

Skylab 3: Successes despite troubles

After spending nearly a week getting settled in their new home in the sky, Skylab 3 astronauts Gerald Carr, Edward Gibson and William Pogue have settled down to business—a lot of it.

Flight planners knew in advance that a major milestone of the mission would be its first spacewalk. With a month and a half since the Skylab 2 crew's departure behind them and as long as 84 days in space ahead, the astronauts would have to make repairs, replenish film supplies and install new experiments before the 100-ton space station would really be ready for work. To make things even harder, the liquid cooling system, which Pogue had repaired early in the flight (it malfunctioned during Skylab 2), appeared to be leaking again.

Fortunately, the leak proved to be not in the cooling system, but in the leak detector, and the spacewalk went smoothly, although it kept both Gibson and Pogue outside for an exhausting six and a half hours. With Carr monitoring from within, the two orbiting handymen crawled almost everywhere on the 117-foot station, replacing film in the solar observatory section, fixing a jammed antenna on the spacecraft docking section and installing scientific instruments on the airlock module and the main body of the workshop. The hardest part was repairing the movable antenna, part of a microwave earth-watching device for measuring everything from the heat of cities to changes in vegetation.

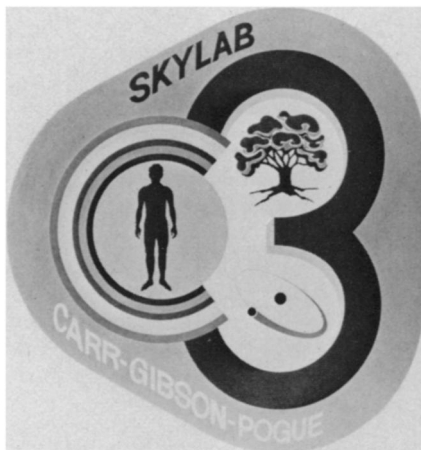
Less than a day after the spacewalk, however, another mishap occurred. It posed no danger to the crew—ground controllers in Houston didn't even wake them up to tell them about it—but it has already delayed the mission's scientific plans. One of the three main gyroscopes that helps Skylab reorient itself in space stopped, apparently from a jammed bearing. The gyro was the one in charge of Skylab's x-axis, the main axis of the cylindrical workshop. With only two gyros remaining, it takes more propellant for the space station to make a given change in its position. If a second gyro were to fail, even this early in the mission, the flight could be cut to as little as 20 days, although it could be stretched by sharply limiting the use of the Apollo Telescope Mount, which requires extra maneuvering to aim its eight telescopes.

The first victim of the forced scrimping on propellant was the brilliant comet Kohoutek. Of the dozen Skylab instruments scheduled to study the comet, only one, a light-amplifying camera to photograph Kohoutek's

giant hydrogen cloud, was specially built for the purpose. It seems to be working fine, but it didn't get started until Nov. 25, a day late, because it required Skylab to reorient itself a full 90 degrees on its x-axis—with no x-axis gyro.

The problem was also felt by one of Skylab's most valuable groups of instruments, the earth resources experiments package. Work with it was postponed at least twice early this week. Part of the reason was dense cloud cover that obscured much of the terrain in the target area. But officials admitted that they were delaying in part while they searched for ways to do the job with a minimum amount of propellant. On the second day of the delay, the astronauts temporarily filled the EREP camera bay with another instrument, a panoramic camera designed to show the distribution of ultraviolet sources among selected stars, star fields, stellar clusters and galaxies.

The sun-watching ATM, however, which in the previous Skylab missions had elated the numerous astronomers responsible for it, seems to be continuing in fine style. Even as the astronauts



were checking it out early this week, the sun seemed to respond as if to an old friend by setting off a series of gigantic flares.

On Nov. 27, another experiment, added late in the planning for the then-already-crowded mission, proved successful when Pogue aimed a camera out through a window and photographed a cluster of glowing lines arching high over the Pacific Ocean. The glow was from barium ions, released by a high-altitude sounding rocket as a cloud of barium vapor and ionized by ultraviolet radiation from the sun. The ions, attracted to the lines of force of the earth's magnetic field, give geophysicists a way of observing the field lines reaching as high as 22,000 miles above the planet. Skylab's lofty viewpoint, free of most of the distorting atmosphere, gives the astronauts 10 times as good a look at the lines as have observers on the ground. □

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New techniques enable a closer which governs the relations of

by Dietrick E. Thomsen

The molecule is the smallest unit of a chemical compound that retains the nature and characteristics of the compound. Since there are many more compounds than elements in nature, most substances are built up out of molecules, and the structure of gross samples is determined by the forces that exist between molecules. These forces are known as van der Waals forces after a Dutch physicist, J. D. van der Waals, who postulated their existence a century ago.

The van der Waals force determines among other things whether a substance is a liquid, solid or gas; it lies at the basis of the structure of liquids and crystals and it determines the solubility of one substance in another. It is thus of the highest importance to physical chemistry.

Lately a new technique, one that uses beams of molecules that collide with each other, is being used in at least three centers of research to study the van der Waals force. The researchers involved are Aron Kuppermann of the California Institute of Technology, Yuan Lee of the University of Chicago's James Franck Institute and Giacinto Scoles of the University of Waterloo in Waterloo, Ontario, Canada.

The van der Waals force is of electromagnetic origin. This is in spite of the overall electrical neutrality of a molecule. If a molecule were a static entity and if all of its electrical charges were distributed in a spherically symmetric way, the effects of its negative and positive charges would cancel each other out. But molecules tend not to be spherical, and their charges are continually in motion. This leads to complicated interactions between the charges of one molecule and those of another. What results is a small attractive force, the van der Waals force.

Compared to the other forces that manifest themselves on a microscopic level, the van der Waals force is a lightweight. It represents a binding