Off on a possible 84-day stay around the earth

The Skylab 3 crew begins the longest manned space mission ever undertaken


NASA

Straining off the launch platform.

From Alan Shepard's 15-minute suborbital swoop aboard Mercury 3 on May 5, 1961, to the journey of Gerald Carr, Edward Gibson and William Pogue up to Skylab on Nov. 16, 1973, the United States launched men into space at average intervals of barely five months for more than 12 years. When this third and final Skylab crew returns to earth, after as many as 84 days in space, the great hiatus will begin. In the next six years—until the space shuttle begins what NASA hopes will grow to be more than 100 flights a year—only one manned space flight will be launched from this country: the U.S. part of the Apollo-Soyuz Test Project, in cooperation with the Soviet Union, targeted for 1975.

As the end of an era, however, Skylab 3 seems likely to provide an impressive finish.

After a six-day delay due to the detection of stress-corrosion cracks in the six-year-old rocket's eight stabilizing fins and then in the adapter between the rocket's two stages, the launch finally proceeded. The Apollo spacecraft was carried aloft from Kennedy Space Center's well-used Launch Complex 39, crammed to the bulkheads with, besides the three astronauts, a full ton of food, clothing, tools, scientific instruments and other equipment for the record-long stay in orbit. "I can't believe all the stuff we stowed in the command module," says Neil Hutchinson, one of the mission's flight directors.

The crew—NASA's first all-rookie team since Gemini 8 in 1966—really won its spurs in the docking operation, using only 485 pounds of fuel in their maneuvering, least of the three Skylab crews and only 30 pounds above the theoretical minimum. "I was absolutely overwhelmed they did it," Hutchinson says.

Except for a little discoloration from its long stay in unfiltered sunlight, Skylab looked as expected. "It's pretty as a picture," said Carr. Commented Gibson: "A good-looking home." Some repairs would have to be made however. Most important, perhaps, was the replenishment of the fluid in the space station's primary cooling system, which failed during the previous crew's occupancy. That crew improvised a solution by draping their liquid-cooled undergarments over a water tank to provide enough heat to keep the cooling loop from freezing solid. The new crew planned to fix the system properly, and they brought along a fluid supply, spare parts and tools for the job.

Another item on the repair list was a microwave antenna used to measure temperatures of different types of ocean surface and terrain as part of Skylab's elaborate investigation of earth's natural resources. The antenna wasn't scanning properly, and the astronauts planned either to fix it or to lock it straight ahead.

Activating the space station lasted into the fourth day of the flight, marred insignificantly by a few "glitches" such as switches left in the wrong position.

Physically, two-thirds of the crew seemed to take to weightlessness better than had the Skylab 2 astronauts, all of whom felt some queasiness. But Pogue, at 43 the oldest of the crewmen, felt nauseous and vomited once. (A bit of short-lived tension was created when flight controllers discovered, in a conversation inadvertently recorded and relayed to the ground, that the astronauts had planned not to mention the vomiting.) Pogue and Carr also swapped jobs for about three hours, allowing Pogue to work in the Apollo spacecraft where less movement was required. All three took antimotion-sickness pills for the first few days, and seemed to be in reasonably good health by Day 3, except for a little "stomach awareness" before mealtimes and some nasal congestion developed by Pogue.

The astronauts' regimen also included taking regular girth measurements of various parts of their bodies, in order to measure the rate of tissue reduction. They also took infrared photos of one another's bodies to document the redistribution of body mass in the first few days of weightlessness. Periodic blood samples are scheduled to investigate the red cell loss that surprised doctors following Skylab 1. ("It had been observed on Apollo," says Dr. Stephen Kimzey, one of Skylab's many medical researchers, but "we thought that the atmosphere of the Apollo was the cause.") Numerous other medical studies are on the schedule, ranging from mineral balance to sleep, but Skylab's studies cover much wider territory.

The first non-medical experiment begun by the crew was a study, designed by a Colorado high-school student, of whether the cytoplasm in the cells of elodea (waterweed) leaves moves differently in weightlessness from that of similar leaf cells on earth. There are 11 student-designed experiments aboard Skylab 3, at least five of them flying for the first time.

Early next week, the astronauts were scheduled to begin working with the station's Apollo telescope mount, a multipurpose nest of telescopes that has exceeded its designers' fondest hopes in its studies of the sun. Its results have been so spectacular that previous Skylab astronauts worked overtime at its controls and got up early to make extra observations. Scientist-astronaut Gibson is particularly qualified for getting the most out of the observatory—author of several papers on plasma physics, he this year published a book entitled *The Quiet Sun*. The three Skylab missions are expected to provide a total of

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. □