

■ The Columbia made a second 2-day flight on 12 November 1981. The launch was delayed by a nitrogen tetroxide spill, a low reading on the oxygen tank, and overpressure in the hydraulic system.

■ In 1982 the Columbia made three successful flights and the crew carried out a number of biological spaceflight tests. There were problems with the auxiliary power unit; 36 insulating tiles were lost; two recoverable booster rockets sank in the ocean.

■ In July 1982, a new, lighter fuel tank (to help increase payload lift) was readied for use.

■ A flight with the new vehicle Challenger scheduled for 18 December 1982 was scrubbed when hydrogen from the fuel system was found leaking in the engine area. Further checking revealed that all three main engines had a fuel or oxygen line leak.

■ In February 1983, NASA ordered a broad review of quality control, to be directed by Air Force Lieutenant General James Abrahamson. He noted that the oxygen leak could have created a "blow torch" in the engine area, had it not been detected fortuitously. "If it had gone undetected," *Science* reported (11 March 1983, p. 1195), "the leak could have resulted in a devastating explosion between 1 and 2 minutes after the Challenger had lifted off."

■ In 1983, Columbia and Challenger made four trips. Sally Ride became the first U.S. woman to travel in space. Several satellites were launched. One was recovered from space for the first time and another (TDRS) limped to orbit when its booster failed. Spacelab experiments were begun, and other "firsts" occurred.

■ In August 1983, more powerful solid rockets were used for the first time. "Inhibitor material" was removed from some of the rocket fuel to allow it to burn faster—another attempt to increase payload lift.

■ In October 1983, NASA detected a flaw in the type of material used as insulation in the nozzle of the solid rocket boosters and postponed a launch for one month to replace the nozzle. Had it not been replaced, rocket flames could have burned through the metal, possibly leading to an explosion or sending the craft into a lethal spin.

■ Discovery and Challenger made five flights in 1984, including the first to deploy three satellites on one trip.

■ In February 1984 NASA announced that the wings of the new vehicles Atlantis and Discovery—made lighter to increase lift capacity—would have to be reinforced with cross straps for extra strength. Wind-tunnel data had been miscalculated. In the interest of losing weight, the casings of the solid rocket boosters also were being changed to

Europe Assesses Its Options

Last week's shuttle disaster has come at a critical time for Europe's space community. It is currently locked in an intense internal debate over the detailed future of its own space programs and, in particular, the relative weight to be given to manned and unmanned space technologies.

The shuttle experience will inevitably strengthen the hand of those who argue the continued need for a European family of expendable launch vehicles, based on the Ariane rocket. But it also poses both technical and political questions to those promoting a greatly expanded European manned-space effort, such as French proposals for the minishuttle Hermès (*Science*, 17 January, p. 209).

In the short term, the delays and/or cancellation of shuttle flights will have an immediate impact on several space research programs. One of the first casualties, for example, will be the Ulysses mission of the European Space Agency (previously known as the International Solar Polar Mission) which was due to have been launched in May. This has already suffered from NASA's previous withdrawal from what was to have been a dual-spacecraft mission.

ESA is also a major contributor to the Space Telescope, for which it has provided 15 percent of the funding, and was scheduled to conduct the Earth Observation Mission with its own astronaut from the Spacelab in August. In addition, several individual countries—in particular West Germany—are participating in the Galileo mission to Jupiter and other scientific projects currently threatened with significant delays.

Conversely, the shuttle disaster has raised speculation that it could boost the commercial prospects for ESA's own launcher, Ariane. French officials, for example, are optimistic that it will raise their chances of persuading the British Ministry of Defense to allow Ariane to launch its Skynet 4c military communications satellite planned for 1988, since the shuttle launches of Skynet 4a and 4b satellites, due this June and next January, respectively, are among those likely to be put back.

Ariane, however, is not without its own problems. The launch of the French remote-sensing satellite SPOT has already been postponed several times (it is now planned for 20 February) because of remedial action needed after the failure of the last Ariane launch in September, and also the discovery last month of leaks in the rocket's fuel system. These delays also mean that there is little slack in the Ariane launch schedule to absorb customers who might want to switch from the shuttle.

Further down the road, the disaster is expected to confront Europe with many of the same questions as those being faced in the United States. In particular, some countries, principally Germany and France, which have argued for priority for a strong manned presence in space, remain confronted by others, such as Britain (and large sectors of Europe's scientific community), which continue to argue for the greater cost-effectiveness of unmanned space efforts.

A compromise between different national perspectives appeared to have been reached at a ministerial meeting in Rome last January (*Science*, 4 January 1985, p. 39). However, it has since become clear that the full range of projects endorsed by the meeting (including those that will constitute Europe's contribution to NASA's space station) cannot be achieved within the budget ceiling that was then agreed to. Some further compromises will have to be made.

ESA said in a statement last week that, while the agency was "deeply shocked" by the loss of the shuttle and the death of its crew, it continued to have "full confidence in the shuttle program and is convinced of its necessity," adding that "manned space flight is an indispensable part of the overall conquest of space."

At the same time, however, Frédéric d'Allest, the director general of France's National Center for Space Studies, has admitted that the catastrophe is going to be "a test for Europe," warning that some may use it as a "pretext" for holding back Hermès, which France has said it would like to see launched in 1995.

Space officials from ESA member states are meeting informally in London this week to try to reach a new balance between their different priorities. Escalating cost estimates, as well as budgetary and timing uncertainties about NASA's space station plans (and the U.S. agency's recent rejection of Europe's proposed hardware contribution) have already complicated their discussion. Last week's events have not made it any easier. ■ DAVID DICKSON