Shuttle flight: Good news for booster

The Jan. 27 return to earth of the space shuttle Discovery from the first secret, military, manned space mission in U.S. history marked a chance for the civilian space agency to release a breath it had been holding for 21 months. The occasion for relief was not so much that a classified Defense Department satellite had been deployed during the flight, but that the satellite's booster rocket then successfully carried it up to its assigned station. An identical rocket had malfunctioned during its only previous use from the shuttle — and the rocket's next use is due in less than a month.

The just-completed mission lasted only three days, one hour and 33 minutes, making it the shortest since the shuttle's second test flight two-and-a-half years ago. It was conducted under unprecedentedly tight-lipped security restrictions, publicly broken only by widely spaced status reports to the effect that "the orbiter Discovery and the crew and other elements of the Space Transportation System continue to perform satisfactorily." Only 42 members of the press, including camera crews, technicians and others, were registered at NASA's Johnson Space Center in Houston during the mission, says a NASA official, compared with about 400 during the previous shuttle flight.

One status bulletin, however, though similarly terse and not revealed until 16 hours before the landing (the landing time, too, was classified until then), was just what NASA had been waiting to hear. "The U.S. Air Force Inertial Upper Stage (IUS) booster rocket aboard STS 51-C [the mission's designation]," it said, "... successfully met its mission objectives." Its former failure had placed the first of NASA's complex Tracking and Data Relay Satellites (TDRS-1) in far too low an orbit (SN: 4/16/83, p. 244), and TDRS-2 — with another IUS — is to be deployed during the next shuttle flight, as early as Feb. 20. Then, later this year, NASA plans to deploy TDRS-3, and a second classified Defense Department mission could conceivably use yet another IUS. (Problems with TDRS-1 have also prevented it from relaying transmissions from earth at high data rates, so NASA has yet another reason for needing to deploy TDRS-2.)

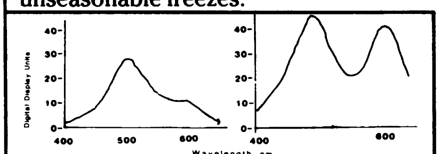
Discovery was described as "very healthy" following its recent mission, with only about a dozen of its thermal protection tiles apparently in need of care — "far fewer," said one NASA official, "than is usually the case." The upcoming flight, however, will be by the shuttlecraft Challenger, many of whose tiles have required reattachment because of a weakened adhesive. By early this week, there were still about 400 tiles remaining to be reinstalled, according to the agency, which was hoping to be able to roll the craft out of its processing building on about Feb. 2.

Besides also deploying a Canadian communications satellite called Telesat-I, the upcoming mission (designated 51-E) will carry a pair of French biomedical experiments derived from two others that were conducted aboard the Soviet Salyut 7 space station in 1982. One will use an ultrasonic imaging technique called echography to monitor blood flow, while the other will examine how the sense of balance adapts to weightlessness. And serving as test subject and technician for the experiments aboard Challenger will be French space agency astronaut Patrick Baudry, who previously trained as the backup crewman for France's Jean Loup Chretien, who operated them on Salyut 7.

Chretien is also the backup astronaut for Baudry for the shuttle mission, which means that if Baudry should become injured or otherwise unavailable for the flight, Chretien could become the first human being to serve as a crew member on both Soviet and U.S. space missions. (U.S. astronauts and Soviet cosmonauts visited one another's docked spacecraft during the joint Apollo-Soyuz mission in 1975, but not as members of the other side's flight teams.) — *J. Eberhart*

IR can spy plant stress before eyes do

When a plant is under stress — from disease, pests, climate extremes or mineral imbalances — its internal leaf structure changes. Though the changes might not be visible to the naked eye, they are visible to infrared (IR) scanners. And this concept serves as the basis for a remote sensing technique being developed in Florida by Institute of Food and Agricultural Sciences researchers Carlos Blazquez, at the Kennedy Space Center, and George Edwards, at the University of Florida's agricultural research center in Lake Alfred. Though Edwards notes that their stress surveys will work "for anything that's green and growing," much of the research has been tailored for the local citrus industry, which has been seriously plagued recently by blight and unseasonable freezes.



Edwards

Twin peaks of infrared intensity (right graph) denote healthy tree. Decreased intensities — especially disappearing 600-nm peak (left graph) — indicate tree near death. Peaks between these extremes signal intermediate stress.

Edwards and Blazquez survey citrus groves from an altitude of 4,000 feet, recording IR radiation from the trees on infrared-sensitive film. Resulting film transparencies, magnified using a microfiche projector, are read tree by tree with a fiber-optic sensor. The intensity of light passing through the film and into the fiber-optic cable is measured by a photodensitometer in 10-nanometer (nm) wavelength steps from 400 to 700 nm.

Establishing which wavelengths exhibit the highest infrared intensities offers a quick gauge of tree stress (see graphs). A healthy tree will show nearly equal IR intensities for its two peak wavelengths. Peak intensities will decline, however, in trees under stress, with the shorter, 600-nm peak tending to disappear faster in citrus trees.

From these intensity peaks, the researchers compute a spectral ratio: the intensity of the first spectral peak divided by the intensity of the second, times a constant (related to the densitometer's projection magnification).

Edwards points out that "there is also a wavelength shift with the stress of the tree," from red toward the blue end of the spectrum. To get a better picture of stress, the researchers determine the difference in wavelengths between the two highest peaks and divide that by the spectral ratio. Plotting spectral ratio on the y axis and peak-wavelength difference on the x axis causes the healthy trees to clump at the lower right of a graph. Trees under increasing stress will span up and to the left on the graph.

Since IR surveys measure thermal emissions, these assays are like taking a patient's temperature. In fact, they're invaluable at finding early signs of disease, explains Thomas Oswalt, citrus extension agent for Polk County, Fla. He says trees that appear healthy to the human eye may show stress in an IR photo, giving the first clue they will develop a lethal blight. Because it can take two or more years to receive new nursery orders, there's a real incentive for diagnosing dying trees early, Oswalt says.

Moreover, since most growers don't even know how many trees they own, Edwards says, they have difficulty quantifying losses from a killing blight or frost. And for large groves, Oswalt says aerial surveys can save 10 to 25 percent of the costs of eyeballing damage from a truck — the usual technique. Finally, IR surveys offer one of the most objective means to establish temporary reduction in grove production value for purposes of seeking casualty compensation or adjusted tax appraisals, Oswalt notes. Edwards is already aiding tax appraisers in Collier County, Fla., in an experiment assessing grove values. — *J. Raloff*

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