SCIENCE NEWS of the week

Challenger: The 2nd Shuttle's 1st Flight

It was never the idea to have just one. Although even the first reusable space shuttle, Columbia, immediately introduced a radical change from the hundreds of throwaway rockets that had characterized the past years of the Space Age, the huge and costly effort has always been directed toward a family of shuttles, working in rotation. And last week, the successful maiden flight of Columbia's sibling, Challenger, just as dramatically changed the essence of the National Aeronautics and Space Administration's "space transportation system" from "shuttle" to "shuttle *fleet*."

Challenger's launching had been delayed two and a half months by the discovery of leaks in the plumbing of its main engines, a problem that required round-the-clock, triple-shift labors by engineers and technicians to keep the fleet's tight future schedule in at least a semblance of order. But once the new craft was set on its new timeline, it went right by the numbers, taking off only 0.08 seconds late on April 4 and landing just over five days later at California's Edwards Air Force Base.

Gen. James Abrahamson, NASA's associate administrator for space flight, called Challenger's initial outing "superb"—and with examples. The original shuttle, Columbia, experienced 82 "anomalies," or technical problems during its own maiden voyage in 1981, according to Abrahamson, whereas Challenger, he says, underwent only 22. For the first time in the six shuttle flights to date, in fact, he says, "we did not have to do any significant replanning of the mission [once the craft was on its way]. It was flown exactly according to plan." In short, "all the indications are [that Challenger] is indeed a better spacecraft."

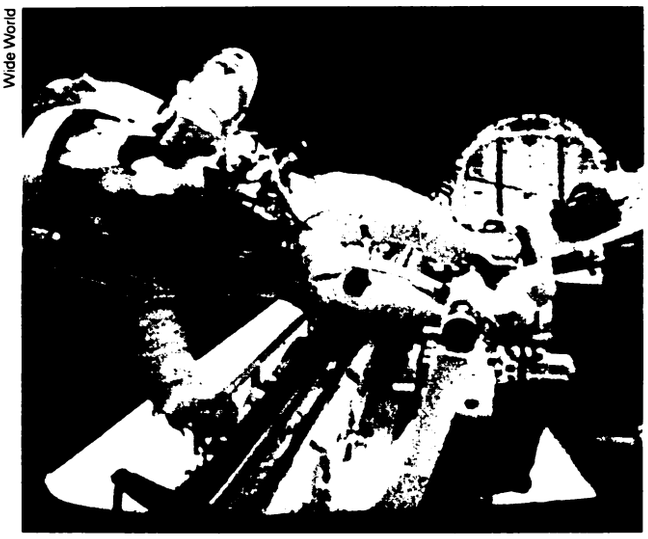
It is also a more powerful one. Its engines, which one NASA official characterized as "probably the tightest engines in the world" after their leakage problems had been fixed, were operated at up to 104 percent of their rated thrust. In addition, Challenger's huge external fuel tank and the motor casings of its solid-propellant booster rockets had been lightened by about nine tons from previous versions, and other changes saved yet more weight. Compared with Columbia's fifth flight last November, Challenger's first carried over 40 percent more payload in its huge cargo bay.

But the goals of the mission depended on more than the operation of the shuttle-craft itself. A principal objective was to deploy the first of NASA's Tracking and Data-Relay Satellites, intended to replace the ground stations that have always been the agency's link with its earth-orbiting satellites. Stretching 57 feet from tip to tip of its solar panels, the 5,000-pound, $100 million TDRS (the first of three, including an orbiting spare) has been described as the largest, most complex communications satellite ever launched. Designed to look down from a fixed equatorial longitude at a "geosynchronous" altitude of 22,235 miles, it is planned to be capable of keeping in touch with as many as 26 lower-orbiting satellites at a time. One of its first and most important jobs will be to relay the vast streams of scientific data expected from the European Space Agency's manned Spacelab research module, to be carried on the ninth shuttle flight, scheduled for late September. If, that is, the TDRS is on station at the time.

Challenger's astronauts deployed the satellite as planned, manipulating controls to stand it upright in the payload bay and releasing a spring to set it free. About 55 minutes later, the first stage of a two-stage Air Force booster called the Inertial Upper Stage ignited automatically to start the TDRS on its way to its geosynchronous altitude. All seemed to be going well, even when a radioed ground command, as planned, ignited the IUS second stage for an expected 105-second "burn." About 80 seconds into that burn, however, all the telemetry signals from the TDRS/IUS "stack" suddenly ceased. Controllers on the ground first concluded that the satellite was tumbling out of control, then that its batteries were about to fail, then that it might be permanently stuck to the dead weight of the now-spent IUS. Order was restored, but the TDRS turned out to be in a low, elliptical orbit rather than the planned circular path. This week, officials were refining a plan to use timed burns from its steering jets in an effort to get the device on station.

No such anomaly marred the flight's other major milestone: the first U.S. spacewalk in nine years. Astronauts F. Story Musgrave and Donald H. Peterson spent nearly four hours maneuvering about the open cargo bay, a task that had been canceled on the previous flight due to spacesuit problems. For the shuttle's busy future, such mobility will be a necessity. —*J. Eberhart*

Wide World



Astronaut Donald H. Peterson holds onto a handrail in the cargo bay of the space shuttle Challenger, during the first U.S. spacewalk since the final Skylab mission in 1974. Together, he and astronaut F. Story Musgrave inspected their craft, practiced rigging a winch cable and tried other tasks under weightless conditions.

Virus now indicted in toxic shock

At first the toxic shock syndrome — characterized by vomiting, diarrhea, fever and rash — seemed to be due to the bacterium *Staphylococcus aureus*, which was already known to be capable of causing a spate of diseases, from boils and wound infections to meningitis and pneumonia. But now the villain appears to be not *S. aureus* per se, but rather a virus that has insinuated its genetic material into that of *S. aureus* and that is commanding it to churn out disease-causing toxins.

This finding, by Steven E. Schutzer, Vincent A. Fischetti and John B. Zabriskie of Rockefeller University in New York City, is reported in the April 15 SCIENCE.

Several factors led Schutzer and his co-workers to postulate that *S. aureus* is serving as a henchman to a resident virus. One was the discovery during the 1960s and 1970s that scarlet fever and diphtheria are due to toxins made by bacteria at the instruction of viruses. Another was the marked similarity in symptoms between scarlet fever and toxic shock. The third was the 1981 finding that *S. aureus* isolated from toxic shock victims makes two kinds of toxins.

To test their hypothesis, Schutzer and his colleagues first collected 12 strains of

S. aureus isolated from toxic shock victims and 18 strains of *S. aureus* from other persons. These included women who had been harboring *S. aureus* in their vaginas and who were not suffering any disease from the bacterium's presence as well as individuals who had acquired *S. aureus*-induced wound or skin infections while hospitalized for other problems. The investigators examined all the strains for the presence of a virus. They found it in 11 of the 12 toxic shock-associated strains, but in only 1 of the 18 other strains. What's more, they managed to get the viruses from two of the toxic shock-associated *S. aureus* strains to incorporate their genetic material into that of an apparently harmless *S. aureus* strain.

Both results, they conclude, suggest that one or more viruses "in certain strains of *S. aureus* may be responsible for the pathogenesis of toxic shock syndrome."

This is indeed a possibility, Mitchell L. Cohen, a toxic shock researcher at the Centers for Disease Control in Atlanta, told SCIENCE NEWS, because "there are lots of viruses that infect *Staphylococcus*." Ellen Jones, another CDC scientist studying the syndrome, concurs. But the number of *S. aureus* strains studied by the Rockefeller group was "rather small," she cautions, and virus needs to be taken from more toxic shock-associated strains before any firm conclusion about an *S. aureus*-inhabiting virus causing toxic shock can be drawn.

Schutzer and his colleagues will now try to see whether the harmless *S. aureus* strain infected with viruses from the toxic shock-associated strains can produce toxic shock-like damage if injected into laboratory animals. If such damage is produced, it remains to be seen whether it occurs via the toxins produced by toxic shock-associated strains. Also requiring further study is the connection, if any, between the viruses and the use of high-absorbency tampons, which seem to enhance a woman's susceptibility to toxic shock (SN: 7/5/80, p. 6). —*J.A. Treichel*

AIDS update: Search for 'Agent X'

Tiny, flower-shaped structures have been found in the lymph cells of homosexual male patients who died of acquired immunodeficiency syndrome (AIDS) and in a group of homosexual males with early symptoms of AIDS. The discovery may help diagnose future cases of this new and increasingly frequent, often fatal disease, researchers at the Centers for Disease Control (CDC) in Atlanta report. Elsewhere on the AIDS trail, virologists and immunologists at a National Institute of Allergy and Infectious Diseases (NIAID) workshop last week concurred that AIDS is caused by an infectious agent, probably one of 17 viruses discussed at the meeting.

The lymph cell structures, called "vesicular rosettes," were discovered by CDC's Edwin P. Ewing Jr. and associates. In the April 7 NEW ENGLAND JOURNAL OF MEDICINE, they described the microscopic vesicular rosettes as "unusual cytoplasmic bodies" composed of a circular cluster of small vesicles — tiny, balloon-shaped pouches. These were found in the biopsied lymph glands of 17 out of 18 homosexuals with lymphadenopathy—an early sign of AIDS characterized by swollen lymph glands. Only two of 31 control subjects with various other lymph-related disorders were found to have the rosettes. Lymph cells from autopsies on patients who had died from AIDS also revealed rosette structures in three of six patients tested.

The structures may be related to an agent common to lymphadenopathy, AIDS and some lymph cancers, the researchers suggest. Although they found no virus particles, Ewing and colleagues speculate that the rosettes could be a manifestation of a viral infection. "If these rosettes prove to be unique to AIDS," the report states, "they may be a diagnostically useful marker." An accompanying editorial by Dorothea Zucker-Franklin of New York University Medical Center, however, pointed to the possibility that these rosettes may actually result from sub-cellular damage to "tuboreticular structures," microscopic bodies that have also been found in increased numbers in AIDS patients.

AIDS first appeared in 1981 in homosexual men and drug addicts, and researchers now believe it is spread by an infectious agent — probably a virus — through intimate contact or blood transfusions (SN: 9/25/82, p. 202; 1/1/83, p. 8). Haitians (and their children), hemophiliacs, drug addicts (and their children) and female sex partners of bisexual men have also fallen victim to the disease. More recently, a small number of black Africans have contracted AIDS. As of mid-March, 434 AIDS victims had died of the disease.

Why AIDS has been found, with few exceptions, only in these specific groups remains a mystery to researchers. However, at the recent NIAID meeting, James W. Curran of CDC discussed a "unifying hypothesis," in which the groups affected by AIDS have one thing in common: they all possess a weak immune system before contracting the disease. "On top of an immunosuppressed individual comes an agent they can't handle," he explained. Kenneth W. Sell of NIAID said "Agent X" could be any of the 17 viruses discussed at the meeting. Or it could be a combination of viruses. Albert Sabin, who developed the oral polio vaccine, cautioned researchers to keep an open mind and consider all possibilities. "At this point," he said, "the net must be spread very widely."

— *P. Taulbee*

Cannibal stars eat companions whole

A long-standing astrophysical theory predicts that a star that gets too close to another star might get swallowed. Now the discovery of close pairs of stars in the centers of certain planetary nebulas is put forward as evidence that such a swallowing has taken place. Albert D. Grauer of the University of Arkansas at Little Rock and Howard E. Bond of Louisiana State University at Baton Rouge describe the phenomenon: The orbit of a binary star system tends to decay with age due to tidal interactions. The two stars approach each other, and as they do they orbit faster and faster. Meanwhile the stars are aging. One possible fate of an aged star is to become a red giant. In that case the star's outer layers expand to form a huge, rather tenuous, atmosphere. If the companion star is close enough, this outer envelope may engulf the companion.

Once the companion is engulfed, its orbital motion is slowed by the resistance of this atmosphere, and it starts to spiral down toward the core of the star that has swallowed it. The energy that the swallowed star loses in the course of this descent into the fiery depths is transferred to the atmosphere of the swallowing star, and the spin rate of that atmosphere increases. The increased spin of the swallowing star's atmosphere facilitates its expulsion to form a ring or halo (the planetary nebula) orbiting at some distance from the center of the system. The center now consists of the core of the red giant and the companion, two separate but very close stars.

Planetary nebulas can be formed by the ejection of the atmosphere of a lone red giant without participation of any binary companion, and it seems to have been assumed for lack of contrary evidence that the stars in the centers of planetary nebulas were single. Over the last few years, however, Grauer and Bond have found that in several such cases the central object is actually a very close pair of stars. Their latest discovery is a double star in the planetary nebula cataloged as Abell 41, located in the constellation Serpens Cauda. These stars orbit each other in only 2 hours and 43 minutes, indicating that they are extremely close together. Three other such pairs previously found have orbital periods between 11 and 16 hours. (The periods of more widely spaced binary stars are measured in years.)

Earlier evidence alleged in favor of star-swallowing was the discovery by Bernard W. Bopp of the University of Toledo of a class of yellow giants that rotate much faster than expected. Bopp suggests that these stars have increased their rotary motion by swallowing companions and absorbing their angular momentum.

— *D.E. Thomsen*