SCIENCE NEWS of the week

The Winds and Rocks of Venus

VEGA is an acronym, formed from the transliterated Russian names for Venus (Venera) and Comet Halley (Kometa Galley). And two Galley-bound VEGA spacecraft have now taken the latest steps in the Soviet Union's long-running, increasingly sophisticated Venera study.

By a substantial margin, VEGAs 1 and 2 are the most advanced members of the spacecraft fleet (including one European and two Japanese entries) bound for encounters next March with the world's most famous comet. Their trajectories were chosen so that, on the way, they would swing past Venus — subject of as many as 15 Soviet spacecraft missions — using the planet's gravity to direct them toward their cometary goal. On the way by, each craft would deploy a capsule, about 2.5 meters across, to give Venus yet another look by two extremely diverse methods.

Last week, as each capsule struck the atmosphere, the deceleration activated a timer that opened the capsule like a walnut, releasing a landing craft that continued on down to the surface and an automatically inflating helium balloon that bobbed along, about 55 kilometers up, while an elaborate network of tracking antennas on earth monitored them to trace the movements of the Venusian winds.

The VEGA 1 balloon and lander were deployed on June 10 (by U.S. time zones) and the VEGA 2 equivalents on June 14. The balloons, developed by the French, were tracked by an international array of antennas that included six Soviet facilities, the three stations of the U.S. Deep Space Network and 11 radio-astronomy observatories. Using Very Long Baseline Interferometry (VLBI), the system followed the balloons' exact movements by measuring the relative positions between each balloon and the flyby craft that had jettisoned it, and between each flyby and Venus's center of mass. A similar experiment, though with far fewer ground antennas, was used in 1978 to track the four descent probes of the U.S. Pioneer Venus mission.

The Pioneer Venus probes, however, were basically just going down through the atmosphere, while the VEGA balloons each provided about 46 hours of data (before their batteries ran out) from their relatively fixed altitude. According to Robert Preston of Jet Propulsion Laboratory in Pasadena, Calif., control center for the Deep Space Network, each balloon traveled about 115° of longitude around Venus, crossing some 12,000 km of the planet's surface (the first two-thirds of it on the night side) at raging wind speeds of about 250 kilometers per hour. Vertical wind speeds were also measured by the three-dimensional VLBI technique, and Valery I. Barsukov of the Vernadsky Institute of the Soviet Academy of Sciences in Moscow described the early indications as "stormy." Producing detailed analyses of the complex experiment, however, may take six months or more, says Preston.

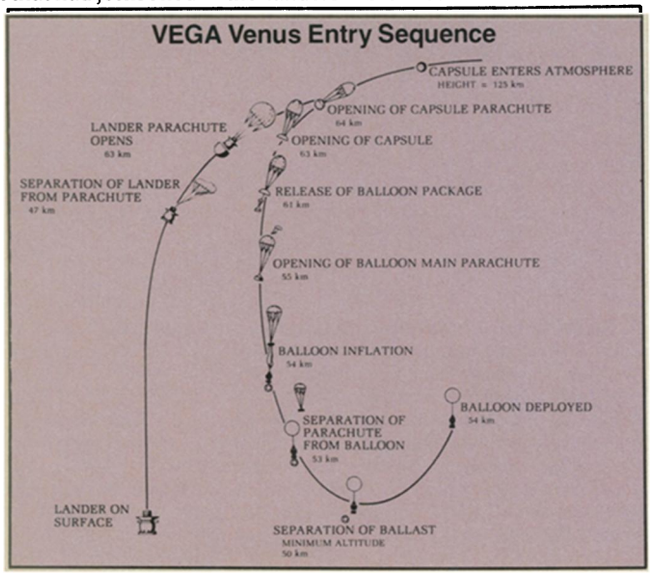
The 55 km altitude of the balloons' cruises was chosen to be in the most dense of the Venusian cloud layers, and each craft was also equipped to measure temperature, pressure, the amount of sunlight getting through and the sizes of the cloud particles.

Another major aspect of the clouds, however, is their composition, which consists largely of sulfuric acid, shown by Pioneer Venus experiments to be as concentrated as the acid in a car battery. Composition measurement of the droplets was the job of the landers on their way down, which they were reported to have accomplished successfully. In addition, the landers were instrumented to detect flashes of lightning, inferred from past spacecraft data and cited by some researchers as possible evidence for ongoing volcanic eruptions. And at least the VEGA 2 lander, according to a French source with Russian scientific contacts, indeed detected lightning.

The key role of the landers, however, was to sample the surface, adding to the results from past Veneras. By one early reckoning, the VEGA 1 lander touched down at 7° 10′ north latitude by 177° 42′ east longitude, while VEGA 2 went to 7° 01′ south by 179° 00′ east, about 1,650 km away, placing both craft several hundred kilometers west of an elevated region known as Atla. Comparing the reported coordinates with past data such as the Pioneer Venus orbiter's radar maps of the planet, James Garvin of the NASA Goddard Space Flight Center in Greenbelt, Md., notes that the VEGA 1 site could be the best example yet sampled of the smooth, lowland plains that cover as much as half of Venus. VEGA 2, he says, may have gone to an area that is even smoother, but about 2 km higher, possibly analogous to earth's continents in comparison with the VEGA 1 locale on the "seafloor."

Both landers were also equipped to sample the surface material (though one early account suggested that VEGA 1's sampler may not have been successful). Both were also the first of their line equipped for both gamma ray spectroscopy (measuring uranium, potassium and thorium) and X-ray fluorescence spectroscopy (providing element-by-element analyses of silicon, aluminum, titanium, calcium, iron and other materials), clues to Venusian mineralogy. Past Veneras have measured only one or the other.

—J. Eberhart



Flying past Venus on the way to March 1986 encounters with Comet Halley, each of the two VEGA spacecraft released a capsule that entered the Venusian atmosphere and separated into an instrumented balloon, which tracked the planet's wind movements for thousands of miles, and a landing craft that sampled the surface material and atmosphere.

Clocks test Einstein vs. Mach

It is almost 70 years since Albert Einstein published his general theory of relativity. The theory has become physicists' standard theory of gravity and the basis of modern cosmology. Yet that has not prevented a steady stream of physicists, discontented with some of its provisions or some of its principles, from trying to amend, rearrange or replace it. So far Einstein's theory has survived experimental tests. The latest test, done recently at the National Bureau of Standards (NBS) in Boulder, Colo., also corroborates Einstein's theory. The experiment concerns one of the foundation principles of the theory, Einstein's idea of the masses of material objects.

Mass is a basic property of material bodies and a number that goes into any calculation of their motions, but the working definition of mass that physicists use has never really satisfied philosophers of science. During the years in which Ein-