found to have a far more complex structure than predicted. They consist mainly of water ice. Voyager 1 results indicate that the A and C rings contain particles with effective diameters of 10 and 2 meters, respectively. The Cassini division, a classical ring element separating the A and B rings, itself contains five broad rings with substructure. The F ring has an unusual morphology, with two components that appear kinked and braided.

The foregoing paragraphs mention only a fraction of the information now available about the Saturn system. Moreover, only part of the experimental data has been analyzed thus far. When analysis is complete, a very substantial body of facts will be added. For centuries scientists have attempted to answer three major questions about the solar system: How did it originate? How did it evolve? and How does it operate today? The information gathered with manned and unmanned spacecraft greatly limits the range of permissible speculation. A theory that covers the origin and evolution of the solar system will illuminate processes that have occurred on Earth. Data about atmospheric motions on Earth, Mars, Jupiter, and Saturn will be used to test models of global circulation.

The Voyager 1 mission to Saturn has been another great success in a long series of U.S. exploits in space. The engineers, scientists, and technicians involved in the era of space exploration can take pride in their work. They have participated in one of humanity's greatest achievements.

—PHILLIP H. ABELSON