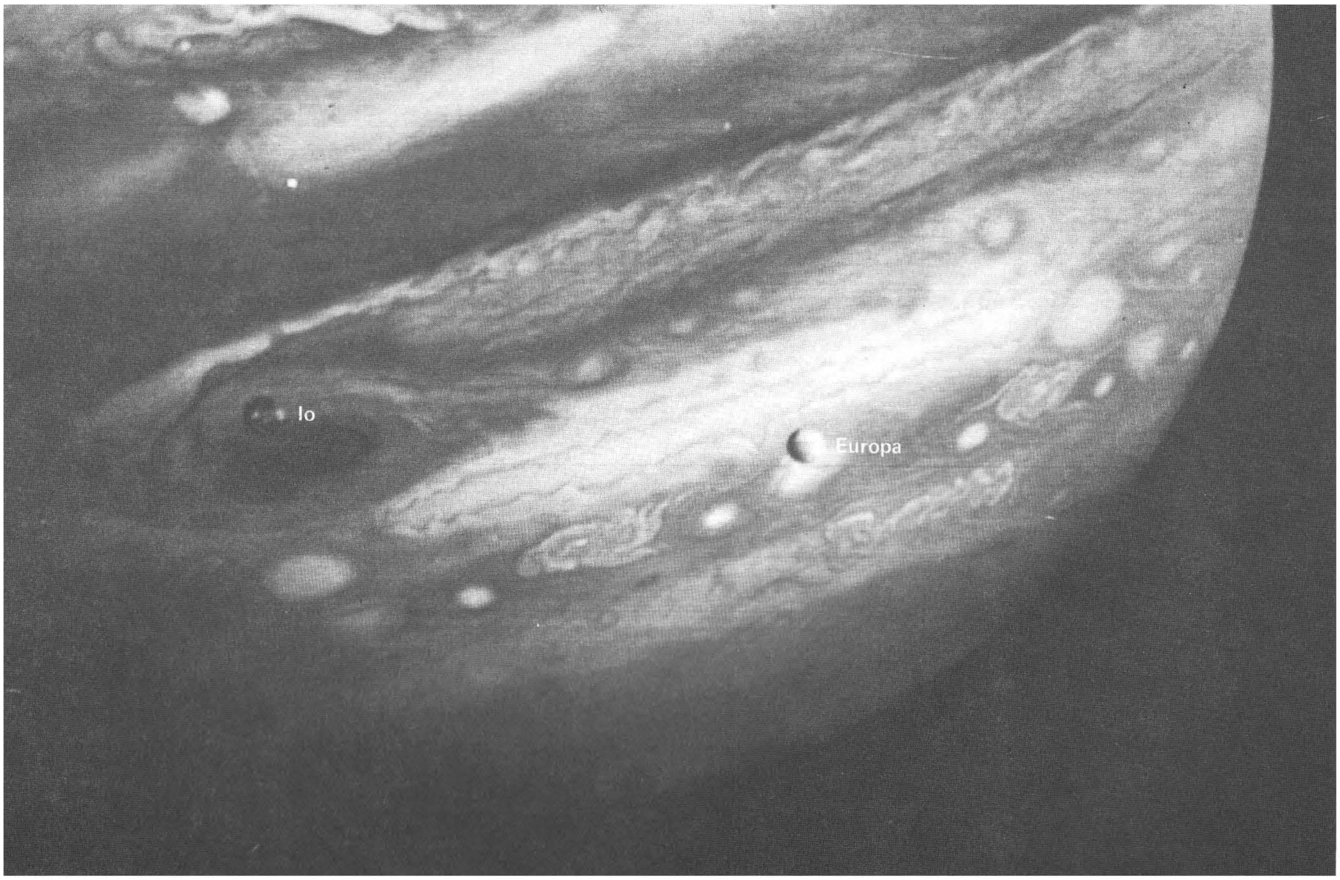
Voyager Bulletin

MISSION STATUS REPORT NO. 36 FEBRUARY 23, 1979



IN TRANSIT — Voyager 1 took this photo of Jupiter, Io,. and Europa on February 13, 1979. Io is about 350,000 kilometers (220,000 miles) above Jupiter's Great Red Spot, while Europa is about 600,000 kilometers (375,000 miles) above Jupiter's clouds. Although both satellites have about the same brightness, Io's color is very different from Europa's. Io's equatorial region show two types of material — dark orange, broken by several bright spots — producing a mottled appearance. The poles are darker and reddish. Preliminary evidence suggests color variations within and between the polar regions. Io's surface composition is unknown, but it may be a mixture of salts and sulfur. Europa is less strongly colored, although still relatively dark at short wavelengths. Markings on Europa are less evident than on the other satellites, although this picture shows darker regions toward the trailing half of the visible disk. Jupiter is about 20 million kilometers (12.4 million miles) from the spacecraft at the time of this photo. At this resolution (about 400 kilometers or 250 miles) there is evidence of circular motion in Jupiter's atmosphere. While the dominant large-scale motions are west-to-east, small-scale movement includes eddy-like circulation within and between the bands.

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Encounter Minus 10 Days

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Public Information Office (213) 354-5011

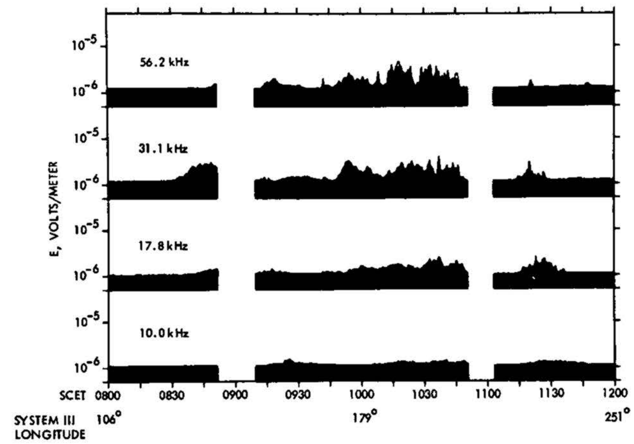
Mission Highlights

Voyager 1 is no longer "going" to Jupiter – it is there! Every instrument's data are showing strong indications of the planet's presence – and its presence is overwhelming.

Auroral-type activity around Io and Jupiter has been observed by the ultraviolet spectrometer (UVS). The gaseous torus cloud associated with Io does not seem to be composed of readily identifiable neutral atoms or singly ionized atoms.

The plasma wave instrument (PWS) is detecting very low frequency emissions (about 10 to 60 kiloHertz) that are not directly related to decametric emissions from Jupiter that have long been observed at Earth. The signals probably originate near or beyond the orbit of Io, and Voyager 1 should fly through this source area, obtaining direct information on the signals. The calculated power of the signals is about 1 billion watts, about the same as Earth's total radiated power. Jupiter's decametric radiation is about 100 billion watts. (These measurements assume isotropy, that is, that the same values can be measured in any direction.)

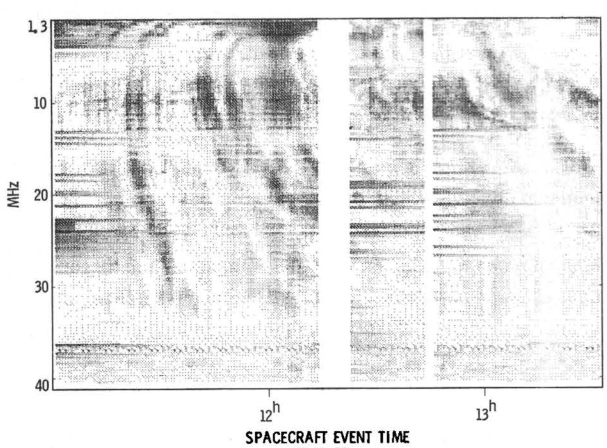
In related studies, the planetary radio astronomy (PRA) instrument is seeing arc structures in its radio spectrum data from about 30 megaHertz to less than 1 megaHertz. Jupiter's magnetic axis is offset from its spin axis by about 11°, so that the north magnetic pole is sometimes tilted toward Earth and the spacecraft. The PRA data shows arcs curving to the left before the magnetic pole tips toward Voyager, and to the right after tipping. Jupiter appears to be the source of the signals, but they are being affected in an area between the planet and the spacecraft – an area through which Voyager 1 is expected to fly.



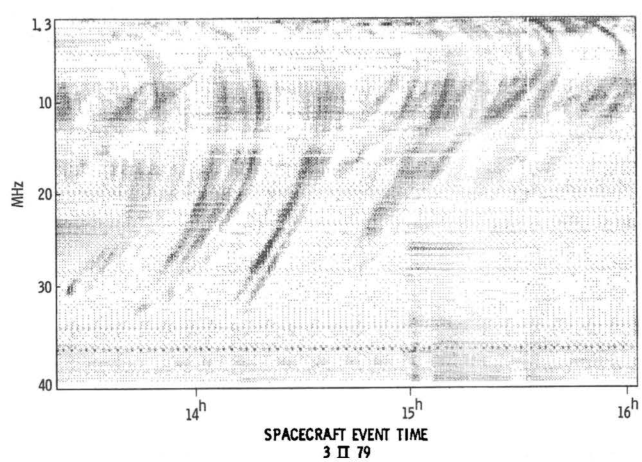
PWS – Voyager 1's plasma wave instrument is recording very low frequency radio emissions from Jupiter which appear to be related to the north and south magnetic poles. This spectrum was recorded on January 20 at about 44 million miles from the planet. The north magnetic pole passage occurs at about 210° longitude.

The magnetometers, low-energy charged particles (LECP) instrument, and plasma instrument are giving strong indications of nearing the bow shock, the interface between the solar wind and the planet's magnetosphere. Bow shock crossing may come sooner than predicted (February 26).

Images taken during January and early February have been processed into a recently released color movie. The rotation movie was compiled from intensive imaging on January 30 through February 3. Atmospheric changes (including current flows) through several rotations of Jupiter are visible, as well as satellites in transit around the planet. Counterclockwise rotation in the Great Red Spot is clearly visible.

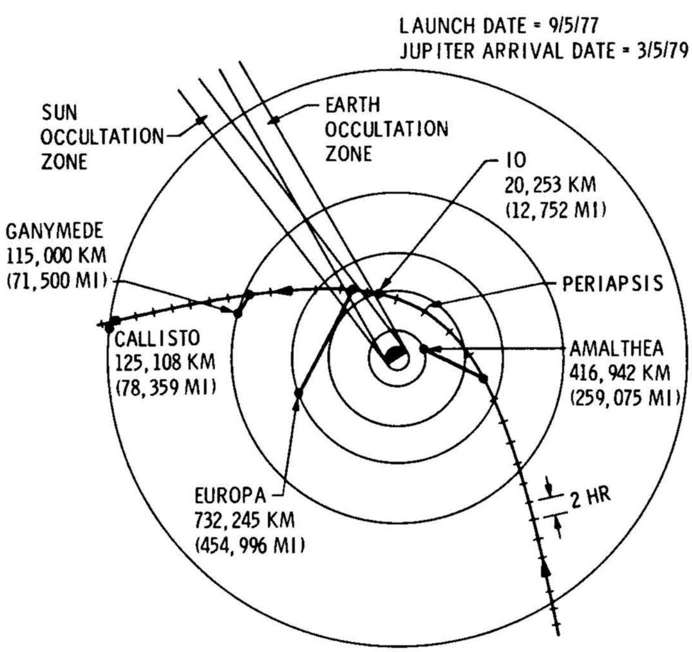


Before Northern Dipole Tip Passage (February 10)



After Northern Dipole Tip Passage (February 3)

ARCS – These radio spectra, collected by Voyager 1's PRA instrument on two different days, clearly show the arc structures associated with Jupiter's north magnetic pole each time it points toward the spacecraft.



A Miniature Solar System

With its thirteen, possibly fourteen, satellites, Jupiter forms what many liken to a miniature solar system. All of the inner satellites are denser and more massive than the other satellites. (Also true for the planets of the solar system – Mercury, Venus, Earth and Mars are all far more dense than Jupiter, Saturn, Uranus, Neptune, or Pluto.)

Voyager 1 will observe the five satellites closest to the planet: Amalthea, Io, Europa, Ganymede, and Callisto. Each is unique and intriguing.

Tiny **Amalthea**, about 120 to 240 km (75 to 150 mi) in diameter, is the innermost satellite, and orbits the planet once every 12 hours (approximately). In the past, it was speculated to be a captured asteroid, because of its small size and its reflectivity characteristics. Its average distance from the planet is 181,500 km (70,077 mi).

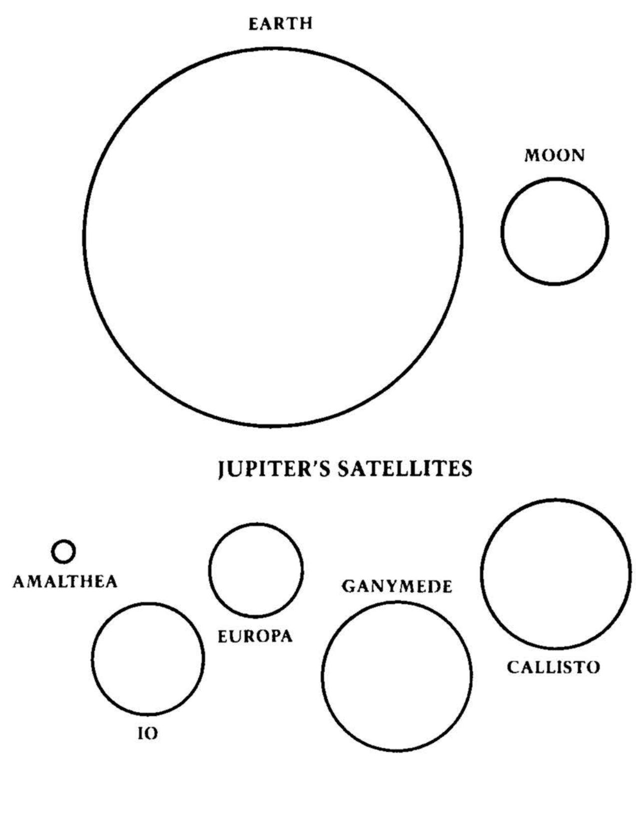
Voyager 1 is most interested in **Io**, so much so that it will risk Jupiter's intense radiation to get close to it. Voyager 2 will not attempt a close flyby of Io, and so will be exposed to less radiation. With reddish polar caps and a tenuous atmosphere, Io is also surrounded by a yellow glow – thought to be a cloud of sodium sputtered off the satellite's surface by particle bombardment.

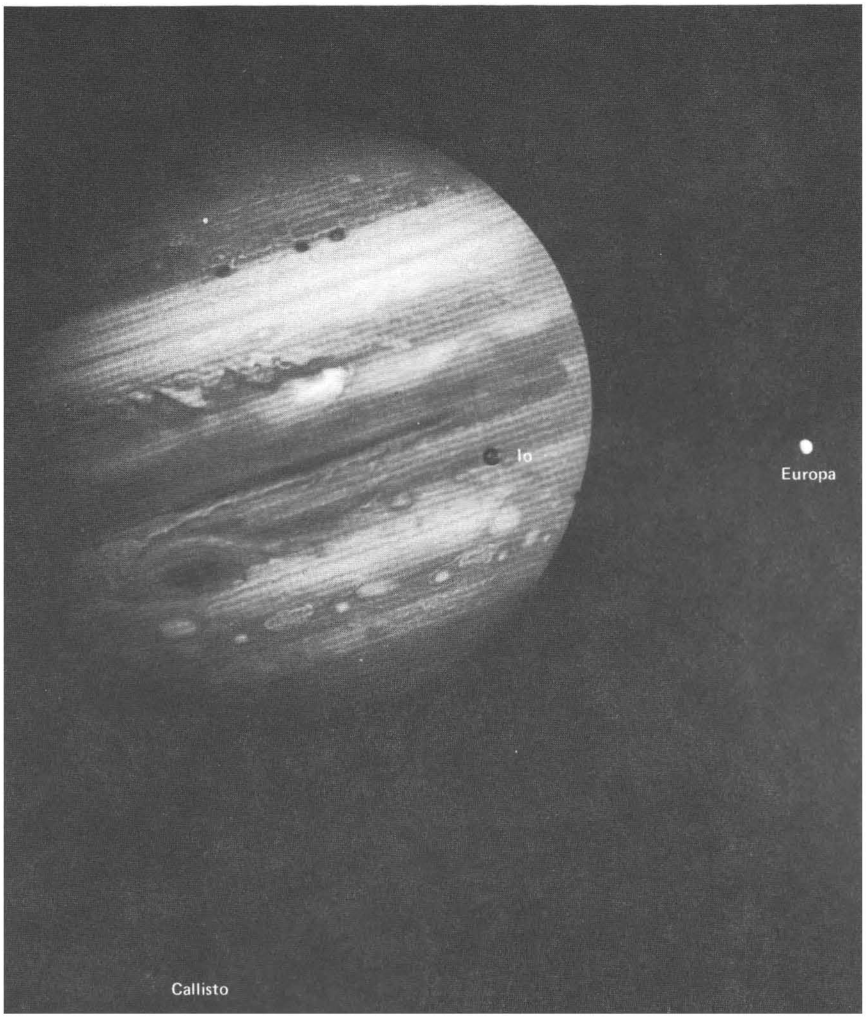
At about 5.9 R_J (Jupiter radii), Io is very much within the Jovian magnetosphere, and, indeed, seems to influence the pattern of Jupiter's decametric radio bursts. In addition, a region known as the Io "flux tube" is a magnetic link between the satellite's surface and the planet. Voyager 1 will spend about 4-1/2 minutes in this area as it flies beneath the satellite's south pole. Voyager 1's closest approach to Io will be from 20,253 km (12,752 mi) three hours after closest approach to Jupiter on March 5. Io is about the size of our moon (3636 km or 2259 mi), and is the third largest of the four Galilean satellites. It rotates about the planet in about 42-1/2 hours at a distance of 422,000 km.

Like Io, **Europa** appears to be a rocky body and recent pictures have shown a dark equatorial band. With a diameter of about 3066 km (1905 mi), it is slightly smaller than our moon and circles Jupiter in about 3-1/2 days from about 671,400 km. Voyager 1 will pass its closest to this satellite, 732,243 km (454,996 mi) on March 5.

Ganymede and **Callisto** are the second and third largest planetary satellites in the solar system (Saturn's satellite Titan is the largest). Both are larger than the planet Mercury. Ganymede is thought to be mostly liquid water with a mud-core and a crust of ice. With a diameter of about 5216 km (3241 mi), Ganymede circles Jupiter in about 7 days at an average distance of 1 million km (62 million mi). Voyager 1 will pass 115,000 km (71,500 mi) from Ganymede on March 5.

Callisto is thought to be half water, although its dark reflectivity indicates a rocky surface. Over 1.8 million miles from Jupiter, Ganymede makes one rotation in about 16 days 16-1/2 hours. Its diameter is about 4890 km (3039 mi). Voyager 1's closest look at Ganymede will be March 6 from about 125,108 km (78,359 mi).





ONE PLUS THREE — Jupiter, its Great Red Spot and three of its four largest satellites are visible in this photo taken February 5, 1979, by Voyager 1. The spacecraft was 28.4 million km (17.5 million mi) from the planet at the time. The innermost large satellite, Io, can be seen against Jupiter's disk. Io is distinguished by its bright, brown-yellow surface. To the right of Jupiter is the satellite Europa, also very bright but with fainter surface markings. The darkest satellite, Callisto (still nearly twice as bright as Earth's moon), is barely visible at the bottom left of the picture. Callisto shows a bright patch in its northern hemisphere. All three orbit Jupiter in the equatorial plane, and appear in their present position because Voyager is above the plane. All three satellites always show the same face to Jupiter — just as Earth's moon always shows us the same face. This photo shows the sides of the satellites that always face away from the planet.

Closest Approaches

Body	Day*	Time (PST)*	Range
Amalthea	3/4	10:21p	416,942 km 259,075 mi
Jupiter	3/5	04:42a	280,000 km 174,000 mi
Io	3/5	07:50a	20,253 km 12,752 mi
Europa	3/5	11:19a	732,245 km 454,996 mi
Ganymede	3/5	06:52p	115,000 km 71,500 mi
Callisto	3/6	09:46a	125,108 km 78,359 mi

*Earth-received time