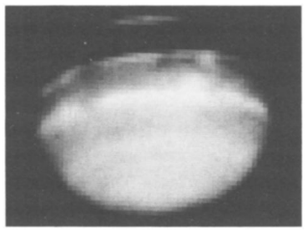
Astronomy

Ron Cowen reports from Palo Alto, Calif., at the annual meeting of the American Astronomical Society's Division for Planetary Sciences

Saturn: Finding the hots . . .

Using an infrared camera, astronomers have imaged several "hot spots" never before detected on Saturn. Richard L. Baron and Tobias C. Owen of the University of Hawaii in Honolulu say the infrared-bright regions likely represent holes in the thick, heat-absorbing layer of clouds believed to blanket Saturn's lower atmosphere. The holes, they say, permit heat from the planet's interior to leak out into space.



Baron, Owen/NASA Infrared Telescope Facility

Infrared image of Saturn taken at a wavelength of 5.1 microns reveals a broken ribbon of hot spots about 15° north of the equator. Dark band indicates Saturn's rings.

Ordinary photographs do not reveal the hot regions, since the shorter wavelengths associated with visible light cannot penetrate Saturn's dense upper atmosphere, Owen notes. And researchers who previously searched for hot spots with infrared telescopes failed to find them, he adds, because the scientists used broadband filters that permit a wide range of near-infrared wavelengths to reach their detectors. Such studies record the bright, overall infrared glow from the planet, which can wash out the hot spots because they radiate only at a few infrared wavelengths, Owen and Baron discovered.

To hunt for hot spots, the astronomers attached a camera known as ProtoCAM to NASA's Infrared Telescope atop Mauna Kea in Hawaii. Instead of recording photons on film, the camera relies on an infrared array — a group of infrared-sensitive picture elements on a semiconductor chip (SN: 11/16/91, p.312) — to make an image. Baron and Owen used a series of special filters that allowed the array to view narrow bands of light between the near-infrared wavelengths of 4.9 and 5.3 microns.

Observing Saturn on July 8 and 9, the researchers discovered an intermittent ribbon of hot spots that stretches at least halfway around the planet at about 15° N. Another infrared-bright region, partly hidden by Saturn's rings during the July study, hints that a similar ribbon exists at 15° S, Owen says. The study also revealed two fainter and thinner infrared-bright zones closer to the planet's north pole, which the researchers speculate may represent unidentified structures in the lower cloud layer other than thermal holes.

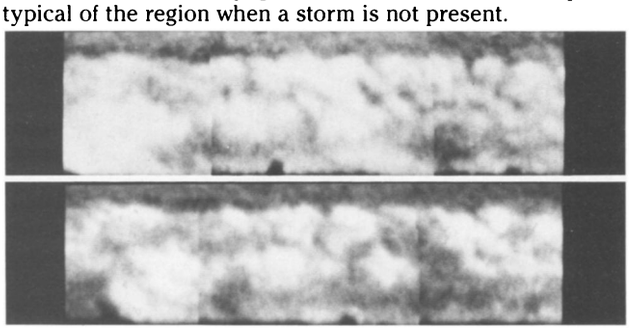
Owen notes that part of the mechanism responsible for hot spots on Saturn resembles that which underlies similar features on Jupiter. Both planets have thick, cloudy atmospheres. On Saturn, atmospheric helium succumbs to gravity, falling toward the planet's interior and releasing heat in the process. Holes in low-lying clouds then act like a camera with its shutter open, allowing the helium's heat, detected as infrared light, to exit from the atmosphere unimpeded.

Owen cites two key differences between the two planets' hot spots: Researchers can view Jupiter's with broadband filters, he says, because Jupiter apparently contains lower concentrations of heat-absorbing phosphine gas than Saturn. And leftover heat from the formation of Jupiter, rather than infalling helium, likely fuels the Jovian emissions.

. . . and tracking a recent storm

Comparing ground-based images with those taken by the Hubble Space Telescope, astronomers have found that a single atmospheric disturbance triggered Saturn's "white spot" — the storm that erupted in September 1990. Reta F. Beebe and Lyle Huber of New Mexico State University in Las Cruces and their colleagues used the images to trace the movement of a closed eddy that accompanied the storm (SN: 11/24/90, p.325).

From the Hubble photographs, they found that a band of clouds moved westward relative to the storm's center at a maximum speed of 125 meters per second. The researchers relied on data from Voyager 2 to determine the wind speeds typical of the region when a storm is not present.



NASA

Two views of Saturn's storm taken by Hubble on Nov. 17, 1990 (top) and Nov. 18 show a band of clouds extending from 7° S to 22° N. Westward-moving wave-like disturbance appears similar to those seen in satellite pictures of storms on Earth.

Icy eruptions on Triton?

A new analysis of Voyager 2 images of Triton, Neptune's largest moon, indicates that a large region just north of the equator scatters light far differently than other areas of this icy satellite. The study suggests that a highly transparent layer of frost blankets this section of Triton, report Pascal Lee, Paul Helfenstein and their colleagues at Cornell University in Ithaca, N.Y. Other regions may have more opaque frost deposits.

Additional processing of the photographs suggests that the transparent frost is thin, since astronomers believe they can discern three large, quasi-circular features beneath the ice in this region. Researchers speculate that cryovolcanism — icy eruptions on Triton's surface — may explain the circular features, whose diameters range from 280 to 935 kilometers.

Tracing Venus' watery past

A new analysis of the chemical processes that deplete deuterium and hydrogen in Venus' atmosphere hints that Venus might once have had an ocean as deep as 10 meters — more than double previous estimates based on atmospheric chemistry.

Mark Gurwell and Y.L. Yung of the California Institute of Technology in Pasadena base their study on the relative efficiencies with which molecular oxygen and related oxygen products can knock hydrogen and its isotope, deuterium, out of the atmosphere. They calculate that it is far easier to deplete deuterium, relative to hydrogen, than previously estimated.

That finding alone does not alter current thinking about an ancient ocean on Venus. But researchers also know that the ratio of deuterium to hydrogen on Venus hasn't stayed the same throughout history, although on Earth the ratio has remained relatively constant. The Venusian ratio, now about 100 times the ratio on Earth, apparently equaled the terrestrial value billions of years ago. So if much more deuterium exited the Venusian atmosphere over that time than had been believed — as the new calculations indicate — then a larger amount of hydrogen must also have escaped. To put it another way, Venus may once have had a greater reservoir of hydrogen than scientists had estimated. Since the concentration of hydrogen typically indicates the presence of water, the new calculations suggest that Venus might have had a substantially larger ocean than researchers had speculated, Gurwell says.

He cautions, however, that a higher concentration of hydrogen over the lifetime of Venus may not mean that the planet contained a huge amount of hydrogen at any one time.