

Anxious scientists hope Jupiter's radiation won't disable Pioneer 10

Jupiter is waiting. Pioneer is approaching. And the scientists are sweating.

Because there's a chance—not just a minute possibility, but a real chance—that for all its sophisticated design, all its elaborate instrumentation, Pioneer 10 may not survive its Dec. 3 encounter with the giant planet.

Pioneer 10 began its 620-million-mile sweep toward Jupiter more than 21 months ago, on March 3, 1972, but it has only recently become "aware" of the planet's presence. The first sign was a tiny image of Jupiter, less than an eighth of an inch wide on the 19-inch monitor screen at the NASA Ames Research Center in California, recorded late in September by the spacecraft's photopolarimeter, which sees the planet by polarized light reflected from its surface. The image has been growing steadily until by Nov. 16, the day the third Skylab crew took off from Cape Canaveral, it was about the size of the moon seen from the earth. At the nearest approach to the planet, about 81,000 miles, it will more than fill the screen.

Early in October Jupiter's powerful gravitational field began to make itself felt, gradually bending Pioneer's path and pulling the spacecraft ever more rapidly toward the planet.

The next sign, which will probably occur some time from Nov. 24 to Nov. 30, will be the detection by Pioneer's magnetometer of the huge shock wave formed where the solar wind collides with Jupiter's magnetic field. A few days later, between Nov. 28 and Dec. 1, the magnetopause will appear.

It's after that that the trouble may start.

There are two possible trouble sources: radiation and electric fields. Pioneer 10 may run into neither, or either, or both.

Radiation damage poses the worse threat, because too big a dose could be fatal to the spacecraft's electronic equipment. No more scientific data, no way to control the spacecraft, not even a beep to judge its position, Pioneer 10 would be exiled, silent and alone, fleeing into space.

The villains, if they are there, will be protons and electrons, trapped and held by Jupiter's surprisingly large magnetic field. Pioneer's designers had no way of guessing the villains' strength. The electron density could only be estimated indirectly from the planet's radio emissions, and the protons could not be measured at all.

Any radiation damage will thrust right at the heart of the matter, breaking down the transistors and other solid-state components that make up the electronics. Particularly susceptible, says William Dixon, Pioneer science adviser for TRW Inc., which built the spacecraft, are certain semiconductor devices used in large numbers in Pioneer's data-handling equipment and other systems. Besides the individual components, some of the 11 scientific instruments aboard are more damage-prone than others. A device that has been counting dust-sized asteroids and meteoroids ever since the journey began uses photomultiplier tubes that are potential casualties. An ultraviolet photometer for measuring helium and hydrogen concentrations is another candidate.

If there is such a mishap, it may not happen until the spacecraft is fairly close to the planet, possibly about 300,000 miles away, which is about six hours before its closest approach, says Charles F. Hall, Pioneer project manager at Ames.

Even if Pioneer 10 "fries," the point at which it happens—or the rate, if there is time to measure it—will be a clue to designers of future probes.

The problem is that many of the reports suggesting cause for concern were not made until after Pioneer 10 was launched. Reports or not, there is uncertainty. One source quotes a high official in the NASA Pioneer office: "If Pioneer survives, it'll be the first time in this mission that I've been right and all the PI's (principal scientific investigators—the experimenters) have been wrong."

On the other hand, Hall recalls the debate speculating that the dust on the moon would be so thick that the Surveyor spacecraft would sink out of sight. "So far, the natural phenomena have been nowhere near as severe as predicted."

Radiation is not the only problem. A serious, though perhaps not fatal, possibility is the buildup of unwanted electrical charges on the spacecraft. This might result merely in additional noise in signals to earth. It could also show up, however, as misleading scientific data, or, in its most dangerous form, as unintentional commands to the spacecraft. A stray signal could, for example, order Pioneer 10 to turn off its transmitter, so that no information at all would reach earth.

As a safeguard, flight controllers have a plan to second-guess the spacecraft. Every 30 minutes, beginning about 24 hours before the closest point to Jupiter, they will send Pioneer a fixed group of commands, such as "turn on the polarimeter," "maintain your data rate," and so on. If everything is operating as intended, the extra commands will be ignored, while any unwanted orders will be corrected.

Pioneer 10 is not a "must-survive mission," according to its designers, but a pathfinder. Pioneer 11, launched April 5 of this year, will not reach Jupiter until Dec. 5, 1974, and flight controllers have until April to alter its path if need be.

Regardless of what happens near Jupiter, Pioneer 10 has already proven a valuable tool. It has come unscratched through the supposedly dangerous asteroid belt, and even reported, after seven months in the belt, that there seems to be no more spacedust (.01 to .1 millimeter particles) there than between the belt and earth's orbit. It has found that the turbulence of the solar wind stays about the same all the way to Jupiter, and that as a result the solar wind's shielding of the solar system against low-energy cosmic rays keeps its effectiveness well out from the sun. The spacecraft has also added sodium and aluminum to the elements identified in the solar wind.

In the closing days of this month, Pioneer 10's teams of scientists and engineers will gather at Ames to follow their spacechild's most trying moments. Will it be a time of discovery—or a deathwatch?

200,000 photos with the telescopes.

This weekend the astronaut's are to resume operating Skylab's other triumphantly successful research tool, the earth-resources-experiments package. The Skylab 3 crew may make as many passes with EREP's cameras as both previous missions combined. EREP, in fact,

was one of the major factors cited by NASA in planning a mission longer than the original 59 days, because of the chance of studying the United States and the rest of the Northern Hemisphere in the dead of winter.

Then there is Kohoutek, the super-comet, subject of numerous Skylab 3

experiments including two spacewalks and an elaborate plan to attempt stereo photography using Mercury-bound Mariner 10 as the other "eye." The Apollo telescope system carries coronagraphs and other devices to study the comet while it is in the vicinity of the sun. □

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325