

Marshall Star
Skylab 30th Anniversary
Special Edition



Once upon a time, in a place called ‘Skylab’ ...

Editor’s note: The following stories in this Skylab 30th anniversary series were written and researched by Marshall Center Historian Mike Wright and Bob

Jaques, an employee of ASRI and a Marshall historian. Fred Deaton and Marshall Imaging Services provided the photographs.

America’s first space station

Skylab was the first American space program wholly dedicated to scientific research, and the Marshall Center played an important role in this unprecedented scientific venture.

Skylab’s three, three-man crews spent up to 84 days in Earth orbit and performed more than 100 experiments. The Marshall Center developed the major Skylab components and the four Saturn launch vehicles used to launch the station and its three separate crews. Marshall was also responsible for directing many of the experiments.

Marshall engineers designed the centerpiece component for Skylab, the orbital workshop, by converting a Saturn rocket stage into a habitable space module containing living quarters and support systems as well as experiment areas. Marshall assignments also included the Skylab airlock module, docking adapter, and Apollo Telescope Mount — the first manned astronomical observatory designed for solar research from Earth orbit.

The Center was also responsible for investigations in materials processing and solar physics, and designed and built a series of Skylab biomedical experiments. Marshall also served as the NASA interface for a series of Skylab experiments proposed by students from across the country.

In 1973, NASA launched Skylab into space using a Saturn V rocket. Unfortunately, a huge panel protecting the orbital workshop from micrometeoroids and solar radiation ripped off seconds after the launch.

NASA had originally planned to launch its first three-man

crew to Skylab on May 15 using a Saturn IB rocket. Faced with the crisis of how to fix the station so that it would be habitable, NASA put the crew launch on hold. It was May 25 when Skylab’s first crew went into space and conducted repairs to the station. They returned home on June 22.

A second crew was launched on July 28 and splashed down on Sept. 25. Repair procedures were part of both missions, but attention also focused on the scientific data that Skylab gathered.

The second mission orbited a pair of common spiders, Arabella and Anita. The experiment was to determine the spiders’ ability to spin a web without the influence of gravity. It was one of the student experiments coordinated by the Marshall Center for Skylab.

The third Skylab crew went into space on Nov. 16 and splashed down in February 1974, setting a new endurance record and reflecting man’s ability to live and work in space for extended periods of time.



A modified Saturn V lifts Skylab toward the heavens on May 14, 1973.

The story of a rescue in space

Marshall, NASA team saved Skylab

Trouble began approximately 63 seconds after a Saturn V launched the Skylab Workshop-Apollo Telescope Mount combination on May 14, 1973.

A panel protecting the orbital workshop from micrometeoroids and solar radiation ripped off. Adding to the trouble, one of the solar arrays for the workshop was torn away and a second array was only partially deployed once in orbit.

The solar arrays were designed to provide electrical power to the orbital workshop. The solar arrays for the Apollo

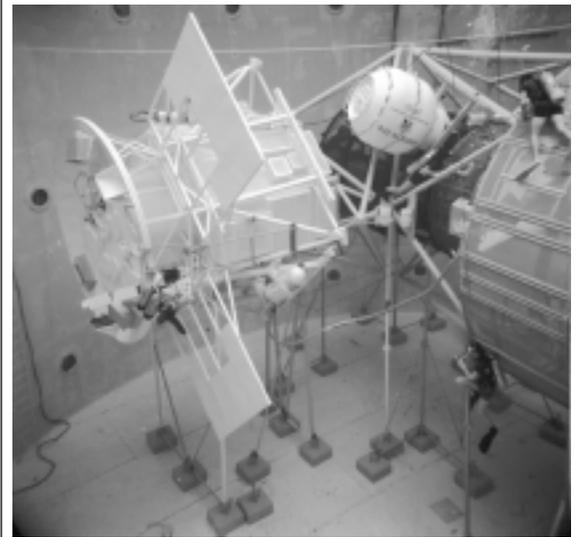
Once in orbit and without the micrometeoroid panel, air temperature inside the workshop quickly began approaching 130 degrees Fahrenheit. Engineers from Marshall and throughout NASA were concerned about the condition of food, film and other equipment inside Skylab. They also worried about plastic insulation material inside the workshop and possible toxic gases if temperatures rose too high.

H. Fletcher

Kurtz, now retired from Marshall, was head of the Center's Mission Operations Office at the time. Kurtz and others began organizing activities at the Huntsville Operations Support Center.

"I quickly became a landlord with about 100 unhappy guests," Kurtz said. "The chain of command went out the window as increasingly senior managers moved into key positions in the HOSC, working directly with those concerned with the rescue."

Skylab, seriously overheating, was maneuvered through varying nose-up attitudes that would best maintain an acceptable "holding condition." For 10 days, and for some time thereafter, the



Practicing a Skylab 'space walk'

Ed Gibson, center, in the astronaut suit, practices a "space walk" on a mockup of the Apollo Telescope Mount on Skylab in the Marshall Center's Neutral Buoyancy Simulator in 1970.



A crippled Skylab in orbit with its heat shield gone, one solar wing gone, and the other solar wing not deployed.

Telescope Mount remained intact.

"It was obvious Skylab was in big trouble," said retired Marshall team member Luther Powell.

space station operated on less than half of its designed electrical system.

All this meant one thing — the first Skylab crew, scheduled for launch May 15, would be delayed until methods could be devised to repair and salvage the workshop. Teams at the Marshall Center, and other NASA centers, who had put years of planning into Skylab, began quickly working to save it. A trouble-shooting team was formed in the Huntsville Operations Support Center from existing support teams. Other space center and industry personnel joined those already in Huntsville. Some personnel did not leave their posts for several days.

Marshall veteran manager George Hopson, and now-retired and former Center Director Dr. J. Wayne Little, co-managed a Thermal, Environmental

Rescue

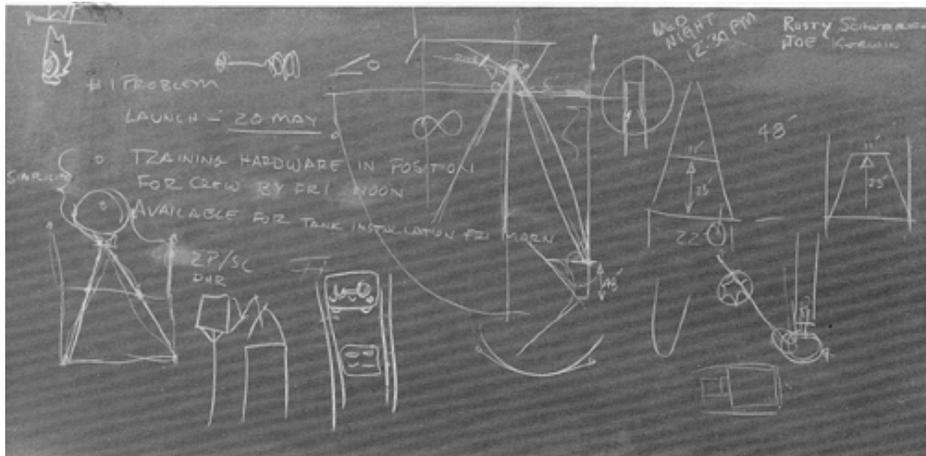
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Control and Life Support team. Littles can recall the many hours that his team members, and members of other teams, dedicated to the repair effort.

“That first ‘day’ for many of us was 44 hours long,” Littles said. “Hopson and I eventually arranged a work schedule of 18 hours on duty, six hours off. We operated in this mode, seven-days-a-week, for six weeks.”

While one team jockeyed Skylab in the nose-up attitude, two others, one led by Marshall retiree Robert J. Schwinghamer, and another led by now-retired Marshall Center Director J.R. Thompson, worked to develop a shield to shade Skylab and enable temperatures to be maintained without constant repositioning.

“NASA was presented with several



Blackboard at the Marshall Center following the “skull session” where the idea for a twin-pole sunshade for Skylab was originated May 16, 1973.

developing the shield. More than a few nights, Schwinghamer said, were spent sleeping on his office floor. The assembled group ranged from design, materials, manufacturing, and simulation specialists

from Marshall, to procedures and stowage personnel from Johnson Space Center. Also present were sail-making seamstresses from New Jersey with their stitching machines and astronauts with a command module simulator flown in from Houston.

Over the next several days, Marshall considered a variety of repair options. Eventually, three methods were developed, tested, rehearsed, and approved. Marshall

astronauts Charles Conrad and Joe Kerwin arrived at the Marshall Center from Kennedy Space Center in Florida to test solutions as they were developed and to practice in Marshall’s Neutral Buoyancy Simulator. At the Kennedy Space Center, the astronauts’ Saturn IB rocket was kept on immediate standby to carry the rescuers and their equipment to Skylab.

At 8 a.m. on May 25, the first crew, whose mission was called “Skylab 2,” was launched from the Kennedy Space Center with astronauts Conrad, Kerwin and Paul Weitz headed toward the orbiting workshop. The rendezvous occurred at 3:30 that afternoon. On the following day, May 26, the crew began to deploy the solar parasol — an orange vipstop nylon-Mylar shade folded against a telescopic pole — through the solar airlock on Skylab, allowing them to avoid an extravehicular activity.

Temperatures began to drop and the crew began to activate the new space station, which was safe and contamination free.

On June 7, the astronauts, working outside of Skylab, used a technique developed at Marshall to successfully cut the strap that had prevented deployment of the remaining solar array.

Looking back on Skylab, Thompson said, “I can’t single out individuals during Skylab’s rescue. We all remember key players, but in the final analysis, it was the NASA team that saved Skylab.”



Delores Zeroles, front, and Ceal Webb, rear, employees of ILC Industries of Dover, N.J., sew a solar shield for the Skylab sunshade May 21, 1973.

possible designs,” Thompson said. “These had to be evaluated, tested and a choice made in less than 10 days.”

Charts were set up and updated hourly on tests related to the quality of air on Skylab and the progress being made

was intensely involved in all three — a parasol sunshade, a twin-pole sunshade, and a set of metal cutting tools for freeing the jammed solar array. Marshall, however, had the lead role in developing the twin pole sunshade and the tools. Skylab

The Skylab astronauts comment on their experiences

Editor's note: *The Skylab mission transcripts are huge documents — each about the thickness of a New York City telephone book. The transcripts and other NASA documents contain hundreds of quotes from the Skylab astronauts — too many to publish in a single article. Here, however, are a few selected quotes from each astronaut:*

• **Charles “Pete” Conrad Jr.**, as he and his crewmates approached Skylab: “Tallyho, the Skylab. We got her in daylight at 1.5 miles, 29 feet per second.”

• **Paul Weitz**, trying with his other crewmates to pry loose a strap holding the Skylab solar wing beam: “We pulled as hard as we could on the end of the Solar Array System panel. We’re all trying to break it loose. It’s only a half inch strip, but man, is it riveted on?”

• **Joe Kerwin**, commenting on the weightlessness of space: “If you go from one module into the other and you’re

frontier and beginning its exploration may be our generation’s greatest contribution to human history.”

• **Owen Garriott**, talking about spider Arabella and her role in the Skylab student experiment: “It seems she learned very rapidly in zero g without the benefits of any previous experience.”

• **Jack Lousma**, speaking eight hours after launch and approaching Skylab, “Here’s our home in the Sky.”

• **Bill Pogue**, offering his personal observation on the meaning of Skylab: “I now have a new orientation of almost a spiritual nature. My attitude toward life and toward my family is going to change.”

• **Gerald Carr**, speaking seven hours after launch and spotting Skylab: “She looks pretty as a picture.”

• **Edward Gibson**, commenting on his departure from Skylab, “It’s been a good home. I hate to think we’re the last guys to use it.”



Astronaut Owen Garriott retrieves film during an extra-vehicular activity outside of Skylab on July 28, 1973.

upside down, you just say to your brain, ‘Brain, I want to be that way to be up.’ And, your brain says, ‘OK, then that way is up.’”

• **Alan Bean**, commenting on the importance of Skylab: “Space is our

Spiders in space

When the second crew headed for the orbiting Skylab workshop on July 28, 1973, one of the many experiments taken with them included two common Cross spiders named Arabella and Anita.

The purpose of the experiment was to see if the spiders could spin webs in the near weightlessness of space and how the webs’ shape and texture would be affected.

The experiment was the idea of Judith Miles, a high school student from Lexington, Mass. She was inspired by an article she read in National Geographic magazine detailing how spiders spun intricate webs.

Spiders can live about three weeks without food but need plenty of water. Prior to launch, each spider was fed a housefly, and had a water supply next to their specially constructed cage.

Astronaut Owen Garriott worked with the two spiders while in orbit. At first, the spiders did not do well at spinning webs. After a couple of days in space, they adapted to their environment and began spinning webs. The experiment lasted about five days. The webs spun in space were significantly finer than those spun on Earth, which proved that the spiders used a weight-sensing ability to size their thread.

Both spiders died while in space of apparent dehydration. It was later determined that the water supply system was not sufficient for the two spiders.

The experiment with Arabella and Anita provided Miles with a great deal of attention within NASA and from the world press at the time, since her experiment proved that biological experiments were compatible with human space flight.



“Arabella,” or “Anita,” spinning a web on Skylab

Historical sources for Skylab missions abound

It's been 30 years since Skylab. It's an adventure that many Marshall team members may have first heard about while they were in school.

Today, many Marshall team members still seek information regarding Skylab's technical development as well as its scientific achievements. Although a complete bibliography of Skylab would total hundreds of pages, it is possible to cite a few publications that may be useful to Marshall team members who need information relative to America's first space station.

In 1983, NASA published "Living and Working in Space, A History of Skylab," by W. David Compton and Charles D. Benson. The book examines early concepts and the development and preparations to fly during the late 1960s and early 1970s. It also traces the results of three manned Skylab missions.

One of the most valuable sections of the book is the detailed bibliography. Marshall team members seeking information on Skylab may want to use the bibliography as a first step in identifying a particular report or document.

NASA Technical Memorandum 64813, "MSFC Skylab Orbital Workshop," is a five-volume set published by the

Marshall Center in May 1974. The volumes deal with system design, performance, materials, reliability, safety, testing, mission support, engineering management and dozens of other topics.

There are hundreds of other technical memorandums related to the Skylab program.

Less detailed is a Skylab series that the Marshall Center published following the actual missions. This set is part of the NASA Special Publication series and the titles are indicative of the subject matter covered. Among the titles are:

- "Skylab, Our First Space Station"
- "A New Sun, The Solar Results from Skylab"
- "Skylab's Astronomy and Space Sciences"
- "Skylab, Classroom in Space"

Also available are various Skylab chronologies published by the Marshall Center and NASA.

In 1974, the Marshall Center published report M-GA-74-6, "A Catalog of Skylab Information." Although many Skylab reports and papers were published after this date, the catalog represents a good one-stop guide to reports, publications and other items related to Skylab.



Summary of Skylab accomplishments

Editor's note: When Skylab was launched, the mission was designated "Skylab 1." The first crew to arrive at Skylab was designated "SL-2," the second crew "SL-3" and the third crew "SL-4."

Experiments	SL-2 Hours	SL-3 Hours	SL-4 Hours	Total Hours	Events Planned	Events Accomplished	%
Solar Astronomy	117.2	306.1	519.0	941.3	879.5 hours	941.3	+7.1
Earth Observations	71.4	223.5	274.5	569.4	62 passes	99	+60
Student	3.7	10.8	14.8	29.3	44	52	+18
Astrophysics	36.6	103.4	133.8	274.2	168	354	+105
Man/Systems	12.1	117.4	83.0	212.5			
Material Science	5.9	8.4	15.4	29.7	10	32	+220
Life Science	145.3	312.5	366.7	824.5	701	922	+32
Comet Observation			156.0	156.0			
EVA time	6.33	13.2	22.2	42.2			

Crew members of America's first space station have solid place in history

A short biography of the Skylab astronauts

First crew:

- *Charles "Pete" Conrad Jr.* — A former Navy test pilot, he was chosen as a NASA astronaut in 1962. His first flight was on Gemini V, and he commanded Gemini XI. He was the commander of Apollo 12 and became the third man to walk on the moon in November 1969. He was commander of the first Skylab crew in 1973. He died in a motorcycle accident in 1999.

- *Paul Weitz* — A former Navy fighter pilot, he was chosen as a NASA astronaut in 1966. His first mission was on the first Skylab crew in 1973. He was the spacecraft commander for STS-6 on the maiden flight of the Space Shuttle Challenger in 1983. He retired as deputy director of Johnson Space Center in 1994.

- *Dr. Joseph Kerwin* — A Navy doctor and pilot, he was selected as a NASA astronaut in 1965. He was the science-pilot for the first Skylab crew. He retired from NASA in 1987 and went into private business.

Second crew:

- *Alan Bean* — A former Navy pilot, he was selected as a NASA astronaut in 1963. He was the lunar module pilot on Apollo 12 and became the fourth man to walk on the moon. He was the commander of the second Skylab crew. He left NASA in 1981 and is now a full time artist.

- *Owen Garriott* — A professor in electrical engineering at Stanford University, he was selected as a NASA scientist-astronaut in 1965. He was a scientist on the second Skylab crew. He later flew in STS-9 — the first Spacelab mission – in 1983. He left NASA in 1986 and is a consultant living in Huntsville.

- *Jack Lousma* — A former Marine pilot, he was selected as a NASA astronaut in 1966. He was the pilot for the second Skylab crew. He was the commander of STS-3, the third shuttle test flight, in 1982. He left NASA in 1983 to work in private business. He lives in Michigan.

Third crew:

- *William Pogue* — A former Air Force pilot and Thunderbird, he was selected as a NASA astronaut in 1966. He was the pilot for the third and last Skylab crew. This was his only space flight. He left NASA in 1975 and works as a consultant.

- *Edward Gibson* — A scientist with his doctorate specializing in solar physics, he was selected as a NASA astronaut in 1965. He was a science-pilot for the third and last Skylab crew. He left NASA in 1974 and formed his own consulting company.

- *Gerald Carr* — A former Navy pilot, he was selected as a NASA astronaut in 1966. He was the commander of the third and last Skylab crew. This was his only space mission. He left NASA in 1977 and went into private business.

Life in space aboard Skylab no ordinary job

Marshall Center celebrates 30th anniversary of Skylab



Astronaut Owen Garriott at the control and display panel onboard Skylab's orbital workshop.

Photos provided by Marshall Imaging Services



The interior of the Skylab orbital workshop.



The "Elbow Prominence" photographed by Owen Garriott while observing a small flare near the sun.



Charles "Pete" Conrad Jr. pedals a stationary bicycle while exercising onboard Skylab.



Skylab in orbit with its solar shield in place and solar array fully deployed.



Skylab's final flight path as it disintegrated on reentry.