1979J3: Discovery of a Previously Unknown Satellite of Jupiter

Abstract. *During a detailed search of Voyager 1 frames for additional observations of the satellite 1979J1, two small dark spots were observed in transit in several consecutive wide-angle frames of the Jovian atmosphere. The size, spacing, and motion of these pairs of dark spots indicated that they were the images of 1979J1 and its shadow. Subsequent analysis of images spanning 6 days, however, proved that the satellite observed in these Voyager 1 frames would have been occulted by Jupiter at the times of the Voyager 2 images of 1979J1 and was, therefore, a new satellite. It was subsequently found in transit on Voyager 2 images within 13° of the Voyager 1 prediction. Its period is 7 hours 4 minutes 30 seconds ± 3 seconds, and its mean distance is 1.793 Jupiter radii (Jupiter radius = 71,400 kilometers). The observable profile appears to be roughly circular with a diameter of 40 kilometers, and the albedo is ~0.05, similar to Amalthea's.*

The satellite 1979J1 was discovered in two pictures taken by Voyager 2 in July 1979 (*1*). A subsequent search of Voyager 1 imaging data for additional observations of this satellite revealed three wide-angle (WA) frames, which each had captured pairs of small dark spots on the Jovian atmosphere; an example is shown in Fig. 1. These frames were shuttered ~20 hours before Jupiter encounter, when the spacecraft was approximately 1.4×10^6 km from Jupiter.

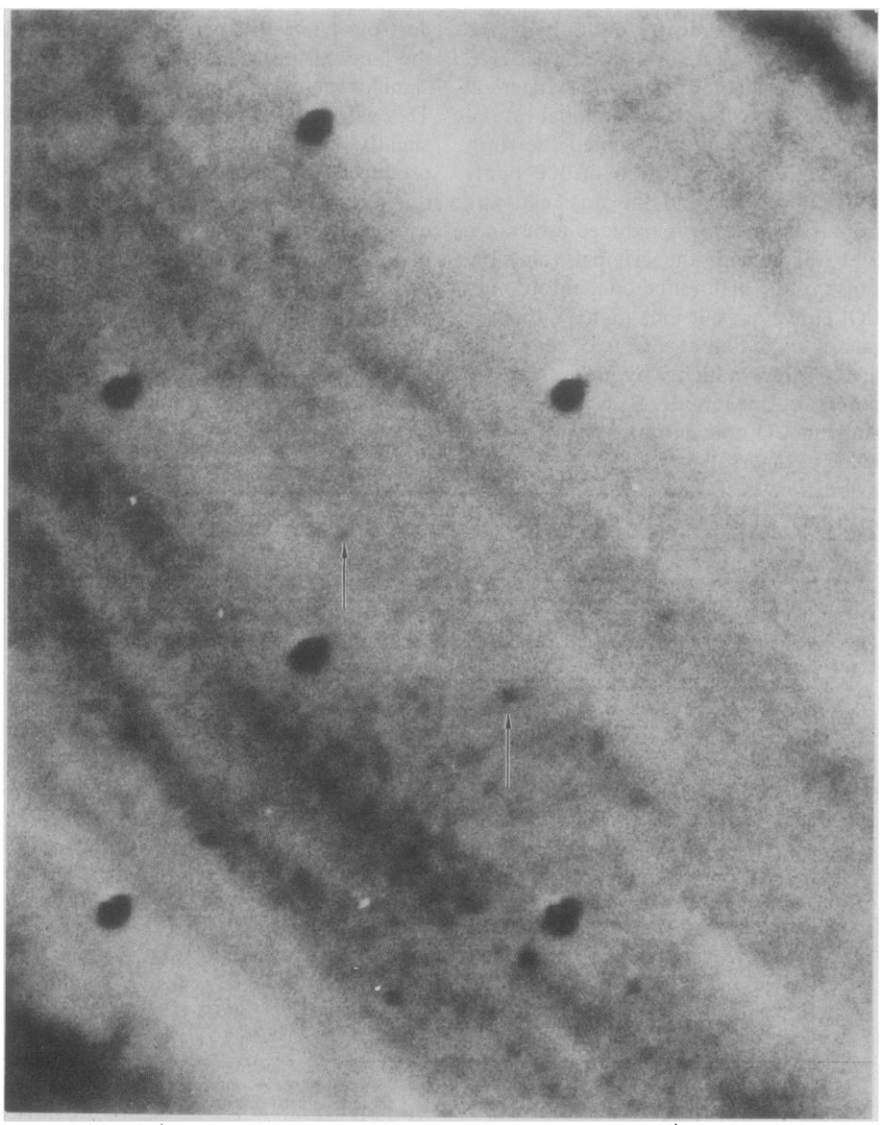

Fig. 1. Voyager 1 wide-angle frame taken ~20 hours from Jupiter encounter shows images of 1979J3 (left arrow) and its shadow (right arrow) against the atmosphere of Jupiter. The large dark spots are camera reseau marks. The other small dark markings are either camera blemishes, which repeat from frame to frame, or atmospheric features, which have a known common motion. The polar axis (south to north pole) of Jupiter would be approximately a 45° line running from lower left to upper right. This is a blowup of about one-fifth of a full frame.

The time interval between these frames was 192 seconds. In this period the dark spots both moved ~40 WA pixels (1 WA pixel ~ 7×10^{-5} radian). The relative motion was approximately parallel to the equatorial region of Jupiter between frames, consistent with motion of a satellite orbiting above the atmosphere. The orbital motion required an absolute velocity of ~31 km/sec, which is near that of 1979J1 in its orbit. In addition, the distance between the dark spots in each frame was approximately 33 WA pixels. With the phase angle of ~ 3° this image spacing is consistent with that of a satellite at 1979J1's orbit and its shadow. Finally, the dark spots were only 1 or 2 pixels across and represented about a 3 percent reduction in brightness relative to the atmospheric background. From comparison of these dark spots with those caused by a body of known size—for example, Amalthea—the object's diameter is estimated to be ~40 km.

These orbital and size characteristics were all very near those of 1979J1, and the dark spots were originally interpreted as the images of 1979J1 and its shadow. This assumption allowed prediction of other observations from the period of 1979J1, and subsequent analysis of Voyager 1 images spanning 6 days allowed a prediction to be made to the times of the Voyager 2 observations of 1979J1, with an expected error of ~17° in orbital longitude. The prediction differed by ~175° from the observed position of 1979J1. The satellite subsequently was found within 13° of the prediction and 162° from 1979J1. The new satellite, 1979J3, was, in fact, occulted by Jupiter at the times of the Voyager 2 observations of 1979J1.

The Voyager 1 and Voyager 2 data for 1979J3 yield a period of 7 hours 4 minutes 30 seconds ± 3 seconds, and a mean orbital distance from Jupiter's center of 1.793 Jupiter radii (R_J = 71,400 km). The profile observed in transit is roughly circular with a diameter of ~40 km. The limited data indicate that the albedo is ~0.05, similar to Amalthea's.

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References and Notes

1. D. C. Jewitt, G. E. Danielson, S. P. Synnott, *Science* **206**, 951 (1979).
2. This report presents the results of one phase of research carried out at Jet Propulsion Laboratory, California Institute of Technology, under NASA contract NAS 7-100.

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