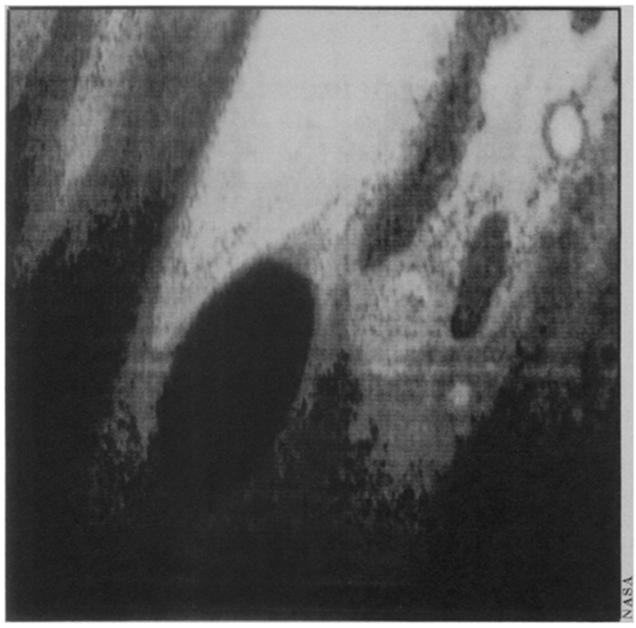
Amazing Jupiter gets more so



The changing face of Jupiter: The huge, white South Tropical Zone, containing the Great Red Spot, has altered in its southern half since Pioneer 10 saw it a year ago. New dark regions show a gap just below the Great Red Spot, with the gap blocked by a large, light-colored convection cell. (Whatever colors such cells is transient—even the Red Spot is white at times.) Yet, says University of Arizona's Tom Gehrels, latitudinal mixing between zones is unlikely.

NASA

"Thunderbolts of Jove!" Wonder Woman used to say. The Pioneer 11 scientists sorting out their new data on Jupiter (SN: 12/7/74, p. 356) didn't hear any (nor were they listening for them), but it's not inconceivable. Experimenters on some future atmosphere probe of the giant planet may just find that the raging shear winds, powerful heat flows, strong magnetic field and numerous charged particles have what it takes to make monumentally stormy weather. Pioneer's researchers, meanwhile, have more than enough to do.

One of the major discoveries about the planet, for example, is that its magnetic field is a great, flaccid bag, often stretching out to span more than 9 million miles of space, but sometimes pushed in to less than half that size by the pressure of the solar wind. Pioneer 11, which passed only a third as far from Jupiter as did Pioneer 10 last year, filled in the gaps in its predecessor's measurements of the density of the electrons trapped by the magnetic field. This will allow plasma investigator (and Pioneer chief scientist) John Wolfe to calculate the delicate pressure balance that sustains one of the solar system's great phenomena: a magnetic field limp enough to grow and shrink like a huge, flat balloon, yet strong enough sometimes to straddle a distance equivalent to 360 trips around the earth.

Another unanswered question from Pioneer 10 was about the thickness of the presumably disc-like field. Even with Pioneer 10's data well in hand, researchers have been comparing the shape of the field to a soggy doughnut, the brim of a floppy fedora and other basically flat objects. Pioneer 11, however, followed a steep path that took it away from the planet at an upward angle of some 45 degrees (which should level off to about 15 degrees and take it as much as 150 million miles above the plane of the ecliptic on its way to Saturn). The final result could be surprising. Three days after leaving Jupiter, says Wolfe, the spacecraft was still inside the huge magnetic envelope, and climbing so sharply that 2 million miles from the planet, the supposed disc was almost 4.5 million miles from top to bottom.

Interpretations of Pioneer data have often been less than unanimous. In the year since Pioneer 10's flyby, for example, radio-occultation experimenter Arvydas Kliore of Jet Propulsion Laboratory and infrared mapper Guido Munch of Caltech have failed to come appreciably closer in rationalizing each other's widely divergent estimates of the temperature in the upper levels of the Jovian atmosphere (SN: 4/13/74, p. 236). One of Pioneer 11's open questions is again about the magnetic field, in this case the part close in to the planet, where the field's modified dipole shape asserts itself. The spacecraft passed close to the poles this time, yet JPL's Edward Smith estimated a north polar field of about 12 gauss at the surface from his helium vector magnetometer, while Mario Acuna of Goddard Space Flight Center said that the possibilities allowed by readings from his flux-gate magnetometer could include a north polar field as high as 30 gauss. As with much of Pioneer's data, time and study will tell more, but the researchers unanimously hope for a chance to collect data from orbit in the future. Smith also estimated a surface field at the equator of between 3 and 6 gauss, and Acuna's quick-look analysis showed a dipole with about a nine-degree tilt (not far from Pioneer 10's indication), in the direction of about 200 degrees Jovian longitude.

One of Jupiter's long-standing mysteries has been its bursts of non-thermal radio energy (see p. 372), and findings by the University of Chicago's John Simpson have now made it stranger still. Using the charged particle detector aboard Pioneer 11 to count the energetic electrons that he believes capable of triggering such emissions (electrons stronger than about three million electron-volts), he discovered that there seem to be about 10 times as many as earth-based monitoring of the radio bursts would indicate. This could affect electron estimates for the entire galaxy, since it seems to suggest that a given radio intensity, as seen from earth, may represent a far more energetic electron source than was previously believed. Whole theories hang in the balance.

Another surprise, says the University of Iowa's James Van Allen (of radiation belt fame), is that the numbers of charged particles surrounding Jupiter's higher latitudes are so great. It could be an effect of solar wind pressure, bulging out the magnetic field and its resident particles above and below the plane of the ecliptic, or it may be another indication of the field's surprising thickness. Until that is resolved, Van Allen says, it will be impossible to say whether the strange in-and-out passages of both Pioneers through the boundaries of the field are due to variations in space or time.

As for the planet itself, the early data analyses need further work before they can be combined into a cohesive picture, although JPL's John Anderson, analyzing Jupiter's gravitation from its effects on the spacecraft's orbit, computed the oblate world's radius to be 44,368 miles at the equator and 41,516 miles at the poles. The gas-to-liquid transition in the largely hydrogen planet, he said, occurs about 6,000 miles down.

Many of these preliminary results will change. Some may be tossed out completely. Others will find their way into the textbooks of tomorrow. But all three futures are months, even years, in the distance. □

NOTE TO READERS

The Dec. 21 and Dec. 28 issues of SCIENCE NEWS will be combined into a single, expanded year-end issue that will carry a review of the important science stories of 1974.