Astronomy

The woes of Magellan

This fall, federal budget cuts may prematurely end the Magellan spacecraft's highly successful effort to map the entire surface of Venus using radar. But Magellan also faces a more immediate threat. At least temporarily, it has lost its voice.

Although the craft, which has already mapped 97 percent of the Venusian surface, continues to bounce its radar off the planet's rugged terrain, problems with on-board transmitters have prevented Magellan from radioing any of these data to Earth since early July.

In order to preserve the life of the more useful of its two faulty transmitters, the craft is likely to remain silent until Aug. 21, says Magellan project engineer David Okerson of Space Applications International Corp. in Washington, D.C. Since Magellan's tape recorder can store only a small amount of data, most of the mapping information gathered this summer will have been lost, he notes.

Magellan's communication woes began early this year, when the craft's main transmitter suddenly stopped adding the Venus mapping data to the standard carrier signal it beams to Earth. NASA engineers commanded the craft to switch to its backup transmitter, but that device has its own idiosyncrasy: Electronic noise, known as a whistle, prevents it from sending a clear signal to Earth (SN: 1/25/92, p.63).

By the end of January, scientists had circumvented most of the problem by encoding the mapping data at a lower-than-normal electronic frequency. Though the lower frequency relays information at less than half the normal rate, researchers found that this signal was not obscured by the whistle prevalent at higher frequencies.

Last month, however, transmission took a turn for the worse. After spending three weeks behind the sun, Magellan emerged with a backup transmitter that was slightly warmer and somewhat noisier. Researchers speculated that the temperature rise had triggered the increase in noise, since the backup device didn't whistle when it was first turned on and remained below 35°C. But in June, they found that a slight cooling of the transmitter only made the noise worse.

Standard 34-meter antennas on Earth, part of a network designed to receive signals from space, could no longer decipher the mapping data. Although 70-meter antennas could still receive the mapping information, these instruments were often busy getting data from other spacecraft.

So on July 15, researchers took a drastic measure. They commanded Magellan to turn off the whistling transmitter – thereby substantially cooling it – and to switch back to the faulty main transmitter, which can relay the craft's engineering data but none of the mapping information. Scientists hope that giving the backup transmitter a rest now will enable it to operate normally during the first two weeks of September, when Magellan will fly over an unmapped portion of Venus' southern hemisphere.

NASA intends to use one of two strategies to keep the backup device working come September. Scientists may decide to turn the device on and off for short periods during each 3.1-hour orbit, so that the transmitter will remain below 35°C. Alternatively, they may choose to keep the device at about 58°C, a relatively warm temperature at which it has sometimes performed well.

Tests scheduled to begin on Aug. 21 should determine the optimum strategy, Okerson says. He adds that the current difficulties will not affect Magellan's ability to probe Venus' interior by measuring surface gravity. That part of the Magellan mission, which will begin in October but could be severely limited in scope by NASA's tight budget, relies only on the craft's standard carrier signal and does not require transmission of mapping data.

Chemistry

High pressure mates helium, nitrogen

For the first time, scientists have used lighter-than-air helium gas to make a solid compound. In the past, helium would form a solid only by itself. Now, Willem L. Vos, a physical chemist at the Carnegie Institution of Washington (D.C.), and his colleagues have used very high pressures to coerce room-temperature helium to combine with nitrogen.

"It's not a regular compound," says Vos. "It's a compound that exists because of packing effects." The substance lacks the covalent, ionic, or metallic bonds that typically link unlike atoms in a material; yet it still forms a solid crystal.

To make this compound, Vos and his colleagues crushed a gaseous nitrogen-helium mixture between two diamonds in a diamond anvil cell. When the pressure exceeded 77,000 times that of Earth's atmosphere, they saw a solid crystal appear.

Its crisp facets indicated that the crystal contained both types of atoms: Pure helium or nitrogen forms rounded surfaces, the researchers report in the July 2 NATURE. The crystal contains 11 nitrogen molecules for every helium atom.

Vos and his colleagues consider this compound one of a new class of materials, so-called van der Waals compounds, and expect that they and others will make more of them this way. Already, Michel Jean-Louis from the University of Paris in France has made a new helium-neon solid, Vos adds.

Eggplant's flavor peaks at 42 days

Spanish food scientists studying the chemistry of eggplant have determined that this purple vegetable tastes best about 42 days after the fruit begins to form. Rosa M. Esteban and colleagues at the Autonomous University of Madrid tracked the acidity and chemical content of three varieties, analyzing them at days 5, 11, 15, 28, 42, and 54.

In the June JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY, they report finding little difference among the three types. But in all three, they observed that sugar content declined during the second week of growth, then increased up through the end of the sixth week, and finally dropped dramatically during the next 10 days. The amount of ascorbic acid and of phenols – important flavor compounds – also increased dramatically through the 42nd day, then dropped precipitously. Thus, they conclude that the eggplant reaches its most delectable state after six weeks.

Silk, glue proteins in worm's cement

By extracting the contents of cement glands from thousands of marine worms, scientists have identified a component of silk and two unusual proteins used for making the worms' tubes.

These polychaete worms build large reef-like mounds made up of single-worm tube shelters. The worms glue together sand particles they collect from water washing over them. Like mussel glue, this tough, waterproof worm cement intrigues chemists studying adhesives (SN: 1/5/91, p.8).

To begin the identification, Rebecca A. Jensen of the University of California, Santa Barbara, allowed worms brought into the laboratory to use only very tiny silica beads for building their tubes. When she and her colleagues analyzed pieces of the worm tunnels, they could separate out the silica from the rest of the chemicals. In this way, they determined that the glue contains a lot of L-dopa, a modified amino acid, says Herbert Waite, a biochemist at the University of Delaware's College of Marine Studies in Lewes. The researchers were then able to isolate two dopa-rich proteins from the cement glands, they report in the June 30 BIOCHEMISTRY.

The L-dopa forms hydrogen bonds more readily than water and so may displace water molecules that would otherwise block adhesion, Waite says. Also, L-dopa may help form links between protein molecules to harden the cement.