cell response occur. He went on to show that different units in the retina therefore distinguish color by their varying reactions to different parts of the spectrum. Retinal activity, Dr. Granit discovered, is controlled ultimately by the brain stem.

From his studies of light and what it does when it hits the eye, he also learned that light waves both excite and inhibit the discharge of electrical impulses—a phenomenon known as on-and-off activity in the eye. When you turn a light on, there is a brief period during which electrical activity in the optic nerve slows down before the expected burst of nerve cell activity takes place. When a light is turned off, Dr. Granit found, the flow of electricity then slows down as diminished light inhibits nerve cell behavior.

At Oxford, where he is in the department of neurophysiology, Dr. Granit's continuing research on nerve impulses has branched out to include electrical control of nerves in muscle tissue, ways nerve impulses convey senses of pain and touch, and further work on electrical activity in the retina. Writing a book describing his past studies of the eye also occupies much of his time.

During what little time is left over, Dr. Granit, who is married to Baroness Daisy Brunn, sails and enjoys his most recent avocation—gardening. His one son, Michael, is an architect in Stockholm. ◈

VENUS OBSERVED

Double probe sketches planet's portrait

If there were such an organization as an International Venus Committee, it could hardly have distributed the labor more evenly. On Oct. 17, Russia's Venus 4 began collecting data some 15 miles above the surface of earth's sister planet and continued all the way down to the surface. Two days later, the U.S. Mariner 5 flew by and made measurements that reached down to just about where the Soviet probe had started.

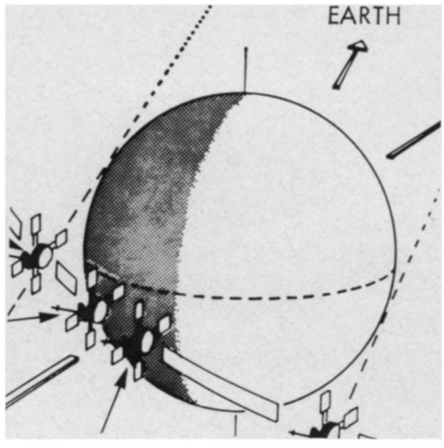
Although scientists from each country are reluctant to formulate theories that depend on the accuracy of the other country's results, they have been able to extract enough information from the reams of data bits transmitted by the two vehicles to fill in a little of Venus's sketchy portrait.

Prof. James A. Van Allen of the State University of Iowa, who discovered the belts of radiation that circle the earth, was unable to detect any such belt around Venus even with the aid of an elaborate instrument that was actually four detectors in one. Either there is no belt at all, he said last week, or it is a million times weaker than earth's and thus virtually undetectable.

One previous Mariner flight, which visited Mars in 1965, found no radiation belt there either. In fact, says Dr. Van Allen, earth's belt is rather extraordinary, since except for the giant planet Jupiter, there is no other object in the solar system known to have one.

The magnetic field of Venus is also either very weak—perhaps a three-hundredth as strong as earth's—or nonexistent, according to Mariner 5. Soviet scientists announced a similar finding, gleefully declaring that their probe had "corrected considerably" the data of America's first Venus probe, Mariner 2, which passed by the planet in 1962. Mariner 2, however, went no nearer than 21,594 miles, compared to Mariner 5, which came within 2,550 miles of the planet.

U.S. scientists would not be pinned down to a temperature for the surface of Venus, but they seemed to go along with the Russian finding of 536 degrees F. The previously accepted figure was about 800 degrees F., measured by Mariner 2. Before that estimates had ranged widely, even down to 40 degrees below zero. U.S. scientists will probably accept the Russian figure until Congress agrees to finance an American Venus lander, at which time the question will be opened all over again.



Mariner 5's occultation experiment.

Early this year, the National Aeronautics and Space Administration published an attempted summary of research into Venus' atmosphere. They could scarcely have been further wrong. More than 60 percent of the atmosphere could be nitrogen, the report said at the time, and most of the rest is neon.

Instead, Venus seems to have an atmospheric makeup much more like that of Mars, although immensely thicker. The Russians first announced that Venus was almost entirely blanketed with carbon dioxide, with only 1.5 percent of the atmosphere made up of anything else. Taking another look at their data, they changed the CO_2 figure to between 90 and 95 percent. The U.S. probe indicated that the amount of CO_2 is somewhere between 72 and 87 percent, if the remainder is mostly nitrogen, though the amount might be as high as the Russian estimate if lighter gases such as hydrogen and helium are also present.

A glowing hydrogen halo, or corona, was detected about 1,800 miles above Venus by Mariner 5, though the Soviet probe found only a weak halo. The reason for the apparent difference, said U.S. experimenter C. A. Barth of the University of Colorado, could be that while Mariner swung around the planet, covering both its dark and light sides, the Russian probe landed directly in the Venusian night, where indeed the hydrogen corona could be as much as 100 times weaker.

Another glowing effect, visible only through ultraviolet filters, was also found unexpectedly surrounding the planet. Possibly, says Barth, it is due to chemical reactions in the atmosphere or bombardment by charged particles freed by electrical discharges from the planet's surface.

The Soviet craft indicated that the pressure at the surface of Venus is about 22 times that on earth, or 323.4 pounds per square inch. Previous estimates had ranged from two or three times earth normal to a crushing 300 times, equivalent to more than 4,400 pounds per square inch. But the pressure would need to be only eight times earth's in order to produce an almost psychedelic phenomenon that prompted Stanford's Prof. Von R. Eshleman to describe the planet as a "hell hole."

The hell, he said, is from the high temperatures. The hole, however, is an amazing effect that would be visible only to an observer whose eyes, unlike an earthman's, could see light in long, millimeter wavelengths. The dense atmosphere would bend such light so much that it would travel all around the planet instead of reflecting back out into space. The result would be that instead of setting, the sun would seem to dissolve a few degrees above the horizon, then "reassemble itself" above the opposite horizon the next morning. During the night the glow from the opposite side of the planet would keep the planet alight with a faint radiance.

In addition, at all times, the horizon would appear to curve up instead of down, so that to the observer it would appear as if he were standing in a hole.

Even had it had no experiments aboard, Mariner 5 would have made a contribution. Analysis of its trajectory provided pinpoint-accurate calculations that led to new values for the mass of Venus (.815003 times that of the earth), the mass of the moon (1/81.2999 times that of the earth), the astronomical unit or mean distance from earth to the sun (92,955,659 miles, plus or minus 62 miles) and other quantities.

Collecting Mariner's information was a nerve-racking experience. The signal strength at one point got down as low as 10^{-20} watts. One team of experimenters at Stanford even arranged to have the entire town of Woodside, Calif., switched to auxiliary electric power to ensure reliable continuous operation for its experimets, which could only be done once during Mariner's 23-minute trip behind Venus.

Despite the reams of data accumulated from Mariner 5 and Venus 4, Venus seems determined to hold on as long as possible to her title of earth's secretive sister (SN: 7/22). Among the unanswered questions: Why does the planet stubbornly rotate in the opposite direction from all but one (Uranus) of the other planets in the solar systems? And why do the dense clouds that cloak her in mystery scream around the planet 50 times faster than she herself is turning? Venus's hostile environment may never see a live astronaut, but scientists will continue to seek their answers in whatever ways they can. Until money and favorable earth-Venus positions are available, they will delve into the tapes of the Mariner message and whatever raw data the Soviets make available. Hidden there may be answers to innumerable questions that we don't yet know enough to ask. ◈

RADIO ASTRONOMY

Progress in Europe: Envy across the Atlantic

American radio astronomers have good reason to envy their European colleagues; two papers in an international symposium just ended at the Massachusetts Institute of Technology outline European projects for large radio telescopes which have been authorized. By contrast, American projects discussed at the symposium are frozen on the drawing board—and likely to remain there for at least a year, victims of present frostbite climate in money for basic research.

The largest fully steerable radio telescope today is the 250-foot diameter dish at Jodrell Bank in England. This will be surpassed by 1970 when a 328-foot dish, now being built for the University of Bonn, West Germany, goes into action. In 1971 the British will again take the lead with a 400-foot instrument.

Dr. O. Hachenberg, of the Max-Planck-Institut für Radioastronomie, describes the $5.5 million Bonn telescope as able to withstand winds up to 40 miles per hour without deformation. He expects to lose only one day of observing time a month through bad weather. His design team studied the possibility of enclosing the antenna in a radome, but concluded it would cost too much.

The major news of the meeting came when H. C. Husband of Husband and Co., announced that the British Government had granted his firm the contract to design a 400-foot telescope as a big brother for Jodrell Bank's instrument, designed by the same firm. Although the Government has not yet decided to build the instrument, this step is almost certain.

Like the 250-footer, the new instrument will be run by the University of Manchester's Radio Astronomy Department, headed by Sir Bernard Lovell. It will cost $14 million, and should be operating within four years. The antenna will function on a broad range of wavelengths down to 10 cm.

The new telescope will be located some distance from Jodrell Bank. This will permit radio astronomers to perform interferometry experiments with the two large dishes; by making simultaneous observations of objects in the sky with two radio dishes, astronomers achieve a resolution equivalent to that from a giant dish stretching between the two. Microwave radio will connect the pair.

American astronomers, while privately expressing some doubts as to whether the new instrument will achieve its anticipated accuracy, unanimously applauded Sir Bernard's success in obtaining funds for an instrument which, in the words of one American, "will keep the British in the forefront of radio astronomy."

The U.S. answer to the giant European dish is a 440-foot antenna enclosed in a radome, proposed by Northeast Radio Observatory Corporation (NEROC), an association of northeastern universities. A special panel set up by the National Science Foundation recommended in August that the proposal should be deferred until more is known about its performance in comparison to that of fixed spherical dishes of the Arecibo type.

NEROC's studies show that a radome-enclosed structure should cost about $17.7 million, about half as much as an exposed telescope of equivalent performance. And the radome offers many additional advantages, according to Herbert G. Weiss of M.I.T.'s Lincoln Laboratory. It gives the radio astronomer an air-conditioned room in which to operate his telescope. An antenna protected by a radome can be constructed inexpensively of lightweight materials, and thus requires less power for steering. Using computers to process all possible antenna designs and a radome to protect the dish, designers can now give the radio astronomer complete control over the performance of his instrument. And a radome-enclosed antenna gives more aperture per dollar, in Weiss's view.

Obviously, radomes have their disadvantages. The dome on NEROC's proposed 440-footer will reduce its effective diameter to 400 feet. Rain increases the noise from the radome. According to C. Scruton of the National Physical Laboratory in England, little is known, at present, about the effects of high winds on radomes.

However, NEROC proponents believe that they have ironed out most of the problems, and foresee that future, larger instruments (above 500 feet) will inevitably require the protection of radomes. Given the funding, there appears to be no reason why fully steerable telescopes so protected should not reach 1,000-feet in diameter. For example, Paul Weidlinger, a consultant for NEROC, announced that he had sketched out a preliminary for a 1,000-foot antenna which appeared perfectly feasible. Possibly, he said, radio astronomers are not brave enough in specifying their requirements. ◈

HOYLE ON STONEHENGE

Building bridges between disciplines

Britain's Stone Age Mt. Palomar—Stonehenge—was apparently built so that ancient sun worshippers could predict when their god would be eclipsed.

Stonehenge is a circular pattern of large stones in southern England that includes 56 stones in the outer ring. The stones are laid out in a scheme that obviously has meaning, but there is no agreement as to what that is.

That Stonehenge served as an astronomical observatory (SN:12/17/66) has been advanced by astronomers since early in this century, but archaeologists