Lightning Found on Venus at Last?

Galileo's fortuitous pass by Venus has yielded the best evidence yet that somehow Earth's neighbor generates lightning

EARTH'S ATMOSPHERE CRACKLES WITH lightning. Jupiter has it too, sporting bolts 100 times more powerful than terrestrial ones. There are signs of strong electric discharges in the atmospheres of Saturn, Uranus, and Neptune. But making a case that lightning flickers through the dense atmosphere of Venus has been difficult. Now new electric field observations from the Galileo spacecraft's swift flyby of Venus have provided strong evidence that—however it does it—Earth's sister planet can also electrify itself.

The news from Galileo challenges some conventional wisdom. Theorists have long doubted that Venus' quiescent atmosphere could generate the strong electric fields needed for lightning, and past evidence for lightning on Venus has drawn strong challenges. In the absence of new missions dedicated to the study of Venus, the prospects for resolving the debate did not seem bright.

That all changed when NASA replotted the trajectory of the Jupiter probe Galileo after the Challenger disaster. A Venus encounter hadn't been in the cards, but new safety considerations forced a cutback in the power of the rocket booster that would propel Galileo away from Earth after its release from the space shuttle's cargo bay. Unable to head directly for Jupiter, the craft was sent on a complex course that included one swing by Venus and two Earth flybys to give it a trio of gravity-assisted boosts. The serendipitous encounter with Venus gave space physicist Donald Gurnett of the University of Iowa and his team the opportunity to use the craft's plasma wave instrument—designed to study the electric field signals generated by plasmas moving in Jupiter's intense magnetic field—to listen for radio discharges from Venusian lightning.

Listening for enlightenment wasn't a brand new idea. The Soviet Venera landers of the 1970s and the Pioneer Venus Orbiter, which reached Venus in 1979, may have detected flashes, though the meaning of the data has been in dispute for a decade. But Gurnett and his colleagues expected that Galileo's instrument would be able to detect lightning signals with much more confidence than the earlier probes. And their expectations were rewarded on 9-10 February of last year, when Galileo swept by the night side of Venus and recorded six abrupt noise bursts that looked just like lightning signals.

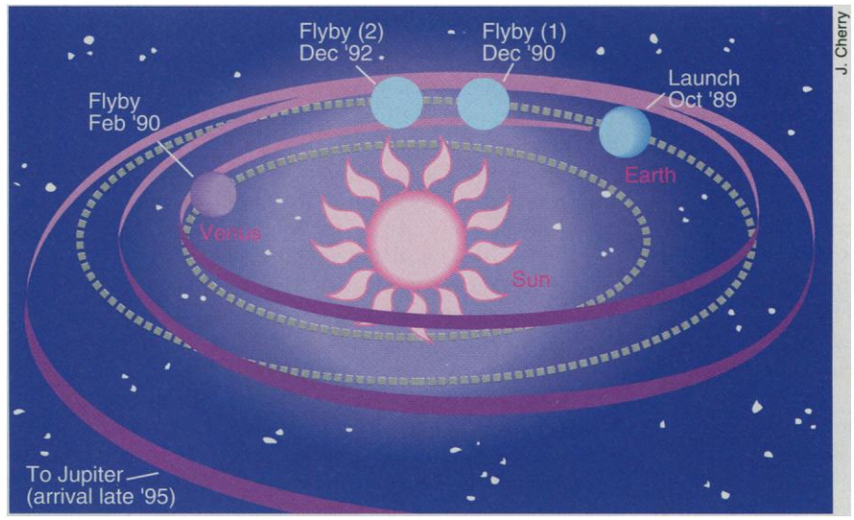
How convincing is the claim? Compared to Pioneer Venus, Galileo could record signals at much higher frequencies, up to 5.6 megahertz, which makes them easier to distinguish from plasma-generated signals and the usual types of spacecraft interference. "I would say our confidence is reasonably high," says Gurnett of his findings, which appear in *Science* this week (p. 1522).

And there are indications that the results are already impressing some of the doubters, if not immediately winning them over. Paul Cloutier of Rice University, a leading critic of the Pioneer Venus data, agrees that the Galileo results have strengthened the lightning advocates' case. "Gurnett's is perhaps the only credible result in the last few years that might be a detection of Venus lightning," he says. Lightning proponents such as space physicist Christopher Russell of the University of California, Los Angeles, go further. "I was confident before" that Pioneer Venus had detected lightning, says Russell, "but I'm pleased by the independent confirmation."

Still, the data leave wide open the question of how Venus manages to produce its electricity. The atmosphere itself seems an unlikely candidate. "It's hard for people to imagine how the atmosphere of Venus would create lightning," says planetary scientist Larry W. Esposito of the University of Colorado. Venus, he points out, seems to lack the lightning-generation system so familiar in terrestrial thunderheads: strong updrafts of condensing vapor, which provide the particles that can carry opposite electrical charges and the vertical motions needed to separate them. (The sudden combination of the separated charges is a stroke of lightning.) On Venus, the clouds tend to resemble fog banks, says Esposito. "You don't see much lightning in fog," he notes.

Maybe the Venusian fog generates electric fields by some still-unimagined mechanism. Or maybe, researchers speculate, the lightning is born not from atmospheric processes but from geologic ones. On Earth, particles rubbing against each other inside turbulent plumes of volcanic ash sometimes generate lightning, and the same thing might happen on Venus. The Magellan spacecraft now mapping the surface of Venus has seen what looks like ash strewn downwind of volcanoes—although such explosive volcanism appears to be rare so far. But Magellan is now retracing its circuits of the planet, in part to search for signs of eruptions since its last pass 8 months earlier. The discovery of volcanic ash that has just settled to the surface could be another shot in the arm for lightning on Venus.

If these Galileo observations prove out, NASA will have fortuitously salvaged at least one scientific achievement from what otherwise could be one of its worst space science debacles yet. Galileo's jammed communications antenna (*Science*, 23 August, p. 846) continues to threaten this grand craft's primary mission: its rendezvous with the planet Jupiter. ■ RICHARD A. KERR



A planetary loop-the-loop. *Galileo must fling itself once past Venus and twice past Earth to reach Jupiter, but the detours have brought scientific payoffs.*