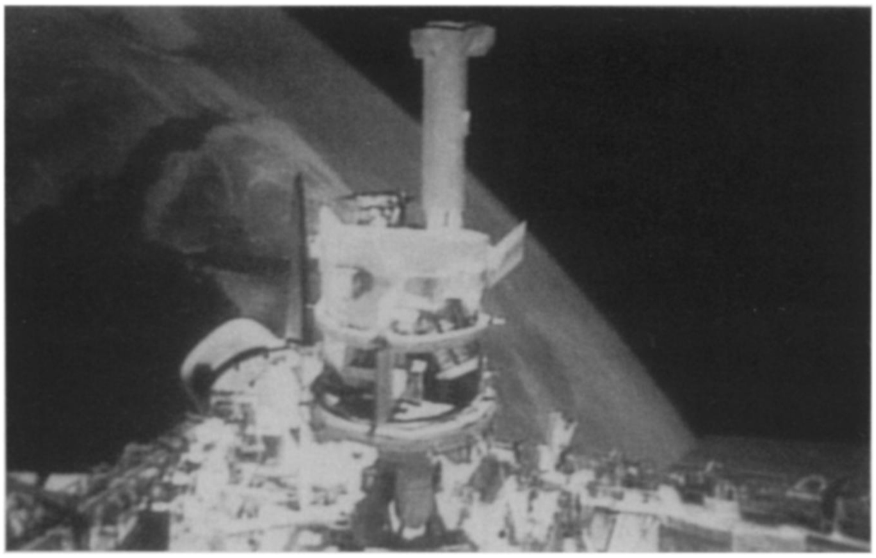
Spacelab 2 on the space shuttle: Abort to success

The 19th space shuttle mission began with a two-and-a-half-week delay, survived the shutdown of one of the vehicle's three main engines more than 67 miles above the ground, endured faulty performance from a vital telescope-aiming device and other instruments — and ended up a success.

The flight, the eighth for the shuttlecraft Challenger, was only seconds away from its originally scheduled launching on July 12, its engines already firing, when the main on-board computer shut everything off, apparently in response to a stuck valve. Reset for July 29, Challenger took off from Florida's Kennedy Space Center and was climbing at more than 8,600 miles per hour when engine No. 1 abruptly stopped firing. Ten seconds later, acting on instructions from the ground, mission commander C. Gordon Fullerton ignited another set of engines, the Orbital Maneuvering System, burning off enough fuel to save weight so that Challenger could reach an orbit that was still safe, though at a lower altitude.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Spacelab 2 telescope array, seen atop its pointing system in shuttle cargo bay.

But what would the effect on the mission be? Called Spacelab 2, it had been in the works for a decade, with plans to study the sun, the stars, cosmic rays, earth's ionosphere and more. The seven-member crew of the science-heavy flight included five Ph.D.s, working in round-the-clock shifts, and communications links with an army of scientists and engineers on the ground. (Less than a day after the troubled launching, NASA concluded that the problem was not with the engine but with faulty sensors that had incorrectly indicated overheating and triggered the shutdown. However, until the diagnosis could be confirmed by analyzing the engine following the flight's Aug. 6 return to earth, the space agency said it would not launch another shuttle mission.)

A key element of Spacelab 2 was solar physics, using a number of specialized telescopes mounted on a precise pointing system that was also being evaluated for several future missions, including studies of Comet Halley from earth orbit. Software problems with the pointing device at first threatened to render the whole solar package nearly useless, but by mid-mission, corrections radioed from the ground had it living up to its promise. Tracking specific locations on the sun's disk, the crew observed sunspots, filaments, granules, prominences and other features. One of the instruments, a solar ultraviolet high-resolution telescope, recorded the first observations ever made of the birth of a spicule, a high-speed jet of gas shooting up into the sun's corona. Many of the phenomena revealed by the instruments could be monitored as they changed over periods as brief as 5 to 10 minutes.

One instrument, called the Solar Optical Universal Polarimeter (SOUP), recorded what one official described as "the best and longest run of solar granulation data ever collected." But in keeping with the mission's pattern of triumph over adversity, the SOUP scored its coup only after inexplicably shutting down on the first day and just as mysteriously restarting with only two days to go. The improving flight was extended a day.

One of the most striking-looking instruments aboard Spacelab 2 was what University of Chicago researchers Peter Meyer and Dietrich Müller called "the cosmic egg." The huge ovoid was sent to count and analyze cosmic-ray nuclei as much as 100 times more energetic than any previously studied. An early look at the data indicated it recorded about 24 million particle events, of which perhaps 30,000 had energies in the formerly unexplored range from hundreds of billions to trillions of electron-volts.

An unexpected finding was provided by an infrared telescope that had been sent along to continue the work of the Infrared Astronomy Satellite in surveying stars and other sources in the infrared sky. During the telescope's very first use aboard Spacelab 2, however, many of its detectors were quickly saturated by a strong source of infrared background emissions of unknown origin, about 500 to 1,000 times more intense than the natural infrared radiation emitted by dust in the solar system.

With the survey plan essentially ruined (though a section of our Milky Way galaxy was mapped at shorter wavelengths), Giovanni G. Fazio of the Smithsonian Astrophysical Observatory in Cambridge, Mass., set about trying to understand the strange background emission. Early speculation included effects due to the instrument itself, some otherwise unsuspected source in the sky, or even the shuttle itself. Studies from past shuttle missions have indicated that many materials can "outgas" trace contaminants of various kinds, too rarefied to matter in some applications but potentially ruinous to state-of-the-art astronomical detectors. One implication could be that the shuttle's cargo bay may be a poor site from which to conduct infrared observations at all, and a NASA spaceborne infrared telescope now in the works was converted even before Spacelab 2 from one that would stay in the cargo bay into one that the shuttle would deploy as a separate satellite.

Also long in the works for Spacelab 2 has been a plan to generate "artificial holes" in earth's ionosphere, using the shuttle's exhaust to restrict the supply of free electrons (SN: 4/22/78, p. 244). Besides aiding general ionospheric studies, one application of such holes (suggested a decade ago by Michael Papagiannis of Boston University) might be to conduct low-frequency radioastronomy through the resulting "windows." Eight holes were planned during Spacelab 2, but the propellant consumed during the launching left only enough hole-making exhaust for four. (Two of them, says Michael Mendillo of Boston University, resulted only from "fantastic" cooperation from other researchers who sacrificed other envisioned uses for the engine firings, such as further raising Challenger's orbit.) All four were well documented from ground-based observatories, however, and through one of them — formed over Hobart, Tasmania — G.R.A. Ellis of the University of Tasmania reported the detection of low-frequency cosmic radiation. —*J. Eberhart*