Shuttle and Ariane: The hard road to orbit

America's space shuttle and Europe's Ariane rocket have each flown five times. Each began with a four-flight test series, after which it was declared "operational" and set forth on the long-sought-for routine access to earth-orbit. But the road is turning out to be not so routine after all.

Last September, the first "operational" Ariane to be launched suffered what is believed to be a problem with the gearing and lubrication of the turbopump in its third-stage engine, and dumped its two-satellite payload into the Atlantic. This resulted in delaying the next flight, from last November to a launching that has only recently been rescheduled for June 3. The subsequent three flights have been scheduled for Aug. 26, Nov. 4 and an as-yet-undetermined date in January — intervals of less than three months, a difficult timetable to keep if other problems arise.

The June flight will also carry a double payload (the European Communications Satellite and the Amsat amateur telecommunications satellite, neither one a replacement for the two that sank), but the European Space Agency feels that it must do more than just succeed. Ariane is a commercial venture, competing with the shuttle for much of its business, and ESA is aware of "the need to preserve the confidence shown by other Ariane customers" who have made firm or tentative commitments to use the rocket in the future. Thus the flight plan has been designed "to reproduce a mission profile resembling as closely as possible" that of flight 5.

But even if all goes well in June, Ariane's delays have already placed ESA in the embarrassing position of transferring one of its own payloads to a different launch vehicle, and a U.S. one at that. The European X-ray Observation Satellite, Exosat, had been scheduled to be carried into orbit by flight #7, but Exosat has to be launched during an extremely limited "launch window." The slipping timetable thus forced ESA into having to choose between an Ariane launch that might be postponed into next year (if there were any more delays) or a U.S. Thor-Delta rocket launched from California. Heavily pressured by scientists eager for the satellite's data (and concerned that a long delay might cause some of the experiments to deteriorate), ESA bit the bullet and abandoned its own booster.

A fundamental goal of Ariane and the space shuttle alike is predictable, reliable service. But if any U.S. National Aeronautics and Space Administration officials were allowing themselves to gloat last year over ESA's launch-vehicle difficulties, they have since had problems of their own to worry about. The shuttle's first operational flight, number 5 overall, was a glowing success four months ago, placing two communications satellites in orbit, and doing so, NASA conspicuously pointed out, for paying customers. Next would come flight #6, which would also be the maiden voyage of Challenger, second shuttlecraft in the fleet. It was to have been launched in January, until engineers detected a hydrogen leak and traced it to a crack in the main combustion-chamber manifold of one of the vehicle's three main engines. A replacement engine was provided, but a leak was found there as well. A second replacement was installed, but a similar leak then turned up in another of Challenger's engines, and then in the third. Soon other cracks, of a different type, were found in engines undergoing long-duration tests at higher thrust levels. By now, NASA has crews of engineers and technicians working 24 hours a day, seven days a week, as officials hope to achieve a launch by the end of this month and struggle to minimize the damage to the timetable for subsequent missions.

But as with Ariane, there is more involved with shuttle flight 6 than just whipping a schedule into shape for its own sake. The key factor is the flight's payload, the first of NASA's tracking-and-data-relay satellites, designed to replace the ground stations that communicate with numerous other satellites in low earth-orbits.

One important early job for the tracking satellite, for example, will be to restore communications with the high-resolution Thematic Mapper aboard Landsat 4, which has been gathering earth-resources data from orbit since last year. The mapping device, which offers better spectral discrimination and vastly sharper images than the multi-spectral scanners aboard this and past Landsats, had been sending back its findings on the X-band communications channel, but Landsat 4's X-band transmitter stopped working on Jan. 15, just as researchers were beginning to become excited about the potential of their new tool. Fortunately, the mapper can also transmit on the Ku band, except that there is no Ku receiver to hear it — until the tracking satellite carries one aloft.

A more serious problem faces ESA's Spacelab 1 research module, due to be flown on the ninth flight of the shuttle. Spacelab is expected to generate so much scientific data that it has been designed to use two tracking satellites at once. The second one is set for shuttle flight 8, but ESA has been hoping to have Spacelab aloft by the end of September. Even if flight 6 is launched late this month, such a schedule would require the next three missions to take off at roughly two-month intervals, leaving little room for delays.

—J. Eberhart

Undersea optical fiber cables tested

Pulses of light moving through cables spun from glass fibers are expected to begin carrying part of the world's transoceanic communications by the start of the next decade. Tests of such technology are underway in various parts of the world, and representatives of Bell Telephone Laboratories, which appears to be furthest along at the moment, speak of having a system ready to deploy by 1988.

In October 1982 Bell did sea trials of a prototype cable for such use (SN: 10/30/82, p. 279). Peter K. Runge of Bell Labs' Holmdel, N.J., installation described the trials last week at the Topical Conference on Optical Fiber Communications '83 in New Orleans. The tests were made off the New England coast in 3,000 fathoms (5.5 kilometers) of water.

Optical fibers promise swifter transmission of more messages in a more slender cable than is possible with electrical signals in copper cables, and a transmission that is virtually error free. The tests support such a promise. Error-free transmission underwater at an information rate of 274 million bits per second for an hour over 18 km was recorded. When the cable was out of the water aboard the ship, all the individual fibers in it were connected in loops to form a path of 218.4 km, and error-free transmission was recorded over this length.

From the engineering point of view the biggest bonus promised by optical fibers is wider repeater spacing. Signals are degraded by passage through the conductor, and a circuit that restores their shape and strength, called a repeater, has to be inserted at intervals. Repeaters mean maintenance, and underwater repeaters have to be raised to the surface for repairs. Repeater spacing in copper cables is usually less than 10 km. For optical undersea cable a spacing about 30 km is often cited as a first practical goal, but much longer unrepeated runs have been recorded in experiments.

The undersea trials recorded unrepeated runs up to 91 km. With the same cable back on shore a group of ten Bell scientists, represented at the OFC meeting by R. E. Wagner of Holmdel, added a piece and succeeded with a 119-km unrepeated transmission at 420 million bits per second — the reported record for such things to date. Such achievements and the possibility of improved, all-optical repeaters (present ones use electronics) prompt I. W. Stanley of British Telecom Research Laboratories in Ipswich, England, to suggest future repeater spacings of thousands of kilometers, possibly a transatlantic cable without a repeater.

Stanley reviewed developments elsewhere in the world. The first underwater optical cable was laid across Loch Fyne in Scotland in 1980, and tests continue in the seas off Great Britain, France and Japan.

—D. E. Thomsen