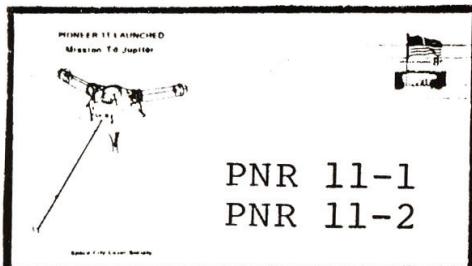


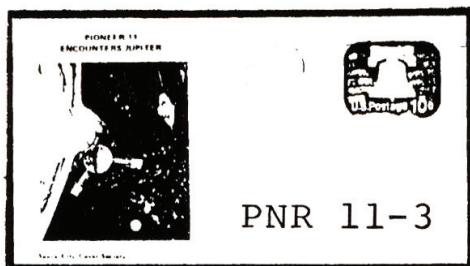
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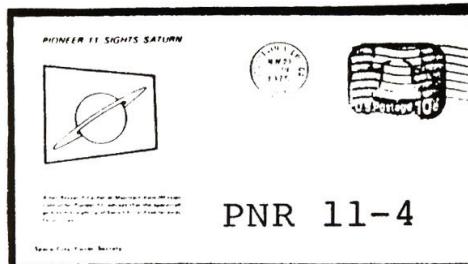
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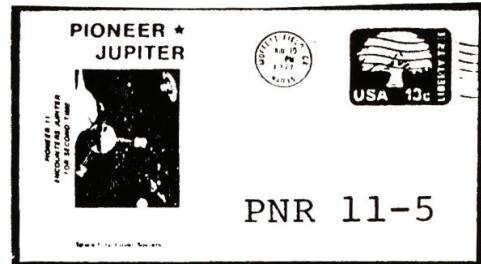
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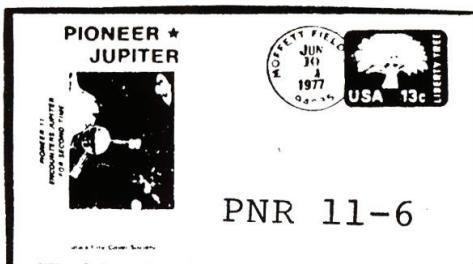
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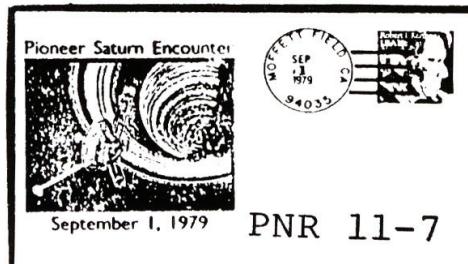
PNR 11-4



PNR 11-5



PNR 11-6



PNR 11-7

SCCS COVERS FOR PIONEER 11

PNR 11-1	Apr 6, 1973	Launch (Cape Canaveral)*	\$4.50
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PNR 11-7	Sep 1, 1979	Pioneer-Saturn encounter (First such in history) Moffett Field CA hand cancel (SCARCE)	10.00

(Ames Research Center is located on Moffett Field CA near the Mountain View CA Post Office. Very little canceling is done at Moffett Field. These are SCARCE.)

* The Canaveral Post Office was closed on launch date and all covers held by Post Office until next morning for canceling. This is as per official instructions from Washington D.C.

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THE MISSION OF PIONEER 11

With the launch on April 5, 1973 from Cape Canaveral, Florida, Pioneer 11 began its journey as a true pioneer of the outer space systems. It would be the first spacecraft to use one outer planet to kick itself from one outer planet to another.

Pioneer 11 used the Atlas-Centaur combination to provide the first two stages of propulsion as it left Pad 39A at Cape Canaveral. The Atlas first stage had two Rocketdyne booster engines, the Centaur second stage had two Pratt & Whitney engines powered by liquid hydrogen and liquid oxygen, and the third and final stage of propulsion was provided by a Thiokol solid-propellant motor.

Pioneer 11 was built by TRW Systems of Redondo Beach, California, as was Pioneer 10. Both of these spacecraft were the first designed to travel into the outer solar system and to operate there for a number of years. This meant that each spacecraft had to have extreme reliability, be of very light weight, have communications systems for extreme distances, and employ non-solar power sources.

HIGHLIGHTS OF PIONEER 11 TO JUPITER

Pioneer 11 had the goal of being the second spacecraft to Jupiter (Pioneer 10 was the first), a trip of 620-million miles. Once there, it was to skim Jupiter at a distance of 26,600 miles, three times closer than Pioneer 10 had flown. Once there, the 570-pound craft would sweep Jupiter at a speed of 107,000 miles per hour, the highest speed ever achieved by a man-made object.

After completion of its Jupiter encounter, provided it survived the radiation, it would then boomerang across the solar system and head for a rendezvous with Saturn and its mysterious rings in September 1979.

If this could be accomplished, Pioneer 11 would be the first spacecraft to use the gravity of one planet (Jupiter) to fly on to the next outer planet (Saturn), an essential maneuver for continued exploration of the outer solar system.

June 5, 1973

By this date, in its second month of travel, the Pioneer 11 spacecraft had moved about 30 million miles away from Earth. It was traveling at 74,000 miles per hour, fast enough to cross the U. S. in about two minutes. All experiments and spacecraft systems were functioning well.

Round trip time for radio signals to travel from Earth to Pioneer 11 and back to Earth at the speed of light had stretched out to four and a half minutes. All instruments aboard the craft were turned on by Controllers at the NASA Ames Research Center in Mountain View, California.

Meanwhile Pioneer 11 had been busy. Its solar wind and interplanetary magnetic field instruments were continuously sampling the Sun's field and wind. Other instruments were measuring solar and galactic cosmic ray particles, and the ultra-violet instrument measured hydrogen and helium from interstellar space beyond the solar system.

August 18, 1973

Pioneer 11 began its seven-month journey through the asteroid belt, believed to be the most hazardous part of the long journey. The asteroids are small bodies, most of them less than a mile in diameter that travel around the Sun like the planets. Although some come closer to the Sun than Earth's orbit and others go out beyond Jupiter, most of the asteroids travel in a doughnut-shaped region between the orbits of Mars and Jupiter.

February 20, 1974

Pioneer 11 was now 410 million miles from Earth, traveling at 36,000 miles per hour, and nearing completion of its trip through the Asteroid Belt. So far it had taken eight hits on its meteoroid detector by high-velocity meteoroids in the Belt. This was about the same as experienced by Pioneer 10 on its way to Jupiter.

March 20, 1974

Pioneer 11 completed history's second trip through the rocky Asteroid Belt. The doughnut-shaped region, lying between the orbits of Mars and Jupiter, at this time was about 50-million miles thick so a spacecraft cannot fly over or under it. Pioneer 11 was now about 70% on its way to Jupiter and had covered 620 million miles. It was now 424 million miles from Earth.

April 19, 1974

NASA made a course change for Pioneer 11 to make it skim within 26,000 miles of Jupiter, then fly back across the solar system on an extended five-year trip to Saturn. Pioneer 10 had flown past the equatorial portion of Jupiter in December 1973 at a distance of 81,000 miles, taking photographs and measurements. This course change would enable Pioneer 11 to provide much better data on Jupiter.

On its new course, Pioneer 11 would now pass the giant planet closer to the polar region, and cover a much wider range of latitudes. It would approach the planet from below Jupiter's south pole, then be pulled rapidly upward by Jupiter's enormous gravity, and intersect the planet's equatorial plane. The spacecraft would then exit from Jupiter, well above the planet's north pole.

This course change would enable Pioneer 11 to reach Saturn in September 1979, six and one-half years after its

launch. This would be well beyond the spacecraft's design lifetime, but Controllers at Ames Research Center felt that it could be done and operational enough to return data.

November 27, 1974

Only four days away from its closest approach to Jupiter, Pioneer 11 today was busy taking color photographs of the planet. And this was from nearly three and a half million miles from Jupiter. The spacecraft, at this distance, was able to see about two-thirds of Jupiter, a view impossible to get from Earth.

Today, the spacecraft passed through interplanetary solar "winds" after a five and one-half hour period the day before inside Jupiter's magnetosphere or magnetic envelope. Dr. John Wolfe, a project scientist at Amers Research Center, said, "The spacecraft would pop in and out of Jupiter's magnetic envelope one or more times before November 28." He explained that the planet's magnetic envelope swells and shrinks like a huge, pulsating jellyfish under pressure from the million-mile-an-hour solar winds.

December 2, 1974

Pioneer 11 made its closest approach to Jupiter at 11:22 p.m. CST climaxing a 21-month, 620 million mile journey. Traveling at a record speed of 107,000 miles per hour, it flew to within 26,600 miles of the cloud tops of Jupiter. This was the deepest any manmade object had ever penetrated the giant planet's searing radiation.

Prior to the close encounter with Jupiter the spacecraft survived a 4,000-volt shock. The shock did no damage but did cause a two percent drop in the information Pioneer 11 was sending to Earth. The incident occurred in an area of intense electron bombardment when the spacecraft was about 500,000 miles from Jupiter. It was near Ganymede, one of Jupiter's moons when the shock took place.

WHAT PIONEER 11 LEARNED ABOUT JUPITER

One major thing learned was that forces at work in the seething interior of giant Jupiter are far more complicated than had been previously believed. Data returned by the spacecraft suggest that the liquid planet's magnetic field, unlike Earth's, may be created by several ring currents... like electric generators...deep within the planet.

Earlier measurements made from a distance of 131,000 miles by Pioneer 10 had indicated only a simple magnetic envelope with a single "generator", much like Earth's.

It now seems that Jupiter's interior may contain a large ring current or generator, along with many eddies or smaller generators, rather than a single large one.

Planetary magnetic fields are believed to be produced by motions of the liquid material in planets' interiors, through mechanisms similar to those of electric dynamos. Earth and Jupiter are the only known planets with a substantial magnetic field.

Besides the big discovery about Jupiter's erratic magnetic field, the flight of Pioneer 11 provided a number of new details about the planet, its poles and its moons, and a greater insight into the nature of cosmic rays from the stars. Some of the findings are:

* Scientists suggest that now it would be best to search for life on Jupiter at its relatively stagnant polar regions.

* Jupiter appears to have all the necessary organic building blocks to support life but until this mission, scientists believed that Jupiter's rapid vertical circulation in its atmosphere would be an obstacle. But this mission showed that the relatively warm and stagnant poles conceivably could harbor living organisms.

* The spacecraft's electronic camera showed for the first time that there was an oval cell of down-moving atmosphere, surrounded by a bright ring of upswelling clouds.

* A new finding bears directly on many studies of our Galaxy concerning electrons. In measuring electrons close to Jupiter, scientists found that there were ten times as many as had been predicted by Earth-based radio studies of Jupiter. If these new findings stand up over a period of time, various celestial theories will have to be reviewed.

* The Jovian moon Callisto, a possible site for any future manned landings, was measured as to its mass. It is one and one-half times that of Earth. Also observed for the first time was an extensive white, south-polarcap on Callisto.

* Scientists now know that "magnetic weather" in Jupiter's enormous magnetosphere is extremely variable. Conditions met when Pioneer 11 passed through it were far different than when Pioneer 10 had gone through it a year before.

* Pioneer 11 showed that all of Jupiter's large moons "sweep out" particles from the radiation belts, reducing the belts' intensity. The closest large moon, Io, absorbs virtually all the low-energy electrons between its orbit and Jupiter. The passages of these moons, each with a different period, constantly stir up the magnetosphere like a "spoon in a bucket of molasses." As a result, there are rapid changes in the magnetosphere.

PIONEER 11 ENCOUNTERS JUPITER FOR ITS SECOND TIME

By passing close to Jupiter on its encounter on December 2, 1974, the planet's gravity and motion acted as a slingshot and sent Pioneer 11 on its way to Saturn. The

trajectory from Jupiter to Saturn to about three times as long as the first leg of Pioneer's journey from Earth to Jupiter.

PIONEER 11 RENAMED "PIONEER SATURN"

The original plans for Pioneer 11 were for Jupiter and if it could then be sent to Saturn, and if the spacecraft was still operable, then the mission would be extended. With the completion of Pioneer's encounter with Jupiter, the mission was officially extended and the spacecraft was renamed "Pioneer Saturn."

THE MISSION TO SATURN

November 20, 1975

Even though Pioneer would not make its encounter with Saturn until September 1, 1979, it had made its first sighting of Saturn on November 20, 1975. Scientists at the Ames Research Center at Mountain View, California (Mission Control for Pioneer) advised that on that date, the spacecraft had made its first sighting of Saturn but it was still too far away for pictures.

December 16, 1977

NASA rejected the recommendations of its own scientists and decided to fly Pioneer Saturn outside the rings of Saturn instead of between the two large rings circling the planet. This meant that the spacecraft would pass Saturn in 1979 at a distance of 18,000 miles from the edge of the planet's outermost ring.

July 24, 1978

Mission Controllers completed final course adjustments for spacecraft's encounter with Saturn on September 1, 1979. This would be man's first visit to the giant ringed planet. The course would bring the craft to within 18,000 miles of the edge of Saturn's outer ring and then swing it under the plane of the rings to 15,000 miles from the planet's surface.

PIONEER SATURN ENCOUNTER - SEPTEMBER 1, 1979

This was the historical day when Pioneer Saturn made the first encounter with the planet Saturn. Previously, the furtherest any man-made craft had reached into space, for a glimpse of our past and future, had been Jupiter. But Pioneer Saturn extended that reach by another 400 million miles. This would set the stage for an even further advance by Voyager 2 and its planned visit to Uranus. But first we had to prove we had the technology to go this far into space.

A. Thomas Young, deputy director of NASA, put it best: "We welcome Saturn into our books of knowledge now and we can report to Voyager 2 that the way is clear. Come on through;

the rings are great." Voyager 2 will follow a path similar to Pioneer Saturn's, including two ring plane crossings, if it is targeted for a Uranus encounter after its planned exploration of Saturn in the summer of 1981.

At Saturn, the question was|the safety of crossing the ring plane. The spacecraft crossed the ring plane in the inbound leg at 7:29 a.m. PDT on September 1, 1979 at a distance of 24,400 miles from the visible rings. It crossed the plane again outbound at 11:24 a.m. at a distance of 19,400 miles.

The spacecraft reached its point of closest approach to Saturn at 9:30 a.m. PDT September 1, 1979. Pioneer was traveling at a speed of 71,141 miles per hour and its closest approach to Saturn was at 12,560 miles from the cloud tops.

SATURN'S MOONS

The spacecraft made its closest approach to five of Saturn's moons prior to its encounter with the planet itself. These five were Phoebe, Iapetus, Hyperion, Dione and Mimas. After the Saturn encounter it made its closest approach to the moons Tethys, Enceladus, Rhea, and Titan.

WHAT WE LEARNED ABOUT SATURN FROM PIONEER

The Pioneer Saturn exploration furnished significant new information about the remote planetary system, including such major early results as these:

*Discovery of a new ring and two additional gaps in the ring system, and nonvisual evidence of the existence of a rarely seen tenuous outer ring.

*Findings that Saturn's atmosphere is slightly warmer than was believed previously, and that the planet emits more heat than can be explained by a simple planetary cooling process.

*Sighting of a close-in moon that may have been previously undetected.

*Conclusive evidence of a strong magnetic field source, and intense charged particle fluxes that are completely eliminated inside the periphery of the ring system.

*Demonstration that there is matter outside the visible edge of the ring system, but that the ring plane can be crossed safely near the planet nevertheless.

PIONEER...A TRUE PATHFINDER

The Pioneer Program gave all of us cause to be proud of what the United States space effort has accomplished and what it will accomplish in the future.

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(Printed October 1991)