A Flash in the Distance

A clever search is underway to "see" lightning on Venus

By John R. Williams

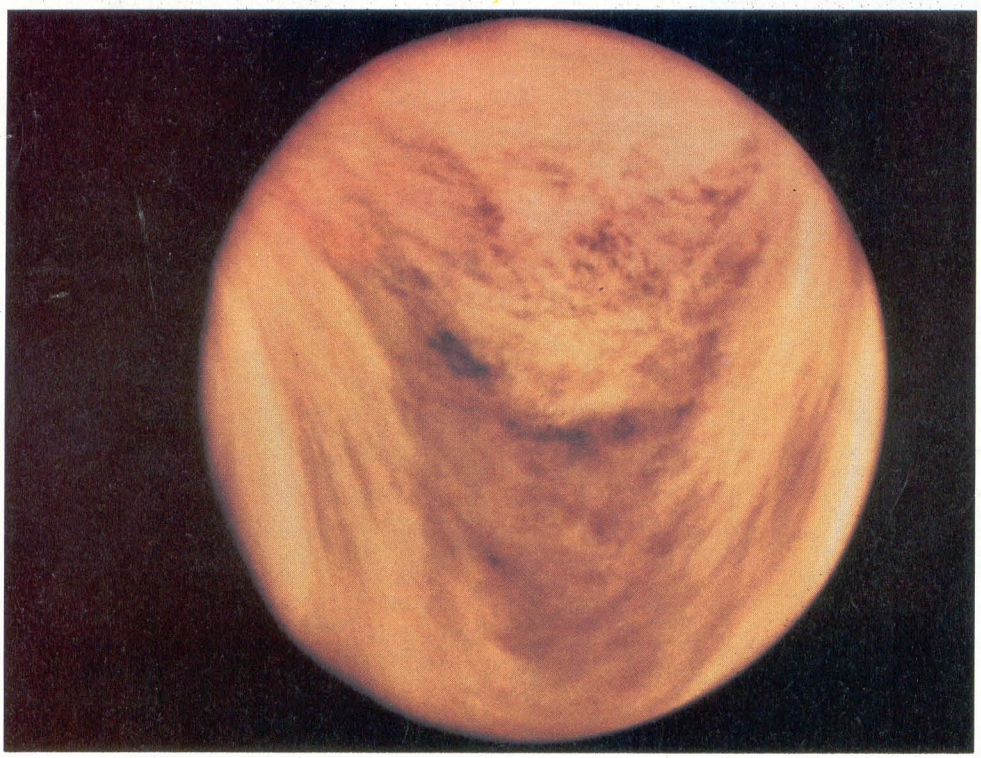
With a little Yankee ingenuity, Bill Baruchi, a scientist at NASA's Ames Research Center, is giving sight to the blind Pioneer Venus probe with the help of the craft's star sensor—a device used for navigation. The innovation could help solve a 13-year-old debate sparked when lightning supposedly was detected on Venus.

Not everyone agrees that lightning flickers in Venus's clouds. The stormy controversy began in 1978 when two Soviet spacecraft, Venera 11 and Venera 12, as well as the U.S. Pioneer Venus, settled into orbit around the cloudy planet. The Veneras dropped landing probes into the atmosphere. During their parachute rides they reportedly detected a flash of lightning and "heard" thunder in the thickening atmosphere. Pioneer Venus's Very Low Frequency (VLF) antenna rounded up radio waves, which are similar to whistler waves. "Whistlers" on Earth got their name from operators on long land-lines during World War I who first heard the rising and falling tones. These radio waves propagate along the magnetic field lines for long distances and are attributed to lightning.

Although the Venera probes "saw" lightning, scientists in the United States questioned the Soviet findings, suspecting the signals were simply static discharges on the craft itself. So scientists await more promising visual data to tilt the balance. This is where Baruchi's experiment comes to play.

The light show strikes when the air can no longer withstand the power charges building up as the clouds churn. As the charge builds, the air ionizes and a channel eats its way from an area of high charge to one of low charge. Flash! BOOM! Pent-up electricity flows in an intense bolt of light and heat. Thunder results when the air slams together and the tunnel collapses.

In addition to a dazzling show and rumbling report, lightning sets off an electromagnetic wave. Pioneer Venus's sensitive VLF antenna routinely picks up the hiss, pop and squeal of this wave, but without an optical camera onboard, the probe cannot see the flashes below.



Baruchi has been working to prove Venus lightning exists for several reasons.

"It's been fun to try and pull this off, but it's hard work too," says the scientist. "The star sensor wasn't designed for this, so we have to tell the spacecraft to open the shutters of the star sensor every 13 seconds to see the star we are navigating by, and we have to tell it to open the shutter when we are swinging around toward the planet. We can't point the sensor at the planet or it will saturate."

Pioneer Venus spins once every 13 seconds as part of its

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stabilization control. Since looking at the planet would saturate the star scanner, where it sees nothing but light, like overexposing a roll of film, Baruchi must measure the light that scatters off the edges of the instrument. It's sort of like looking sideways at someone next to you—you see movement, but little else. The blackness of space is his starting point. Baruchi measures the darkness with an occasional cosmic ray hit, which causes a little blip in the sensor. Baruchi compares this background noise to data the spacecraft gathers when pointing near Venus. If it is brighter than the background noise, then he's got a strong candidate for lightning on the planet.

Baruchi hasn't detected anything yet.

If there is lightning, the storms appear to be just like weather systems on Earth, says Chris Russell, the primary investigator of the magnetometer experiment aboard the craft. The radio signals are loudest on the evening side of the planet. On Earth, storms usually set up in the afternoon as the Sun warms the ground. Air spirals upwards and collides with cooler air, spawning thunderstorms in the early evening. Venus's weather systems appear to work in the same way and lightning may correspond to active volcanoes. Magellan, with its thorough radar-mapping mission, may confirm the existence of volcanoes. The only difference between Venus lightning and the terrestrial variety is that lightning on Venus is a little slower. As yet, Russell cannot explain why.

"We know what lightning sounds like on Earth. We're trying to deduce stuff from a distance," says Bob Strangeway, principal investigator of Pioneer Venus's plasma wave experiment. "On Earth we know lightning occurs. You see the lightning bolt, you hear the thunder and you know something is going on. Then they deduced that whistlers were caused by that after observation. On Venus we hear the whistlers and if we heard that on Earth we would likely attribute it to lightning. We have no strong evidence—visual stuff—and people tend to rely more on that."

"We extrapolate from knowledge on Earth with danger," Strangeway adds. "With Jupiter we had visual data on lightning. That helped a lot; and it was easier to prove."

Although Baruchi's experiment has not shed solid light on the question of Venus lightning, he plans to keep working until Pioneer Venus spirals into the atmosphere and burns up sometime in late 1992. □

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