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Ballooning Around Venus

On 19 September 1783 a sheep, a rooster, and a duck went aloft—the first passengers in a balloon. Their trip was made possible by the finding of French scientists Joseph and Étienne Montgolfier that a fabric bag filled with hot air would rise. Shortly after their discovery the Montgolfiers launched an unmanned balloon which, to the astonishment of all, flew for 1.5 miles. In November 1783 the first manned flight took place when a balloon carrying two passengers traveled 5.5 miles in 23 minutes. The advancement of science had its protesters in that era, too: when scientists ballooning from Paris landed in a small rural village, they were attacked by peasants terrified by the arrival of beings from outer space.

The Montgolfiers came to their epic invention by observing that smoke flowed upward from fire and deducing that smoke had some mysterious property that they called "levity." The term seems fairly appropriate to describe ballooning, even though it now has a long tradition of scientific exploration and, sadly but inevitably, military applications. Ballooning conjures visions of a leisurely sightseer, whereas a spacecraft presents an image of a single-minded workaholic. Thus, the description in this issue of *Science* of the arrival of two balloons in the atmosphere of Venus strikes one not only as a scientific landmark but also as a delightful adventure. It seems appropriate that a visit to our nearest planetary neighbor, often only a mere 26 million miles away, was accomplished by a meandering balloon.

The proposal that a balloon could be used to explore the atmosphere of Venus was the idea of Jacques Blamont of France, who then enlisted the support of Soviet, French, and American scientists in a fine example of international cooperation. This cooperation was sustained and intimate as plans evolved from a focused mission to Venus alone to the final alternative of releasing a balloon from each of two Vega spacecraft on their way to Comet Halley. Moreover, the tracking of the balloons across Venus required the dedicated teamwork of scientists and engineers at radio observatories in ten different nations: Australia, Brazil, Canada, Great Britain, West Germany, South Africa, the Soviet Union, Spain, Sweden, and the United States.

These scientists had no easy task. The atmosphere of Venus has been described as a close approximation to the atmosphere of hell. The planet's surface temperature is about 470°C, in which even heavily insulated instruments may last only an hour. The balloons, therefore, were engineered to settle at an altitude of 54 kilometers, where the temperature is only 32°C. The winds on Venus blow with hurricane velocity, and the atmosphere contains primarily sulfuric acid as well as hydrochloric and hydrofluoric acids. At the balloons' altitude, solid-state materials could be used, whereas only vacuum tubes could last any time at lower atmospheric levels. The balloons, in fact, produced a wealth of valuable data for 46 hours.

This research is designed largely to satisfy curiosity about Venus, a planet almost the size of Earth but nearer the sun. Venus, like Uranus, rotates differently from the other planets. As in most basic research, there is a serendipitous and practical side in addition to the gathering of pure data. Although Venus rotates on its axis at about one-hundredth the rate of Earth, its atmosphere rotates far more rapidly. The greenhouse effect of Venus and the velocity of rotation of its atmosphere are significantly different from those of Earth. Since it is not easy to create meteorological experiments in a test tube, the prospect of testing ideas about meteorological behavior on Venus is attractive. In California, a state with an atmosphere as close to heaven as is conceivable, there has been some hellish weather recently. But warnings from meteorologists, armed continuously with information from space-based satellites during the recent floods, kept the loss of life very low. Weather prediction is still an imperfect art, but information from distant Venus may one day provide meteorological theory that will benefit earthbound nonballooners.

It is intriguing to speculate that a model for international cooperation was also developed by the teamwork of scientists from the Soviet Union, France, and the United States. Discovering common goals is easier in science than in world politics, but the search for enterprises that transcend international frictions cannot abate. Otherwise, the atmosphere of Earth may resemble that of Venus.—DANIEL E. KOSHLAND, JR.