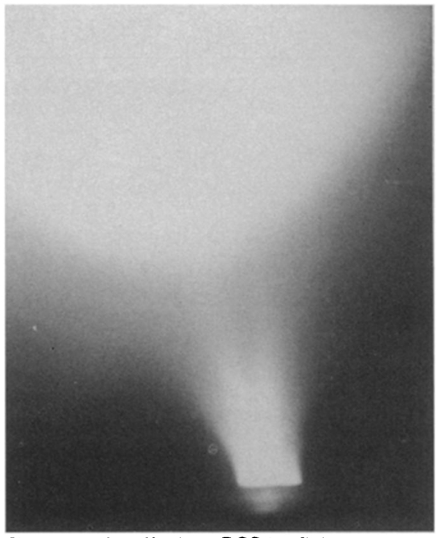
Environmentalism on the space shuttle

The space shuttle is basically just a high-tech truck, operating between earth and orbit. Many of the things it will carry, however, are just as high-tech, and their owners and operators thus find themselves with some correspondingly high-tech concerns about "pollution" and other potential problems of the new transportation system. Gases and solid particles given off by materials in the shuttle's cavernous payload bay, for example, may amount only to parts per billion or less, but they can make a significant difference if they settle on the mirror of a telescope whose design has been pushed to the limit to take advantage of the instrument's presence above the atmosphere. In addition, gases could distort spectral readings, while sunlight scattered by particles could wash out views of extremely faint astronomical sources in the otherwise dark sky.

There may be hundreds or even thousands of such potential contaminants in and around the shuttle, which has been heavily instrumented to study them ever since the second of its four test flights. Last week, in a motel near the National Aeronautics and Space Administration's Goddard Space Flight Center in Maryland, nearly 300 people, many of them future shuttle users, gathered for three days to find out what is known so far about the shuttle environment — and to urge NASA to find out more.

One of the most striking findings, discovered in photos taken eight months ago during the shuttle's third mission, was an intense glow around some of the craft's external surfaces (SN: 6/19/82, p. 408). Last week, Stephen B. Mende of Lockheed described the results of an experiment hastily added to the fourth flight, which showed the glow to have a spectrum extending from about 6300 Å up to at least the test instrument's 8000-Å limit. Such an emission, while "in no way definitive," would be consistent with an interaction between the shuttle's skin and neutral oxygen atoms from the top fringes of earth's atmosphere. (The glow was fainter during the fourth flight, which orbited about 55 kilometers above the previous mission's 241-km altitude.) At the conference, a panel of plasma researchers headed by Roger Williamson of Stanford University recommended that continued study of the glow be "given the highest possible priority" on subsequent flights.

A plastic film called Kapton, used as the substrate of thermal blankets around cameras and other equipment in the payload bay, was reported to have lost as much as 35 percent of its mass (though that is only 0.0001 inch of the thin film) during the various missions. The tensile strength of the substance also dropped, from 22,000 pounds per square inch to about 18,000. The changes were tentatively attributed to oxidation, as were the discoloration and accelerated aging of paints.



Jitters and pollution: RCS jet firing, photographed during shuttle's 4th mission.

The major gaseous contaminant was water, produced from the nozzles of the shuttle's reaction-control-system (RCS) engines, whose firings also seemed to accompany the detection of methane, ethane, ammonia and other gases.

But the RCS causes more than chemical pollution, at least from the standpoint of a scientist with an instrument requiring an extremely steady platform, such as a telescope aimed at a distant target. The RCS nozzles fire to help with stabilization of the shuttle, but according to Ted Gull of NASA Goddard, it takes about 15 seconds for the craft to settle down after each firing. At NASA's Marshall Space Flight Center in Alabama, says Gull, shuttle astronomy missions are expected to require from 60 to 400 RCS firings per orbit, but with shuttle orbits lasting about 90 minutes, 400 firing would mean that the craft "never reaches a quiescent state."

Few of the shuttle's environmental problems are expected to be extreme — "it is basically a clean machine," says one space agency official — but they all take some understanding if they are to be effectively second-guessed. At last week's meeting, in fact, it seemed at times as though getting the voluminous data out to the army of potential users was posing as much of a problem as any contamination source. There are millions of individual measurements to be considered, and it is often difficult, said one engineer, for either the user or the shuttle's operations people to be sure of what will best meet the user's needs. "The agency is unable at the present time to handle data in a timely manner," said Williamson, and several of the meeting's panels and individual participants recommended that NASA set up a centralized, user-oriented data bank to keep everyone informed.

The environment in question is not limited to the time between liftoff and landing, but includes the months prior to launch that payloads may spend at Kennedy Space Center in Florida, where payload-handling procedures are still being refined. One research group told the meeting of a solar-flare X-ray polarimeter used during the shuttle's third flight. "Analysis of the data," said their report, "has been complicated by contamination . . . by small amounts of oxide and/or nitride, apparently acquired from the ambient atmosphere during the long preflight storage and integration periods." —*J. Eberhart*

More H_2O-splitting comes under fire

On the heels of a widely publicized University of California scheme for using solar energy to split water in order to extract hydrogen fuel (SN: 9/25/82, p. 198), another such method now is receiving national attention. Just as before, the developers of the latest scheme claim their laboratory method has the potential for being developed into a large-scale, economically feasible commercial procedure. And, just as before, other researchers in the solar energy field seriously doubt those claims.

The latest claims come from Marek Szklarczyk and Ali Q. Contractor of Texas A&M University at College Station. Their water-splitting method consists of two wire-connected silicon electrodes immersed in solution. One silicon electrode is impregnated with phosphorous, causing it to be an electron-excessive, or negative, terminal. The other electrode is doped with boron, causing it to be an electron-deficient, or positive, terminal. When a solar-light simulator shines on this set-up, aqueous hydrogen ions (H^-) pick up electrons at the negative terminal to form hydrogen gas (H_2), and hydroxyl ions (OH^-) give up electrons at the positive terminal to form oxygen (O_2) and hydrogen atoms. Using this set-up, says Szklarczyk, an overall power conversion efficiency (energy output divided by energy input) of at least 10 percent can be achieved.

While it is possible the Texas A&M team has achieved such a high energy conversion efficiency, says solar energy researcher Jack Kilby of Texas Instruments Inc. in Dallas, the cost associated with scaling up their silicon system probably would preclude any commercial application. "Conventional silicon cells are on the market today for \$7 to \$10 a watt, and that's not a very economical price," he says; Szklarczyk's system "would appear to [involve] similar costs."

Bruce Parkinson of the Solar Energy Research Institute in Golden, Colo., says that claims regarding recent schemes for splitting water are "getting out of hand" and are misleading the public into thinking the energy problem is being licked.

—*L. Garmon*