

# Challenger Disaster Muddles NASA's Future

Far from settling down to a technical investigation like those that have often followed even the most tragic airline accidents, the turmoil surrounding NASA ever since the Jan. 28 explosion of the space shuttle Challenger has continued to grow. Ranging from a scathing indictment of the agency's safety policies by its chief astronaut to the climactic beginnings of recovery of the remains of Challenger's crew, the affair has rapidly grown to affect NASA from the topmost heights of its administration to the width of its operations to the shape of its future.

As both a presidential commission and a team of investigators set up by NASA itself continued to probe the actual cause of the mishap, attention remained focused on the likelihood of leaking seals between segments of one of the shuttlecraft's two solid-propellant booster rockets. In a reconstruction of the accident's possible events, Deputy Shuttle Chief Thomas L. Moser of NASA's Johnson Space Center in Houston described to the commission a scenario that began with a puff of smoke, observed coming from the right-hand booster about half a second into the flight. A plume of flame was observed from the same area at about 58 seconds; and at 64 seconds, he said, there was a possible leak of liquid hydrogen propellant from the shuttle's huge external fuel tank. At 72 seconds, the engineer/analysts believe, the lower of two metal braces connecting the booster to the external tank broke, allowing the still-firing booster to pivot into the tank with its explosive contents. Though the booster itself had still not been recovered when this scenario was constructed, Moser said "there are places on [recovered pieces of] the external tank where we can detect impact from the right."

But even apart from the technical analysis itself, another focus of the shuttle investigators has been the question of why Challenger was allowed to take off at all. Engineers from the rocket-booster manufacturer, for example, had already told the commission members of prelaunch concerns that the cold weather at Cape Canaveral might render the seals unsafe. And on March 4, veteran astronaut John Young, head of the NASA astronaut office, sent a strong memorandum to several NASA officials, including all the astronauts, questioning the agency's way of dealing with safety issues in the shuttle program.

Noting the status of the booster-rocket seals as a "priority 1" item — in which the shuttle and the lives of its crew would be at stake if something went wrong — he wrote, "There is only one driving reason

that such a potentially dangerous system would ever be allowed to fly — launch schedule pressure."

"People being responsible for making Flight Safety First when the launch schedule is First cannot possibly make Flight Safety First no matter what they say," he added in the memo, which was publicly released four days later by NASA. "If the management system is not big enough to STOP the Space Shuttle Program *whenever* necessary to make Flight Safety corrections, it will NOT survive and neither will our three Space Shuttles or their flightcrews."

Besides his comments, Young included a list of six "examples of uncertain operational and engineering conditions or events which we 'routinely' accept now in the Space Shuttle program." Ranging from quick-disconnect valves that might close unexpectedly to an incorrectly locked-up valve in the shuttle's reaction-control system, four of the cited cases, he said, could have resulted in the loss of vehicle and crew. In addition, he enclosed a list of nearly three dozen other "safety-related items" that had been prepared on the day of the accident by the shuttle Systems Division. "On an individual basis," wrote Young, "they were not big enough to slow or stop the launch rates. But totally, this list is awesome. The list proves to me that there are some very lucky people around here."

Several NASA officials were quoted in the press as saying that some of the cited items had already been dealt with, noting that safety has always been the agency's primary concern. When Young's memo was released by NASA, in fact, it bore a cover letter by recently appointed "shuttle chief" Richard H. Truly, in which Truly wrote that "I certainly concur with John's thrust — that flight safety must be NASA's first consideration. . . . We will not launch again until safety related issues have been properly addressed throughout the total NASA system."

The presence of Truly in the shuttle program at all, in fact, was another result of the Challenger incident. The former astronaut had twice flown the shuttle in space (as well as during its earlier airdrop tests from the back of a 747 jet), most recently on a mission aboard Challenger that landed Sept. 5, 1983. Less than a month later, Truly left NASA to head the U.S. Naval Space Command. But less than a month after Challenger's accident, Rear Admiral Truly was back at his old agency as NASA associate administrator for space flight, or shuttle chief. The change also hastened the transfer of the job's former occupant, Jesse W. Moore, to his already announced new position as head

of Johnson Space Center.

As for when the shuttle will fly again, a NASA "Replanning Task Force" is evaluating candidate schedules that would begin in 12 to 18 months, though an actual go-ahead still depends on the accident investigation and other analyses.

But NASA's changes are extending all the way to the top. For months, the agency has been operating under Acting Administrator William R. Graham, named to the temporary post while then-administrator James Beggs went on leave because of charges stemming from a criminal indictment. On Feb. 25, however, Beggs resigned from the job. President Reagan's new choice as space agency head is James C. Fletcher, who, if confirmed by the Senate, will be taking on the post for the second time. He originally became NASA administrator in 1971 — the year before the space shuttle program was announced — and stayed until 1977. Now a board member of five corporations, he also chairs the Three Mile Island #2 Safety Advisory Board and is a consultant to (and former director of) the President's Defensive Technologies Study Team, which formulated the program for the Strategic Defense Initiative.

Does Fletcher see any parallels between his first tenure at NASA and his possible second, such as the possibility of being there when the shuttle rises, phoenix-like, from its own ashes? "It's very different," he told SCIENCE NEWS, commenting that he is reluctantly accepting only because the President asked him. The first time around, he says, "I wanted the job." — J. Eberhart

## Female-to-male AIDS link found

Scientists tracking AIDS have identified the suspect virus in vaginal and cervical secretions of some antibody-positive women and have found possible signs of it in red blood cells.

Though the discovery of the virus in genital secretions does not prove that women can infect men through heterosexual contact, the virus's presence does provide a possible route for transmission, according to members of two research groups that made the findings independently of one another. Suspected female-to-male transmission is a rare occurrence in the United States — as of March 10, only 41 of 18,070 reported U.S. AIDS cases were in men with heterosexual activity as the only possible exposure, according to the Centers for Dis-

ease Control (CDC) in Atlanta.

Heterosexual transmission in both men and women "has been going up," says CDC epidemiologist Harold W. Jaffe, but it has remained at about 1 percent of the total U.S. AIDS cases. It's "not likely" the percentage will increase in the next year or two, he says, "but beyond that who knows?"

Both studies were described in the March 8 LANCET. In one, Harvard and Boston University researchers collected cervical secretions from 14 women who had antibodies to the AIDS virus in their blood. Only three were free of signs of immune dysfunction, and all were in high-risk groups — because of either intravenous drug abuse or sexual relations with intravenous drug users or bisexual men. Four of the women were prostitutes.

To make sure they were not looking at viruses from the blood, the researchers collected cervical secretions during the middle part of the menstrual cycle. They found the virus in four of the 14 women.

In the second study, University of California (UC) researchers in Berkeley and San Francisco grew low but measurable levels of virus from the vaginal and cervical secretions of four of eight antibody-positive women. One woman from whom the virus was cultured was menstruating at the time of collection; another initially cultured negative, but tested positive after self-induced orgasm.

Researchers from both groups note that despite the low virus levels and the relative infrequency of female-to-male transmissions, the studies indicate such transmission is plausible and emphasize the importance of safe sex practices. "Both men and women, heterosexual and homosexual, should be cautious about their choice of sexual partners and sexual technique," says Martin S. Hirsch of Harvard.

Says Constance B. Wofsy of UC San Francisco, "It confirms there is some virus there and therefore the vagina in a nonmenstruating woman could be a potential source of virus exposure to a man. But the factors that will allow a man to be susceptible to this small number of viral particles need to be determined. This just gives a little more emphasis to why people should use condoms."

Neither study identified the cellular residence of the virus, which is now known to infect not only white blood cells but also central nervous system cells (SN: 1/12/85, p. 22). In the February PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 83), Morton J. Cowan of UCSF and his colleagues describe finding abnormally high levels of an enzyme in the red blood cells of AIDS patients. The abnormality may prove useful as a confirmatory AIDS test, he says, and also suggests that the virus may be infecting the precursor cells that develop into red blood cells. "It warrants further investigation," he says. — J. Silberner

## Trickle-down theory of eastern quakes

In spite of the infamous seismic grumbings at the plate boundary in the West, some of the largest earthquakes in the United States have occurred in the East, far from any plate boundary (SN: 10/10/81, p. 232). Eastern U.S. intraplate earthquakes are particularly worrisome because no one has located the obvious surface faults along which such earthquakes are generated; rather than falling along clear fault lines, the quakes that dot eastern seismic maps are sprinkled about in a diffuse array. This has left scientists hard-pressed to explain how eastern earthquakes are created, let alone make forecasts of when, where and how much they will rattle the earth.

Now a group of researchers has used a number of old and new observations to construct a model for eastern quakes that, if borne out, could provide a key to earthquake forecasting. Seismologists John Costain and Gilbert Bollinger, along with petrologist J. Alex Speer, all at Virginia Polytechnic Institute in Blacksburg, suggest that changes in rainfall, which diffuses down an extensive network of fractures, can trigger earthquakes along faults buried to depths of about 20 kilometers. If this "hydroseismicity" hypothesis is correct, comments Archibald Johnston of Memphis (Tenn.) State University, "it will spark a great deal of additional work because not many people have been looking at this problem."

The idea that the movement of water in the earth's crust is linked to seismicity is not a new one. Scientists have long known that practices such as injecting fluids into the crust in drilling oil wells can trigger shallow earthquakes (SN: 5/4/85, p. 281). Many scientists have also noted some correlation between natural changes in the water table or river levels and increased seismicity. For example, the large earthquake that shook Charleston, S.C., in August 1886 was preceded by two years of unusually high rainfall and followed by a "dry spell" in both seismicity and rainfall. And Johnston, with co-worker Susan Nava, has recently found that six to nine months after the Mississippi River is at its highest level, seismic activity increases in the New Madrid, Mo., area — the region that hosted the nation's largest historic earthquakes in 1811 and 1812.

One past proposal suggests that water flow can trigger relatively shallow earthquakes by increasing the pore pressure in the rocks and lubricating an already stressed fault. This causes the normally locked blocks of rock on the sides of the fault to slip past one another, creating an earthquake. Costain now thinks that this mechanism is responsible for much deeper earthquakes as well. He notes that in the process of drilling the world's

deepest hole, Soviet scientists have reportedly discovered fluids circulating through a fractured crust at depths of as much as 11 km. Previously, researchers had assumed that at such great depths all the joints and fractures normally open to water flow would be sealed by the weight of the overlying rocks.

In building its model of hydroseismicity for the eastern United States, Costain's group draws on seismic reflection profiles and other studies indicating that the eastern crust is riddled with a diffuse network of near-vertical fractures extending down to about 20 km. According to the researchers, this fractured fabric was created during two rifting periods, starting about 200 million years ago when the North American continent was pulled apart from Africa and the Atlantic Ocean basin opened. In their model the researchers envision groundwater traveling down to 20 km along a network of connected fractures and then flowing back up to fill the rivers and lakes; somewhere during that journey, they propose, earthquakes can be triggered.

Costain says that the diffuse distribution of earthquakes on seismic maps is consistent with the diffuse patterns of fractures that they envision. Moreover, the researchers note that the four major seismic regions in the southeastern United States are located within groundwater basins that are fed by waters originating at higher-than-average elevations.

Because the hydroseismicity hypothesis is relatively new, few seismologists have had a chance to scrutinize Costain's arguments. The group will present its hypothesis in April to the Seismological Society of America.

In the future, Costain's group would like to do more detailed statistical studies to test the relationships among rainfall, rivers and earthquakes in the eastern United States. They are also interested in applying their hydroseismicity idea to the Basin and Range Province in the West, which is now being actively extended and rifted. "Out there, you'd have all kinds of opportunity for getting fluids into a rifted fabric, much more so than you would in the East," remarks Costain, although he adds that the active rifting itself may be enough to explain all of the seismicity in this region.

If the hydroseismicity hypothesis is correct, says Costain, "then once we have data about the flow of groundwater in an area, we may be able to forecast earthquake activity following extended periods of rainfall." For the moment, the researchers are wondering what impact the floods that devastated parts of central and southwest Virginia last November will have on seismicity of that region. — S. Weisburd