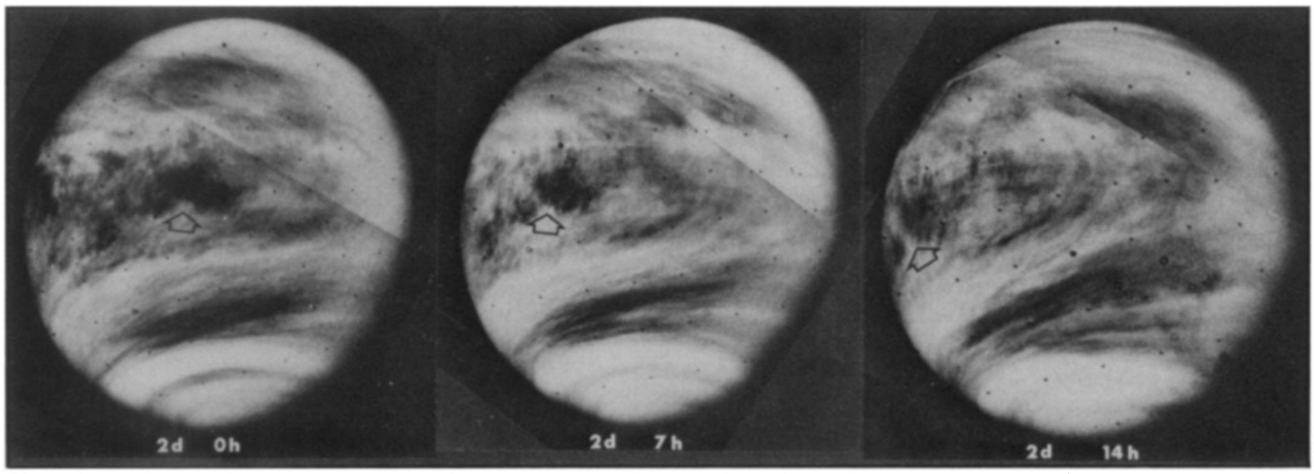
Mariner's Venus: A Chinese dinner



NASA

Ultraviolet views of Venus at seven hour intervals show polar spirals and rapid rotation of atmospheric features.

"My God!" said the scientist. "Planets in front of us, planets in back of us—we hardly know which way to turn." On March 23, Mariner 10 will take its first pictures of Mercury, with other measurements soon to follow. Yet the same researchers who are eagerly awaiting man's first close look at that tiny world are still feeling their way through Mariner's reams of data on Venus, much of it scarely six weeks old. "It's like a Chinese dinner," says Stanford's H. Taylor Howard, whose team is analyzing radio signals sent from the spacecraft through the edges of the planet's atmosphere. "Two hours later you're hungry for more information."

For Venus is startling indeed, and with every look it gets more so, even though its most remarkable features are invisible. Ultraviolet measurements indicate that it seems to be girdled by a bulging, disklike belt of carbon monoxide, somewhat like a gaseous version of Saturn's rings. Symmetrical whorls of cloud, again seen only by UV light, cap the poles and amaze observers with their regularity, now that they have recovered from being amazed that they could see any features at all. And then there is the Eye.

The Venusian Eye, some 7,000 kilometers wide and 2,000 kilometers in a north-south direction, stares steadfastly at the sun—almost. Apparently a huge, turbulent, convection cell, according to Michael Belton of Kitt Peak National Observatory, it is a permanent marker of the spot at which the sun's heat falls perpendicularly on the clouds. The Eye is not at the exact "subsolar points," however. It is displaced about 3,500 kilometers westward by the rest of the atmosphere racing by at a speed Belton now estimates at 100 meters per second, like the high-altitude jet streams of earth. The interference of the Eye in turn creates another spectacular effect: huge "bow waves" like the upstream ripples in water flowing around a piling.

The atmosphere apparently maintains its raging pace all the way to the polar regions. This means that the angular velocity of the wind is greater at higher latitudes, which winds the ultraviolet cloud structure up like a pair of Maypoles, creating striking spiral bands that wind poleward from about 50 degrees of latitude.

The improbable orderliness of the Venusian atmosphere is everywhere. Howard's radio experiment has revealed four distinct temperature inversions, 56, 58, 61 and 63 kilometers above the surface. On the night side of the planet, the ionosphere, too, has layers, with identical peak densities of 10,000 electrons per cubic centimeter 120 and 140 kilometers up. The more intense day side reaches a single peak, at 145 kilometers, of 300,000 electrons per cubic centimeter.

The composition of this strange atmosphere is as fascinating as its structure, in part because there is no substantial magnetic field to protect it. Previous Venus probes—Mariner 5 and the Soviet Venera 4 and 6—reported that if there was a field, it was less than one hundredth as strong as earth's. John Simpson and a team from the University of Chicago armed Mariner 10 with a charged particle detector up to 1,000 times more sensitive than previous instruments, and still found no trace of a magnetosphere. There was also a magnetometer aboard, however, sent by NASA's Norman Ness and colleagues, which spotted a slight irregularity in the interplanetary field as the spacecraft neared the planet, apparently due to the deflection of the solar wind by a "pseudo magnetopause" induced in the Venusian ionosphere.

A true magnetic field would cause a wide deflection in the solar wind (the magnetopause is the zone where they collide), bending it wide of the atmosphere. Instead, at Venus the solar wind plunges right on in, bringing a load of hydrogen (SN: 2/16/74, p. 100) but stripping off substantial quantities of helium (it will hardly be missed—Venus' "helium glow" is three times as bright as earth's) and possibly carbon and oxygen. Venus was apparently formed in a relatively warm part of the primordial cloud from which most of the hydrogen had floated away, says Harvard's Michael McElroy, but the hydrogen from the solar wind plays an important role. In the form of hydrogen chloride, even though there is less than a part per million in the atmosphere, says McElroy, it helps stabilize the carbon dioxide that is the major gas present, by keeping the sun's heat from dissociating it into carbon monoxide and atomic oxygen. (CO and atomic oxygen are both present, however, along with carbon and perhaps argon and neon.) The heat, Mariner 10 reported, gets as high as 890 degrees F. on the surface, although the top of the cloud deck is a chilly 9 degrees below zero.

All this and Mercury too. On March 16, flight controllers at Jet Propulsion Laboratory in Pasadena made their final trajectory correction, which should carry Mariner 10 some 670 kilometers from the sun's closest companion. □