

# Jupiter in (Sharper) Focus

Just released after months of computer enhancement, the latest Pioneer 11 photos of Jupiter show a wealth of detail

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Photo: NASA

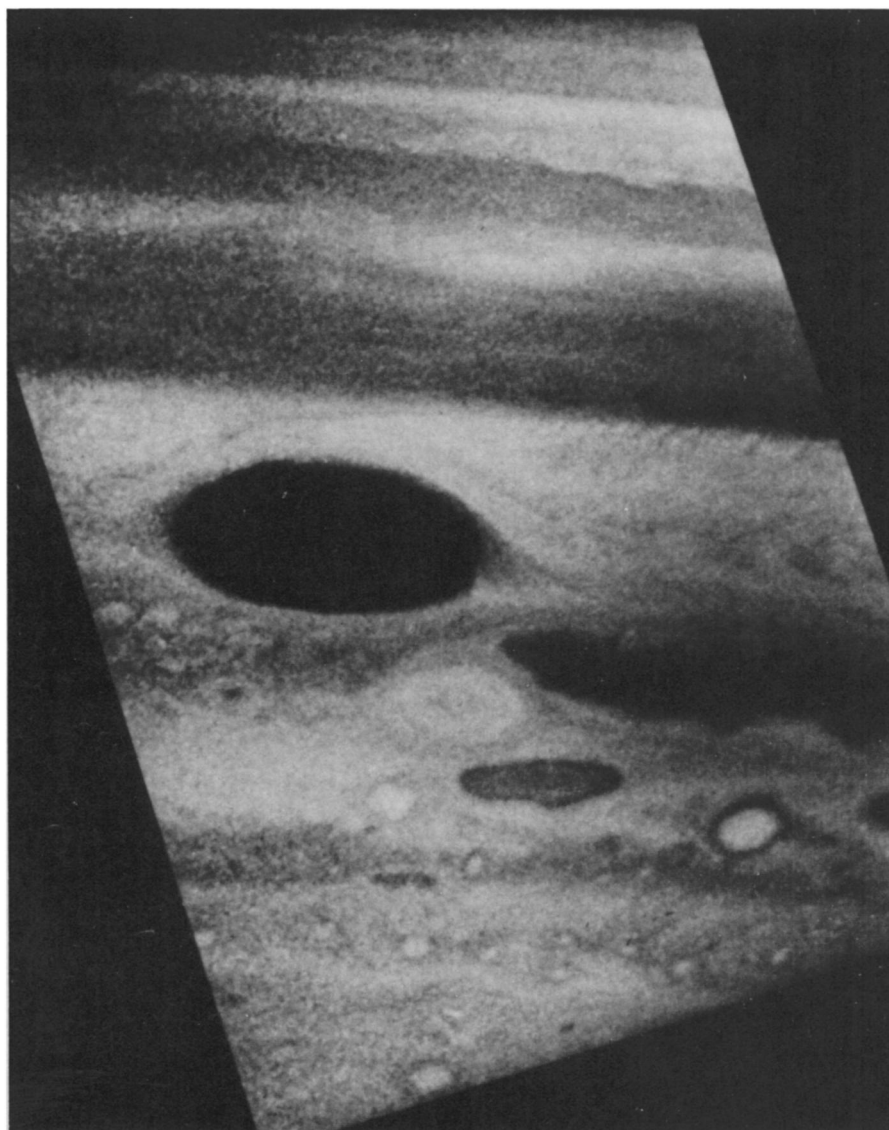
It has been five months since the doughty Pioneer 11 spacecraft reported on its encounter with mighty Jupiter, and the probe's photos of the planet have, like wine, improved with age. During the intervening time, a huge team of photo-processing experts at the University of Arizona have been applying a host of computer, optical and other techniques to bring out the best in the priceless images.

The fruits of their labors are the clearest pictures in existence of the titanic, cloud-banded world, including dramatic evidence of the wind flows around the famous Great Red Spot and what may be the first signs of hurricane-like storms in Jupiter's north polar region. (Some long-overdue credit should be given to the Santa Barbara Research Center in California, which built the remarkable, triple-threat imaging photopolarimeter—it makes polarized and zodiacal light measurements too—that took the photos in the first place.)

Before Pioneer 11 took a look, no one had ever seen the polar regions of Jupiter, even by telescope, since there was simply no way to get "above" the planet and look down. The University of Arizona's Tom Gehrels, chief of the mission's imaging team, had tentatively predicted that the strong bands that girdle the lower Jovian latitudes would be missing, and he was right (SN: 106:357). The first, unenhanced photos also seemed to show, however, a complete lack of the huge, spinning storms that some researchers have described elsewhere on the planet. Painstaking computer processing has now revealed what Andrew Ingersoll of the California Institute of Technology believes may be just such storms, resembling roundish smudges, thousands of kilometers across, in the upper right quadrant of the photo at left. Other researchers feel that the smudges are simpler convection cells or turbulence effects.

Taken 600,000 kilometers from the planet, the photo also offers the first detailed view of the transition from regular banding as it breaks up to become the mottling of the north polar region. The lowest swath of swirling cloud structure marks the north edge of the North Equatorial Belt, with slanted streaks above it in the North Tropical Zone. Poleward of that is the North Temperate Belt, its northern edge scalloped into north-pointing peaks. The area of the photo extends to within 17 degrees of the pole.

Jupiter appears to be a planet of storms, with the Great Red Spot reigning as the storm of them all (SN: 107:224), and among the most recent enhanced Pioneer 11 images is one that shows more details of the Spot and its surroundings than have been seen before. The Spot itself seems to show signs of a counterclockwise spiraling, while white cloud streams move from right to left along the Spot's northern edge and from left to right on the south, forming triangular regions of wind shear at the Spot's "ends." (The direction of



*Jupiter's storm of storms shows increased detail from computer enhancement.*

the flows was determined from photo sequences, Ingersoll points out, providing, in effect, animated movies of Jupiter.)

Below the eastern end of the Spot is one of three white ovals which are usually spaced about 120 degrees apart around the planet. The new photo seems to show signs of rotational motion in the oval, such as the suggestion of an "eye" in its center. Also visible is a stream of darkish cloud material between the oval and the Spot, apparently pushed northward into the white zone containing the Spot by the turbulence of the oval's wake. This stream, says Ingersoll, appears to be one of the first observed examples of mass transfer between the dark belts and light zones, although this is not unexpected from Jovian weather theories.

Additional enhancement of Pioneer 11's Jupiter photos probably has little more to offer, says Gehrels, but the Arizona team is now hard at work on another prize: a unique photo of the Jovian satellite Ganymede, recorded in December 1973 by Pioneer 10. The unenhanced photo (SN: 107:5) shows tantalizing

glimpses of what may be a polar cap, perhaps even of water ice, as well as seemingly moonlike detail. Gehrels says intrigued researchers plan to push enhancement efforts on this photo "to the limits of present knowledge."

Meanwhile, the Pioneers fly on, Old No. 10 simply continuing out toward the rim of the solar system and No. 11 swooping back in across the system to a 1979 rendezvous with Saturn. Hopes for the Saturn encounter are high, and Gehrels reports that a problem with the Pioneer 11 camera—a tendency to stick during its stepped scanning operations—seems actually to be improving. Also, as the spacecraft climbs out of the plane of the ecliptic on its way to the ringed planet, the photopolarimeter is providing bi-monthly maps of the diffuse skyglow known as zodiacal light. In its other mode, polarimetry, the same instrument is still studying Jupiter, measuring light polarization angles across the Jovian disk to learn what the indicated scattering can tell about cloud layers, aerosols and other characteristics of the atmosphere. □