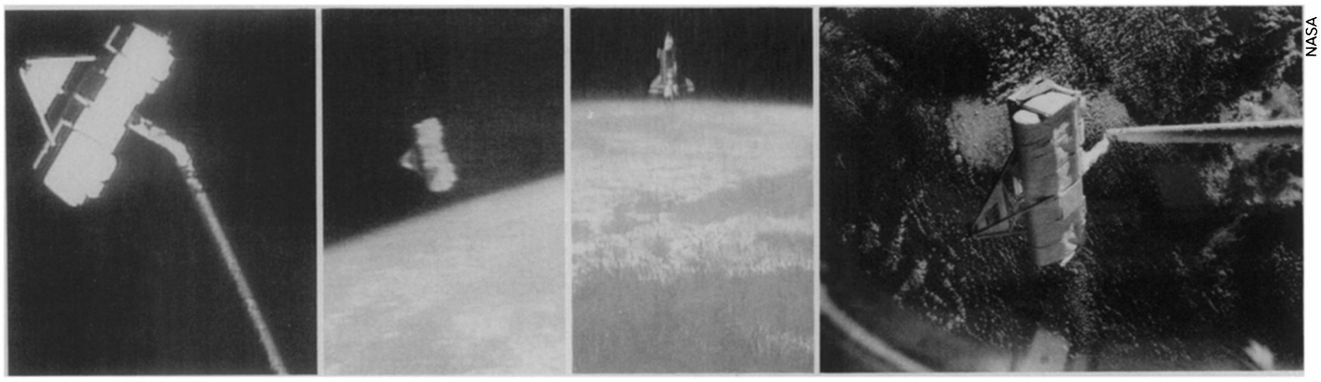
Shuttle 7: 'We Pick Up and Deliver'



L to R: The SPAS-1 satellite pallet, grasped by the shuttle's remote-control arm, is lifted out of the cargo bay, then set free in space where it moves away and photographs the shuttle itself, and is later retrieved by the arm.

"We've been told some crews in the past have announced, 'We deliver,'" said Robert Crippen, commander of the seventh space shuttle mission, alluding to the deployment of a pair of communications satellites during flight 5 last November (SN: 11/20/82, p. 324). "Well, for flight 7, we pick up and deliver."

Carrying payloads up from earth and depositing them in space is a major part of the shuttle's business, ranging from setting out satellites for communications and weather-watching purposes to deploying major observatories such as the huge Space Telescope, now expected to be launched in 1986. Another important role, however, is getting some of them back again. Some may be satellites that need repair, like the Solar Maximum Mission, or Solar Max (SN: 5/23/81, p. 324), whose ailing attitude-control system is scheduled for an attempt at on-site replacement during flight 13 next April. According to the head of NASA's shuttle program, Air Force general James A. Abrahamson, the ability to conduct such tasks (past satellites have been known to succumb to ills as minor as blown fuses) will "revolutionize the way we operate in space, bringing down costs and improving reliability." Other payloads will be retrieved for deliberate return to earth, like the Long Duration Exposure Facility (LDEF), designed to stay aloft for as long as a year at a time to subject various test materials to the space environment, after which it will be brought back down, given a new load of samples and sent up again. Before the crew of shuttle flight 13 goes to work on Solar Max, it is scheduled to place LDEF in orbit, for pickup by flight 24 the following March.

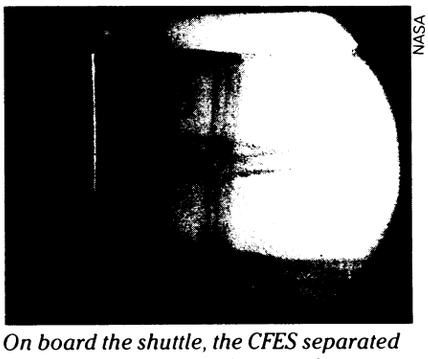
The highlight of flight 7, which lifted off on time on June 18, was the first test of whether the shuttle could indeed retrieve objects in space. The first items on the mission's busy agenda, however, were the deployment, as on flight 5, of two communications satellites. Canada's Anik C-2 is the second in a three-satellite series that will operate entirely in the 12/14 gigahertz communications band, each providing

Under zero-gravity conditions, splitting up is easy to do

A forerunner to an orbiting drug factory was put to the test last week on the space shuttle Challenger. While all the data from that test have not yet been analyzed, preliminary results look promising. In fact, officials from the companies that sponsored the experiment expect an improved model of the system — which separates a stream of sample material into individual chemicals and does so more efficiently under zero-gravity conditions — to be generating the first space-manufactured commercial product within several years.

The chemical-separating scheme — called a continuous flow electrophoresis system (CFES) — already had passed with high marks tests on two previous shuttle missions, say officials of the sponsoring companies, McDonnell Douglas Astronautics Co. and Ortho Pharmaceutical Corp. (a division of Johnson & Johnson). The tests are leading up to the production in space by the CFES of a new drug for the treatment of a protein deficiency disease, says David W. Richman of McDonnell Douglas in St. Louis. (The details regarding that drug still are corporate secrets.)

Electrophoresis is the movement of particles in solution when they are placed in an electrical field. The continuous flow version involves injecting a continuous stream of sample material onto a carrier fluid. Because the particles in the stream have different charges and sizes, they move at different speeds away from one electrode toward another with opposite charge, Richman explains; "this natural phenomenon makes electrophoresis a very useful technique for separating the different components of a mixture." On the ground, the technique is generally only useful for separating dilute solutions, because gravity can cause a sample that is more dense than its carrier fluid "to collapse in a blob around the [sample injection] port," Richman says. In space, where gravity is no longer a limiting factor, the CFES has been shown to generate 463 times more volume of separated material per unit time than that of the corresponding ground system, he says.



On board the shuttle, the CFES separated protein mixtures and also was shown to successfully separate pigmented plastic spheres into distinct streams of red (far right vertical band), white (left) and blue (center).

During the recent shuttle mission, Sally K. Ride, Frederick H. Hauck and John M. Fabian tested the system on the complex mixture of proteins naturally produced by living cells, in an attempt to isolate potentially therapeutic proteins. A McDonnell Douglas engineer is scheduled to operate such a system during a 1985 shuttle flight to obtain enough of the new protein deficiency disease-fighting drug in order to start testing on human subjects.

—L. Garmon

twice the capacity of the first Anik. Indonesia's Palapa 2 carries 24 transponders, providing voice, video, telephone and data services to the country's thousands of islands. Each was deployed by angling it upward in the shuttle's huge cargo hold on a turntable that was then set rotating to provide the satellite with stabilization. An automatic sequencing device then released a pair of springs to push each satellite free of the shuttle, after which a "kick motor" fired to send each satellite up to its planned geosynchronous altitude, from which it would hover over a fixed longitude on the earth below. Both deployments, conducted on successive days, went not only as planned, but more precisely than NASA had even been willing to commit itself to in advance. The ability to offer pinpoint accuracy of deployment could be valuable not only to NASA (in selling the shuttle's launch service) but to potential customers, for whom it could represent a greater planned operating lifetime for their satellites.

Preparations for the shuttle's first deployment-retrieval exercise began on the flight's third day. The key to the operation was the craft's "remote manipulator system," a 50-foot-long electromechanical arm that can be controlled from within the passenger compartment. The arm had been tested on two previous flights, but it had never been used for so much as picking an object up and putting it down, let alone setting it out in space as what NASA calls a "free-flier." The object of its attention last week was SPAS-1, a German-built Shuttle Pallet Satellite carrying 10 experiments concerned with materials-processing, remote sensing of the earth, evaluation of the near-shuttle environment and more.

With Sally K. Ride (the first U.S. woman in space) monitoring the controls of the SPAS itself, fellow-astronaut John M. Fabian guided the arm so that a snare-like arrangement of wires grasped a fitting provided expressly for that purpose on the pallet. Lifting the SPAS out of its berth in the cargo bay, he commanded the arm to release its grip, leaving the normally 3,307-pound pallet hovering in the weightlessness of orbit. Pausing briefly, he "took hold" of the SPAS again—the shuttle's first retrieval of a free-flying object — to confirm that both hardware and procedures were working. Letting go again for about a minute, he recaptured the SPAS a second time, this time to await approval from the Mission Control Center in Houston to free the pallet to go on a journey of its own. The device's electronics had been showing unexpectedly high temperatures, but approval finally came, and when Fabian released the SPAS again, Crippen gradually moved the shuttlecraft, Challenger, until it was about 1,000 feet below and ahead of the pallet.

From there, a TV camera aboard the pallet revealed a SPAS-eye view of the shuttle itself, hovering in the distance. During these operations, data indicated that the pallet was jostled only slightly by the firing of the shuttle's attitude-control jets, although it apparently detected exhaust particles even at the 1,000-foot limit. With the SPAS off on its own, Fabian and Ride put the arm through some other paces, simulating the presence of a larger, heavier payload. Then Crippen flew Challenger back toward the pallet once more, and with both shuttle and pallet set in "free-drift mode" so that neither was firing its thrusters, Fabian again took the device in "hand." "The [arm] was very controllable, and the SPAS itself was a very stable platform," Fabian said.

Ride then set the pallet to rotating slowly, about 0.1° per second, and astronaut Norman E. Thagard was still able to pick it up with the arm. The crew then took an extended lunch break to let the pallet's electronics cool again. After that, Ride released the device again while astronaut Frederick H. Hauck guided the shuttle to different distances, firing the attitude-control jets to gauge the pallet's response. At one point, said Crippen, "they really did upset it. It's a tribute to the engineers who put the SPAS together that it could take the kind of hits that it took."

The shuttle's next flight, planned for August, is scheduled to test the arm with a greater mass, a "payload flight-test article" that would weigh 8,500 pounds on earth. Even when weightless, objects still retain their inertia, and one of the shuttle's future payloads, to be deployed by the arm, is the Space Telescope, which on earth will weigh more than 32,000 pounds.

Other activities on flight 7 included a number of tests such as an electrophoresis experiment (see p. 4). Thagard, a physician who was added to the crew to study nausea and other symptoms that have affected about half the past shuttle astronauts, ran some tests, but there seemed no need for a bedside manner. "From the initial reports," says one NASA official, "nobody got sick. We had a bunch of leadbellies up there." —*J. Eberhart*

Senile dementia linked to immunity genes

Alzheimer's disease, a form of brain failure causing irreversible mental deterioration, is genetically confusing: it appears in some cases to run in families, but it also appears sporadically in unafflicted families. A recent analysis of the largest known family with Alzheimer's disease now indicates that susceptibility for the disorder may be carried on at least two genes — a finding that, if substantiated, could account for both patterns of transmission. And because both genetic regions are involved in coding for normal immune function, the study suggests that the expression of the disease may depend on an accumulative disability to fight off an inherited toxin.

University of Rochester geneticist Lowell R. Weitkamp studied an eight-generation family of 257 individuals, 51 of whom had Alzheimer's disease. Based on blood samples taken from almost 100 living family members, Weitkamp found that dementia was associated with variations in two components of the body's immune system; the genes for one, called HLA, are carried on chromosome six, and the other, the immunoglobulins, are coded on chromosome 14. The association suggests that the genes implicated in Alzheimer's disease are located near the genetic regions that code for immune response, which further suggests that such progressive senility may involve malfunction of the brain's immune reaction.

The extended family under study — an isolated and inbred clan from New Brunswick, Canada — was originally studied (through clinical interviews, brain autopsies and historical records) by Linda Nee and Ronald Polinsky of the National Institute of Mental Health in Bethesda, Md., and the inheritance pattern they found indicated that Alzheimer's was carried by a single, dominant gene.

But according to Weitkamp, further analysis of the specific patterns of inbreeding, age of onset and duration of the disorder indicate that individuals who are more closely related have a more similar disorder than that seen in more distant relatives; this, Weitkamp says, points to the importance of more than one modifying gene in the actual development of dementia. In addition, Weitkamp says, the apparent linkage of the disorder to a particular HLA type in one part of the family is correlated with extensive inbreeding in that branch of the family; because inbreeding increases the chances of combining both "susceptibility genes," it would appear that the second gene must contribute to overall vulnerability. What may happen, Weitkamp speculates, is that some kind of viral DNA is integrated into the chromosome and transmitted by a single, dominant gene; but the expression of the illness is ultimately dependent on two (or perhaps even more) genes, which could be inherited from either an afflicted parent or a healthy carrier.

Weitkamp previously discovered a linkage between the HLA genes and depression (SN: 12/5/81, p. 356), and indeed a number of disorders seem to be related to variation on chromosome six. If a disorder requires an interaction between two susceptibility genes in order to be expressed, Weitkamp suggests, the nature of that interaction could produce transmission patterns quite unlike the linear pattern seen in this uniquely inbred family; it may be that apparently sporadic cases of Alzheimer's are indeed inherited, but through genes that are not expressed in every generation. —*W. Herbert*