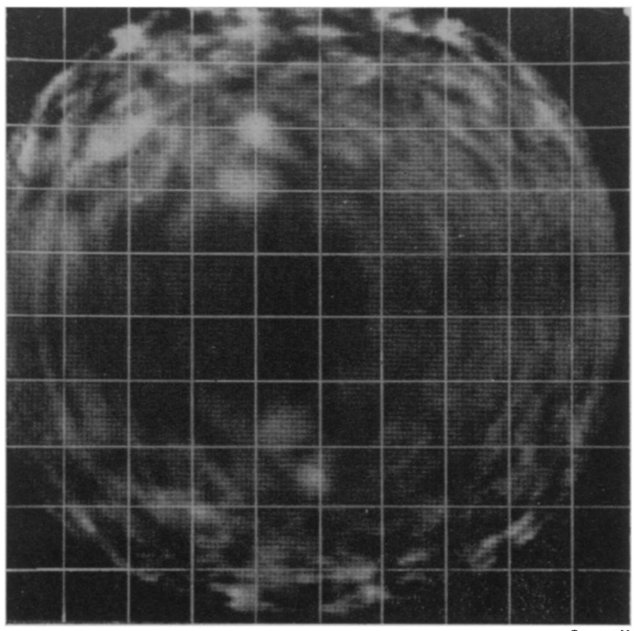
Venus Observed

Radio telescopes are peeling the bashful planet to its veiled surface



Cornell

Venus by radar; bright means rough.

Venus has a rough skin—but she keeps it under wraps. The planet's negligee consists of an apparently unbroken layer of clouds that visible light cannot penetrate. Radar waves, however, can pass through the clouds and reveal her surface delights.

Success in penetrating the planet's wrapper has come to three groups of American astronomers—one at Cornell University, Ithaca, N.Y.; another at the Jet Propulsion Laboratory in Pasadena, Calif., and the third at the Massachusetts Institute of Technology's Lincoln Laboratory in Lexington.

There may also be similar work going on in Russia. A group, under the leadership of Academician V. A. Kotelnikov, has done radar work on Venus, but it is not known whether they are working toward surface maps.

The Cornell group has announced that its map "shows for the first time exact location of unusually rough areas which may be mountains." The existence of bumps or prominences—few outside Cornell will go so far as call them mountains—has been known for several years. Continuing observation and data analysis attempt to secure finer detail. The Cornell group, led by Dr. Raymond F. Jurgens, has mapped a third of the planet's surface. In preparation is a map of the whole surface that will show details, they believe, as clearly as the best optical telescopes would if Venus were cloudless.

The Cornell announcement came almost 10 years to the day after earth's first radar contact with Venus on Feb. 10, 1958. In those days the simple proof that a radar beam had reached the planet (26 million miles at closest approach) and returned was cause for jubilation.

Using radar to examine Venus became more practical as more powerful transmitters, bigger receiving telescopes, and more refined methods of data analysis developed. The world's largest radio telescope, the 1,000-ft. diameter dish at Arecibo, Puerto Rico, is being used by the Cornell group.

The basic technique is to send a pure tone, the radio equivalent of a tuning fork signal. In reflection, rough spots indicate their existence by scattering the radiation more than smooth areas. To identify the rough spots, the reflected signals are analyzed for frequency changes and time delay. Each type of analysis characterizes a particular region of the planet; combining analysis of time delay and frequency shift narrows the possible locations of the roughness.

A further refinement can be gained by interferometry—comparing signals received at telescopes spaced widely apart. Data from interferometric experiments at Lincoln Laboratory are still to become available.

The radar studies had to wait not only on technology, but also on celestial mechanics. Useful observations can be made only at periods of closest approach between Venus and earth, and these amount to a few months every 19 months. The last closest approach was Aug. 30, 1967; the next will be April 9, 1969.

Surface prominences were first observed during the approach of 1964. From following the motions of these prominences, Dr. Richard Goldstein, a member of the JPL group, was able to calculate the rotation of Venus. It turned out—with a contrariness characteristic of her namesake—to be in the opposite direction from nearly all other circular motions in the solar system.

The JPL group issued a first map in 1964. Refinement of data allowed the astronomers to follow up with a better one in 1966. New measurements were possible in 1967, and these are now being analyzed and combined with older ones. According to Dr. Goldstein present equipment should be able to distinguish objects 10 miles apart on the surface of Venus.

Already the data lead to informed speculation about the nature of the planet's surface. Professor Thomas Gold, director of Cornell's Center for Radiophysics and Space Research, says the amount of radar reflection indicates that the planet's surface is probably composed of denser material than the surface of the moon.

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