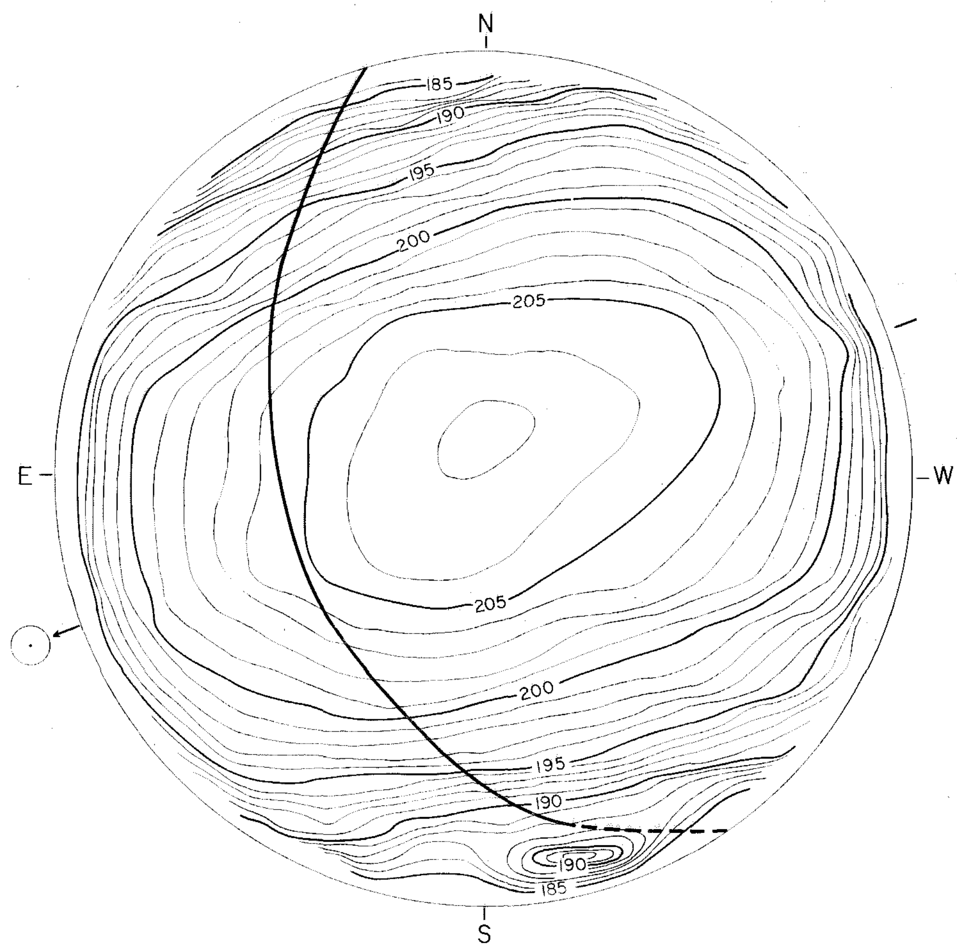


Temperature contour map of Venus, December 15, 1962

VENUS OBSERVED

The most detailed observations yet reported of the upper atmosphere of Venus have just been disclosed by Caltech investigators. Bruce Murray and Robert L. Wildey, research fellows in space science, and Senior Engineer James A. Westphal scanned the planet Venus with a heat-sensitive detector fitted to the 200-inch telescope on Palomar Mountain. The observations were made on four successive nights before, during, and after Mariner II flew by Venus last December 14. They showed that:

1. A storm region was clearly visible on one weather map (above), near the southern tip of the planet. It was about 1,000 miles across, similar in size to many storms in the earth's atmosphere, and the temperature in the region was about 5° Kelvin (10°F) hotter than in the surrounding atmosphere. Although the storm region was clearly defined on only one night, it disturbed the temperature distribution in the southern hemisphere on all four nights of observation. No similar disturbances were noted elsewhere on the planetary disk.

2. The temperature of the upper atmosphere was the same on the planet's dark side as on the sunny side (the sun is the small circle on the left in the drawing above), indicating a surprisingly efficient distribution of the sun's energy that falls on the sunlit side.

3. The apparent temperature of the atmosphere is about 205°K in the central region of the planetary disk and grows gradually colder toward the "top" and "bottom" of the disk. (Top and bottom refer to the direction perpendicular to the plane of the planet's orbit around the sun.) The maximum difference in temperature is about 20°K.

In general, the overall temperatures found were not too different from those observed by other workers using less sensitive instruments. The measurements made by the Caltech group, however, are the first ones to map in detail the atmospheric temperatures across the planetary disk.

The fact that temperature similarities are not bulls-eye-shaped but tend to stretch across the middle of the planet like a semi-squashed bull's-eye, coupled with the finding that the investigators detected no temperature differences between day and night, could most easily be explained by a modest rotation of the planet. However, there also may be other more complicated explanations of the temperature distribution.

For instance, the mode of rotation suggested by these data may be inconsistent with the recent interpretations of radar observations, which indicate a very slow reverse rotation.

Whether Venus rotates on its axis more than once every time it makes one complete orbit around the sun every 225 days has long been a puzzle to astronomers. The planet is blanketed with a dense cloud cover that shows no tell-tale surface markings to give a clue as to its rotation rate.

Measuring device

The Caltech team scanned the planet's upper atmosphere with an infrared radiation measuring instrument designed and built by Westphal. The device is 20 to 50 times more sensitive than any previous one devised for measuring temperatures of comparatively "cold" celestial bodies.

Linked with the 200-inch telescope, the instrument measured the temperature of segments of the planet's atmosphere as small as 260 miles in diameter. Up to 30 scans were made horizontally across the planet, from top to bottom, on four successive nights, Dec. 13, 14, 15, and 16, in the early morning hours just before sunrise.

Those dates coincided with the Mariner II fly-by observations so that the Caltech group could correlate their findings with those of the Venus space probe. Venus was in a favorable position for such observations. It was comparatively near-by (about 36,000,000 miles away). Also, about a quarter of its disk was illuminated by the sun, which made it possible to get temperature readings of the light and dark areas of the planet's atmosphere.

The unique crystal detector (which also recently showed that the dark side of the moon is much colder, 270° F. and below, than previously supposed) "sees" heat waves through a "wave-length window" in the earth's atmosphere that admits infrared radiation whose wavelengths are about 20 times longer than those of visible light.

The tremendous light-gathering power of the 200-inch Hale mirror collects and focuses the longer infrared waves just as it does light waves. Instead of being focused onto a photographic plate, as light waves are, the infrared waves are filtered and focused onto the special crystal detector.

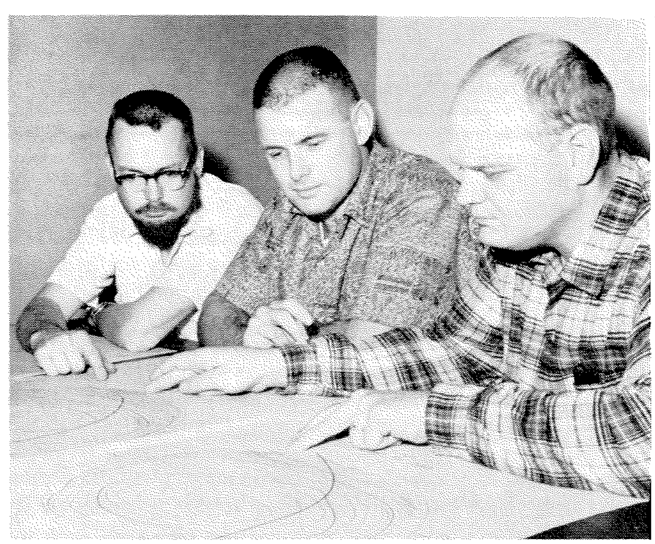
The crystal is of germanium. Scattered through it are mercury atoms which, when struck by heat radiation, give up electrons. The more intense the incoming radiation, the greater the number of electrons that are given off. The varying number of electrons causes a slight voltage fluctuation in the crystal. These variations, calibrated to indicate temperature, are amplified about one million times and recorded.

Sensitivity control

So that the crystal will be as sensitive as possible, it is maintained in a container cooled with liquid hydrogen, lowering its temperature to about 423° below zero (F.) Liquid hydrogen also cools radiation shields around the crystal. The shields reduce background noise from "hot" surroundings on earth.

The observing is done with a double beam system that looks at the spot whose temperature is to be taken and at the same time compares its radiation with that emanating from a nearby spot in the sky. Only the difference in radiation between the two beams is amplified.

This research is sponsored by the Caltech Division of Geological Sciences with the support of the National Science Foundation and the National Aeronautics and Space Administration.



Senior Engineer James A. Westphal and Research Fellows Bruce Murray and Robert L. Wildey study light-temperature contour maps of Venus.