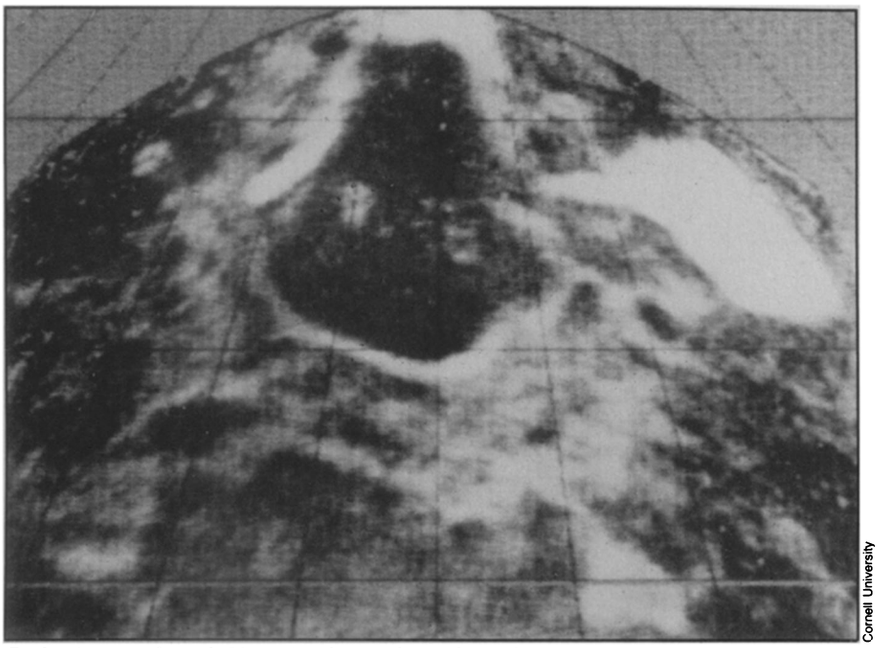
Radar image of Venus hints at tectonism



Radar image of north Venusian hemisphere shows basin (center) and Maxwell (right).

Volcanoes are numerous on the surface of the earth and frequently in the news. Our various visitors to Mars have given evidence of volcanism on that planet. Now, it appears, Venus joins the group of volcano-spawning planets. The first map made from the data of a new radar study of the planet, which covers a large section of Venus's northern hemisphere, exhibits three features that, observers say, are hard to attribute to external causes such as meteorite bombardment. They appear to be evidence of internal tectonic activity, possibly volcanism.

The three features include a large area discovered by previous radar studies and tentatively named Maxwell plus two small spots on the northern edge of a newly discovered "basin" that may or may not be a meteorite crater. The radar map that shows them results from a survey of the planet undertaken at Arecibo Observatory in Puerto Rico by D. B. Campbell and R. B. Dyce of Arecibo and G. H. Pettengill of Massachusetts Institute of Technology. Their report is in the Sept. 17 SCIENCE. According to these observers, their present work is the best resolved radar study of Venus to date.

Radar can "see" the surface, but interpretation of the returned signal faces important difficulties. One is the lack of sensitivity when long wavelengths are used. The other is the so-called delay-Doppler ambiguity: If the radar beam is wider than the planet—at planetary distances this is difficult to avoid—each point on a radar map will contain superimposed information from two points on the surface that happen to lie at equal distances from the antenna.

Improvement in sensitivity was made possible by the recent resurfacing of the Arecibo telescope, which allows the use of centimeter wavelengths, thus permitting an improvement up to 50 times the best previous figures for Venus studies. The two-point ambiguity can be resolved by interferometry, using a second telescope at some distance from the first. The difference between the backscattered signal received at the two telescopes can separate the information from the two points. For interferometry a second antenna 30 meters in diameter was constructed 10.7 kilometers north-northeast of the main (330-meter) Arecibo telescope. The arrangement was calculated to provide a resolution of about 4 kilometers on the surface of Venus in equatorial regions. At latitudes beyond 30° the resolution would be gradually degraded, reaching 20 kilometers at 60° latitude.

The data were taken in two-hour observing sessions each day for a two-month period around the inferior conjunction of Venus in August 1975. When such data have been properly reduced, they can be turned into images, photographic prints that show the difference in brightness reflected from different parts of the surface.

The image now published shows the area between northern latitudes 46° and 75° and over 80° in longitude. The average resolution is about 22 kilometers.

The two most salient features in the picture are a dark area about the size of Hudson's Bay (1,500 kilometers north to south and an average width of about 1,000 kilometers) and a bright area about the size of Oklahoma. The dark area is bounded by bright streaks, and—"in spite of the implications"—is called the northern basin. The bright boundary may be a steeply sloped rim. The origin of the basin can possibly be explained as the result of a meteorite impact, and such an interpretation is strengthened by a somewhat bright region to the southeast of it that could be the sort of ejecta blanket that such impacts throw out.

But the large bright area (Maxwell) and the two bright spots on the northern edge of the northern basin are something else. These areas all give the impression of overlying an older surface. Maxwell is big enough so that an enhanced image and detailed study could be made. It and the two bright spots of the basin show a probable high degree of surface roughness, well-defined boundaries and irregular shapes. There is also a suggestion of a series of linear ridges. "In conclusion," say the investigators, "Maxwell and the two other high-contrast features seem very indicative of tectonic activity," perhaps a large lava flow.

The noted characteristics make "an origin based on the impact history of the planet hard to conceive. There are no equivalent features on the moon." This in its turn throws some doubt on the meteoritic interpretation of the origin of the basin, because if tectonics could do what it seems to have done in Maxwell, it could also have made the basin. □

Soviets produce metallic hydrogen

"Nature did hydrogen a grave injustice," says Leonid Vereshchagin, director of the Institute of High Pressure Physics in Moscow. All the other elements in hydrogen's column of the periodic table are metals. Hydrogen alone is an electrical insulator, a dielectric. (The characteristic of a metal is that it has a structure endowed with a certain number of free electrons that can drift through the material as an electric current.)

Since location in a given column of the periodic table establishes a presumption of similar behavior, scientists have long believed that it ought to be possible to pressure hydrogen into a transition to a metallic state. Attempts to pressure hydrogen into a metallic state have failed up to now.

Ye. Yakovlev, a senior researcher at the Moscow Institute of High Pressure Physics, reports a success. His report and Vereshchagin's comments were first published in PRIRODA, a publication of the Soviet Academy of Sciences (issue No. 4 of the 1976 volume). An abridged English version appears in the Sept. 2 NEW SCIENTIST.

Researchers in the United States have tried to make metallic hydrogen with explosives. Explosions do produce very high pressure shock waves, Yakovlev concedes, but they have the drawbacks of high temperature and short duration "compounding the difficulties both of ob-