RADAR ASTRONOMY

Closeup of Venus

Though it is the brightest planet in the heavens, Venus has always been less than clear to astronomers. Wrapped in dense clouds of gases, the Venusian surface remains hidden even to the most powerful optical telescopes. Now, scientists are employing electronic means to explore the mysteries of the earth's sister planet. Using radio beams, Radar Astronomers Richard M. Goldstein and Shalhav Zohar of Caltech's Jet Propulsion Laboratory reported last week that they have mapped 160,000 sq. mi. of Venus, an area about equal to the size of the entire U.S. Northeast.

Their rough but unique closeup of Venus stems from 17 radar probes with NASA's 210-ft. dish antenna at Goldstone, Calif., last summer. At that time Venus was only 26 million miles from the earth. Since then, the scientists have been "drawing" a map by feeding their electronic findings into a computer. The result shows three blotches of extremely rough terrain, which Goldstein presumes are mountains, moonlike craters or fields of boulders.

Clocking the Signal. Celestial radar mapping is based on the same radio-echo techniques used in plane spotting and ship navigation. But bouncing radar waves off planets requires far more power and precision. For the Venus experiment, the Goldstone installation operated at 100,000 watts, twice the power of the largest U.S. commercial radio stations. When the signals came back 4½ minutes later, they measured just a tiny fraction of a watt.

Yet even that faint feedback carries a definite message. If the signals bounce back polarized—in other words, with their electric fields reversed—they indicate rough terrain. Unpolarized echoes, on the other hand, mean smooth surfaces. In either case, the target areas are pinpointed by a system of coordinates similar to latitude and longitude. One coordinate is located simply by clocking the signal: the quicker it bounces back, the closer the bounce-back point is to that part of Venus nearest to Earth.

Determining the other coordinate is a more complicated matter of listening for a so-called Doppler shift in frequency. If the echo comes from the side of the planet spinning toward Earth, it will rise in frequency, just as the whistle of an approaching train seems to move up in pitch. If the reflection comes from the side rotating away from Earth, it will go down in frequency.

While their map is the clearest view yet of Venus, the Caltech researchers are not the only radar astronomers mapping that planet. Similar surveying is being carried out by Cornell scientists using the 1,000-ft. dish telescope at Arecibo, Puerto Rico, and by MIT astronomers at two sites in Massachusetts. In March, Venus will again approach Earth. By boosting their radar signal to 450,000 watts, Caltech's electronic cartographers expect to make even more detailed maps.

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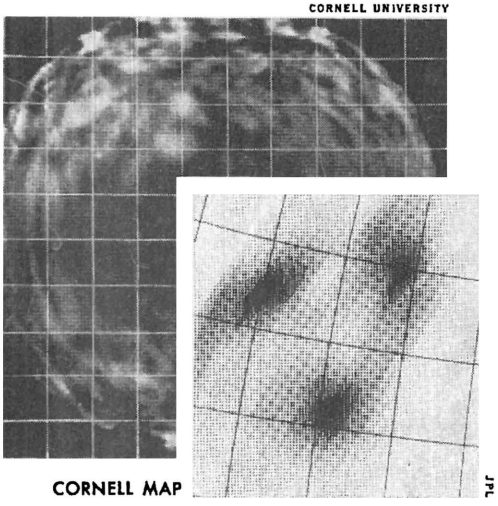

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JPL

JPL DETAIL

NUCLEAR PHYSICS

Father of Fission

The nuclear age dawned in the wrong place at the wrong time. In 1938, outside Berlin's Kaiser Wilhelm Institute for Chemistry, Nazis paraded in the streets. Inside, German Chemist Otto Hahn patiently probed the secrets of the atom. He repeated an experiment that had been tried by half a dozen researchers, including Enrico Fermi in Rome and Irene Joliot-Curie in Paris. With his primitive equipment, he repeatedly bombarded the element uranium with neutrons in an effort to create new man-made radioactive isotopes. According to the theories of the time, the neutrons should have combined with the nucleus of the uranium atoms to produce heavier, unstable isotopes. Yet he kept finding lighter atoms of barium. Gradually, the inexplicable presence of the barium, which is only about half the weight of uranium, persuaded Hahn that he had done what had always been considered impossible: he had split the atom.

Hahn's innate caution stopped him from making so bold a claim in public. "As nuclear chemists," Hahn and his young collaborator, Fritz Strassmann, wrote later, "we cannot bring ourselves to take this step, so contradictory to all the experience of nuclear physics." But Hahn's former co-worker, Physicist Lise Meitner, had no such hesitation. Hearing of the experiment in exile in Sweden, she not only proclaimed that Hahn and Strassmann had achieved nuclear fission, but also calculated that each atom of uranium had released 20 million times as much energy as a comparable amount of TNT.

Fission's frightening potential quickly became apparent to scientists everywhere. But Hitler considered the new theoretical physics too contaminated by Jews like Lise to be worthy of much support. Although not a Jew himself, Hahn was no friend of the regime. Throughout World War II, he was left undisturbed at his work, exploring radioactive isotopes. In the U.S., where scientists assumed that the Germans were following up his atom-splitting success, the race was on to achieve fission on a more Promethean scale. In 1945, after Germany's defeat, the results were displayed at Hiroshima.

AP

HAHN & MEITNER IN BERLIN (1959)
Appalled by the impossible.

Shattered Remains. One of many German scientists interned by the Allies, Hahn heard the news of the atomic bomb in England. Normally a man of dry, underplayed wit, he became so depressed by the appalling application of fission that his colleagues feared that he might commit suicide. Once back in Germany, Hahn struggled to rebuild the shattered remains of his old institute as president of its successor, the Max Planck Society. He also became an outspoken foe of atomic weapons. In 1957, joining the 17 other prominent West German scientists in the Göttingen Manifesto, he vowed never to take part in nuclear research for military purposes.

In postwar Germany, Hahn became the most revered elder statesman of what had once been Europe's proudest scientific establishment. He collected many awards, including a Nobel Prize in chemistry for his discovery of fission. But he always accepted such honors with characteristic humility. Visiting an atomic reactor or nuclear power station, he would shrug modestly: "It has all been the work of others." In a soon-to-be-published 300-page memoir, he brushed off his historic work in fewer than five pages. Last week, at the age of 89, the father of fission died peacefully in his beloved Göttingen.