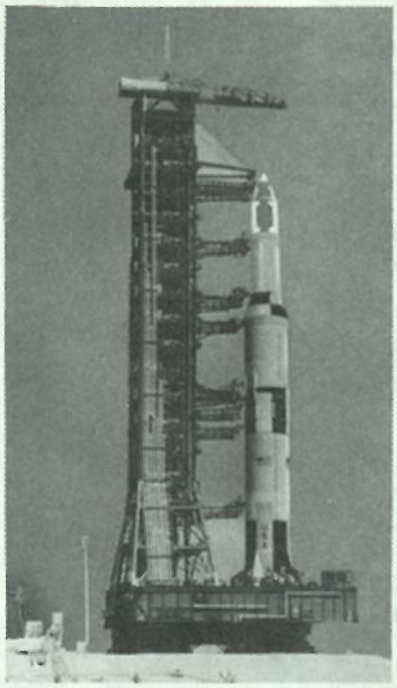
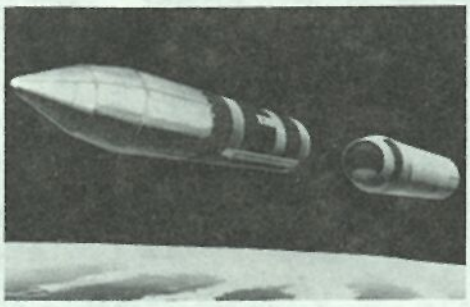
MARSHALL SPACE FLIGHT CENTER

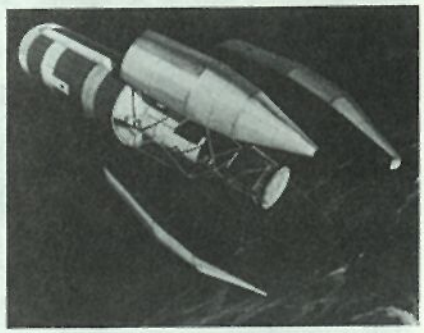
SKYLAB



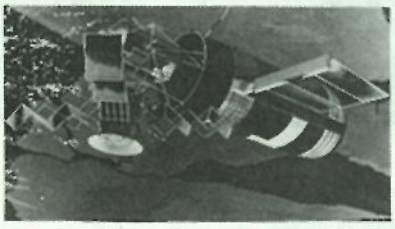
Saturn V with Skylab Payload



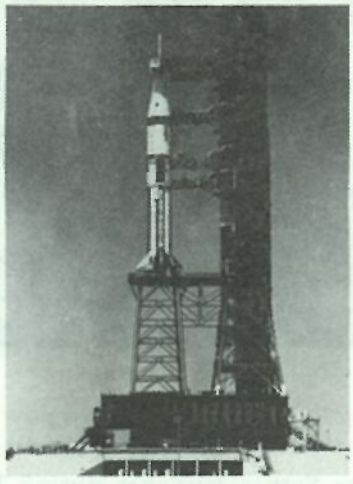
Separation of payload from second stage of Saturn V in orbit.



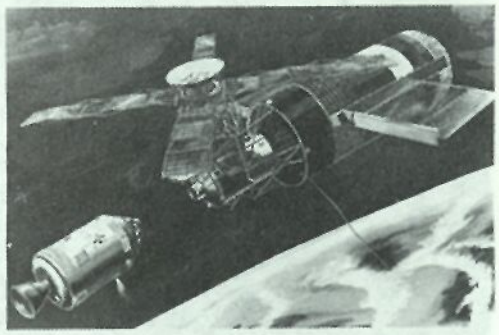
Shroud used during launch is discarded.



Deployment of Apollo Telescope Mount



Saturn IB on pedestal at Launch Complex 39



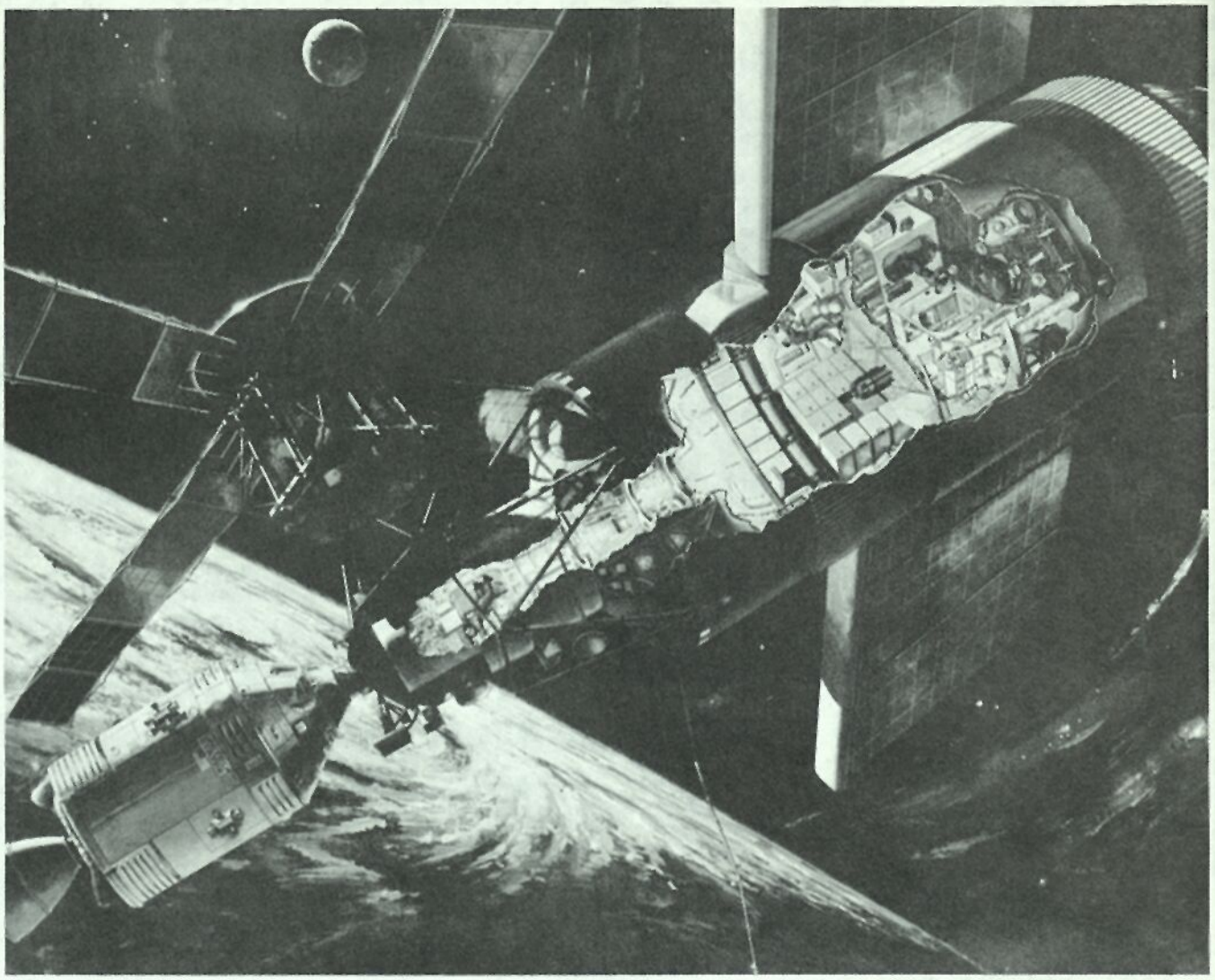
Arrival of Skylab crew

WORKING ON A NEW FRONTIER

Skylab, America's first experimental space station, will be placed into Earth orbit in early 1973. Dwarfing previous manned spacecraft, this huge cluster of hardware will include roomy living quarters and laboratories equipped with complex scientific equipment for three astronauts.

Three separate three-man crews will visit Skylab, living and working there for periods up to 56 days. In Skylab's unusual environment, high above Earth's atmosphere in the weightlessness and vacuum of space, they will undertake the most intensive space research yet defined. Here they can look up to study the Sun, look down to observe the Earth, and look inward to evaluate man's ability to work successfully in zero-gravity for long periods. No laboratory on Earth can provide the answers to questions that will be asked in the Skylab experiments.

At an altitude of 435 kilometers (270 statute miles), Skylab will speed around the Earth in an easterly direction in an orbit at a 50 degree angle from the equator's plane. Its path will reach 5551 kilometers (3450 miles) north and south of the equator, crisscrossing most of the Earth's surface, except for the Arctic and Antarctic. Moving at 8 kilometers (5 miles) per second, it will complete an orbit in 93 minutes. Its sensitive instruments will observe and record millions of bits of data about Earth's land, sea, and air; about the Sun; and about the condition of the crew members themselves.



The Skylab Program will require four Saturn launches during 1973. The eight-month mission will begin with liftoff of the unmanned workshop from the Kennedy Space Center on a two-stage Saturn V vehicle. Skylab will maneuver into its planned attitude, point toward the Sun, swing its solar observatory 90 degrees from the vertical launch position to operation position, and pressurize its quarters with an oxygen-nitrogen environment to make ready for the arrival of the astronauts.

One day after the Saturn V launch, a Saturn IB will boost an Apollo spacecraft and the first three-man crew into a low Earth orbit. Using the spacecraft's service propulsion system, the astronauts will climb to the Skylab's altitude, dock, and enter. After 28 days they will reenter their spacecraft and return to Earth for a splashdown in the Atlantic Ocean.

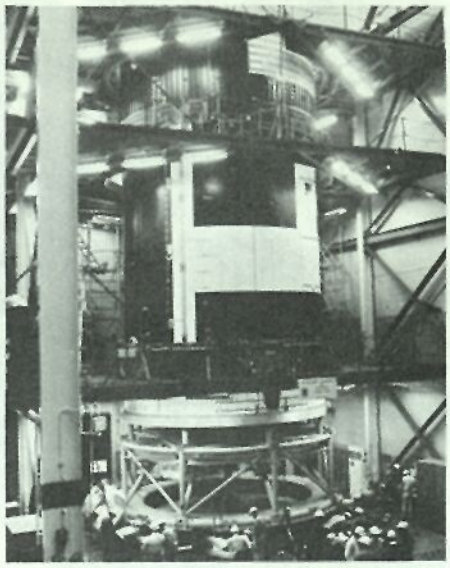
About sixty days after the first crew's return, another Saturn IB will start a second crew on a visit to Skylab, this time for 56 days.

And thirty days after the second crew's return to an Atlantic recovery area, a third crew will be launched for another 56-day flight. Recovery of the third crew will be in the Pacific Ocean.

CLUSTER COMPONENTS

Saturn stage – The largest element in the Skylab cluster is the workshop and crew quarters section. It is made from the third stage of a Saturn V, the launch vehicle used in Project Apollo to send men to the Moon. This stage is outfitted on the ground, however, to serve as a spacecraft rather than a propulsive stage.

The hydrogen tank is modified to form a two-level area stocked with food and other provisions and equipment for experiments. A shield envelopes the workshop for protection against meteoroids, and two huge wings covered with solar cells spread out from the sides.

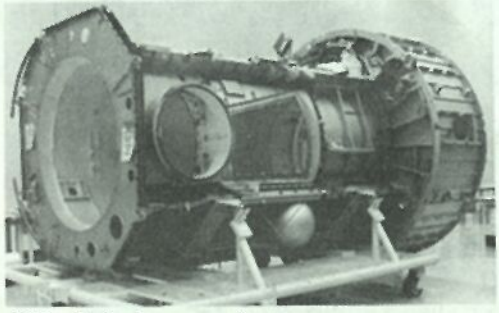


Workshop stage with meteoroid shield

Other components were designed and built to make full use of the laboratory in the sky. These include:

Airlock Module – A pressurized passageway for entering and leaving the workshop. The Airlock also contains a good bit of equipment for environmental and thermal control, for distributing electrical power, for supporting voice communications and data handling, and for supporting some of the experiments aboard.

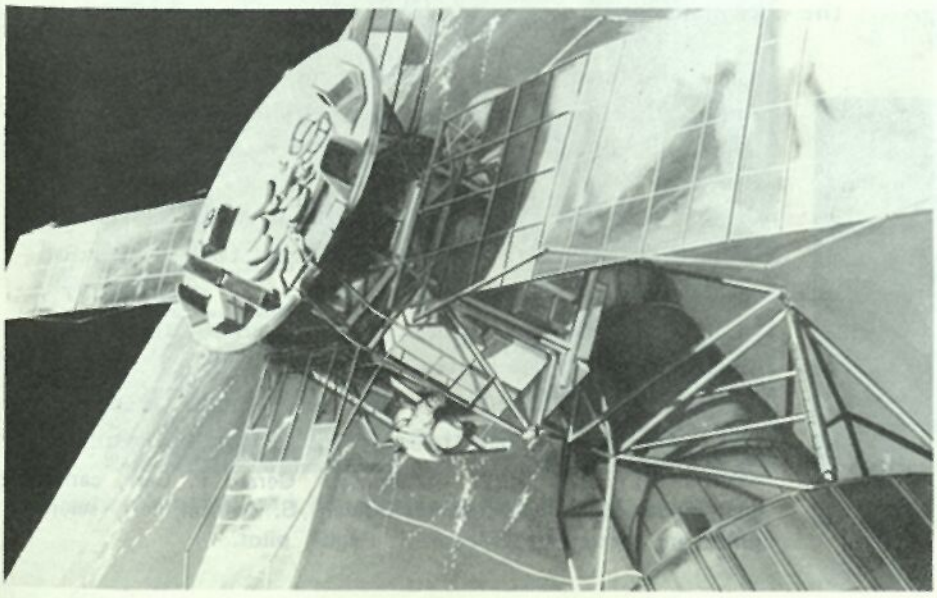
Multiple Docking Adapter – Joined to one end of the Airlock, the Adapter has two ports for docking the Apollo spacecraft which brings the crew members up from Earth. It also functions as a major experiment control center.

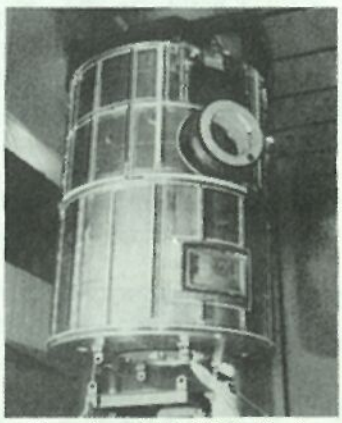


Airlock during manufacture

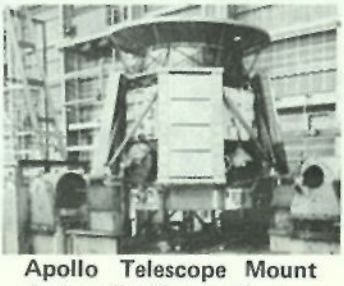
Apollo Telescope Mount – Houses four very special telescopes and other instruments which can be manned for studying the Sun. Stowed above the Multiple Docking Adapter at launch, the ATM is swung aside at a 90-degree angle, once in orbit. The largest solar cell array system ever devised for a spacecraft will provide electrical power for the ATM.

The array is made up of four wings, folded for launch, and opened by a scissors linkage after reaching orbit, to form a huge cross measuring 30 meters (98 feet) across.





Transfer of Multiple Docking Adapter



Apollo Telescope Mount during vibration testing

FIRST SKYLAB CREW -- Astronaut Charles Conrad, Jr., center, commander; Scientist-Astronaut Joseph P. Kerwin, seated, science pilot; and Astronaut Paul J. Weitz, pilot.

SECOND SKYLAB CREW -- Astronaut Alan L. Bean, right, commander; Scientist-Astronaut Owen K. Garriott, left, science pilot; and Astronaut Jack R. Lousma, pilot.

THIRD SKYLAB CREW -- Astronaut Gerald P. Carr, center, commander; Scientist-Astronaut Edward G. Gibson, left, science pilot; and Astronaut William R. Pogue, pilot.

CREW SELECTION

Skylab has many of the characteristics and equipment of an airliner, a hotel, a medical laboratory, a solar observatory, and a scientific laboratory. All this is manned by only three men, each one of whom must be something of a pilot, a scientist, and a doctor. Crew members for the Skylab missions were named January 18, 1972.

The six major areas of training for the mission include flight operations (launch, rendezvous, reentry), Skylab cluster-systems operation, medicine, solar physics, Earth-resources experiments, and other experiments which require considerable knowledge of astronomy, biology, and engineering. Although all crew members will receive some training in each of these six areas, one man will be designated the expert in each area. He will receive additional training and will have the primary inflight responsibility in his designated areas.

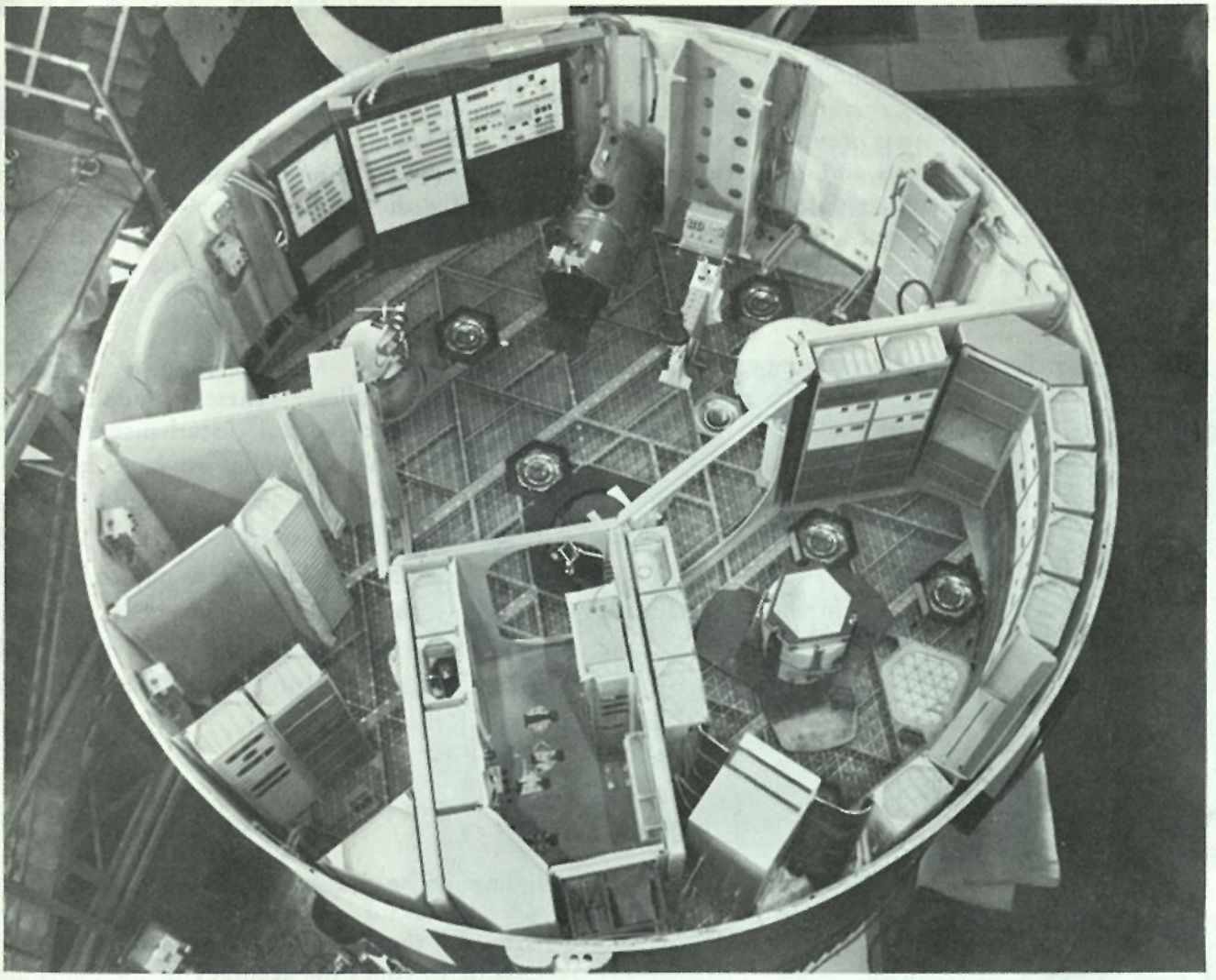
LIVING IN SPACE

In Skylab the astronauts will be free from the confining cockpit-like environment of the Mercury, Gemini, and Apollo spacecraft. To the astronauts who have flown in space during these three previous manned space flight projects, entering Skylab will be like stepping into a house, after living for days in the cockpit of an airplane.

The living area includes a bedroom, where each crew member will have his own compartment for privacy, a cabinet for his personal items, and a bed, hanging on the wall. Since lying down means nothing in the absence of gravity, the astronauts will sleep standing up against a flat surface.

The bathroom, called waste management compartment, also has unusual fixtures. A shower is located in the work area just outside.

The combination den and dining room has a table where all three crew members can eat together. Food is stored in freezers, refrigerators, and a small pantry. Trays will warm the pre-cooked frozen foods, and the astronauts will use knives, forks, and spoons. The diet of 2500 calories per day will more closely resemble Earth meals than the food served on previous flights.



Layout of crew quarters in Skylab

Weitz, Conrad, and Kerwin sample the Skylab menu.

Astronauts prefer to sleep standing up in Skylab.

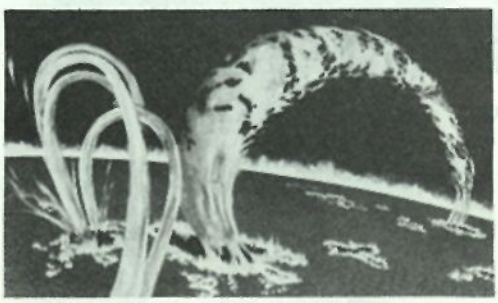
EXPERIMENT WORKLOAD

The nine astronauts will conduct more than 50 scientific and engineering experiments during the five months in which Skylab is occupied. Extensive biomedical, Earth observations, and solar astronomy investigations will be conducted throughout the entire period, but the emphasis will shift with each mission. The first mission will stress medical experiments; the second will concentrate on using the Apollo Telescope Mount instruments to observe the Sun; and the third will focus on Earth's resources.

MEDICAL

Medical research will be an important part of each Skylab mission. Many of the fears commonly held before the beginning of manned space flight have proved groundless. These included fears of excessive radiation, disorientation, psychological disturbances, and dire physiological effects from weightlessness. While we have learned a great deal about man's ability to live and perform useful work in space, some major questions are still unanswered. Skylab will help to answer them. The medical experiments will observe physical changes in the astronauts. Their sleep will be monitored, and nutritional needs will be studied. Records will be kept of uneaten food. The daily fluid intake will be recorded, and samples of urine will be collected, frozen, and returned to Earth for analysis.

STUDYING THE SUN



Skylab will have eight telescopes and other instruments which the crew will use for selective pointing and zeroing in on specific areas of the Sun. The astronauts can point their instruments with 10 times the accuracy of the unmanned solar observatories now in orbit.

One of the major tasks on Skylab missions will require astronauts to leave the pressurized spacecraft on trips to remove film from the instruments in the solar observatory. Six such trips will be made during the three missions.

The ultimate source of all energy on Earth is the Sun. Skylab's manned solar observatory provides a new and exciting tool for studying the Sun and solar phenomena.

SURVEYING EARTH'S RESOURCES

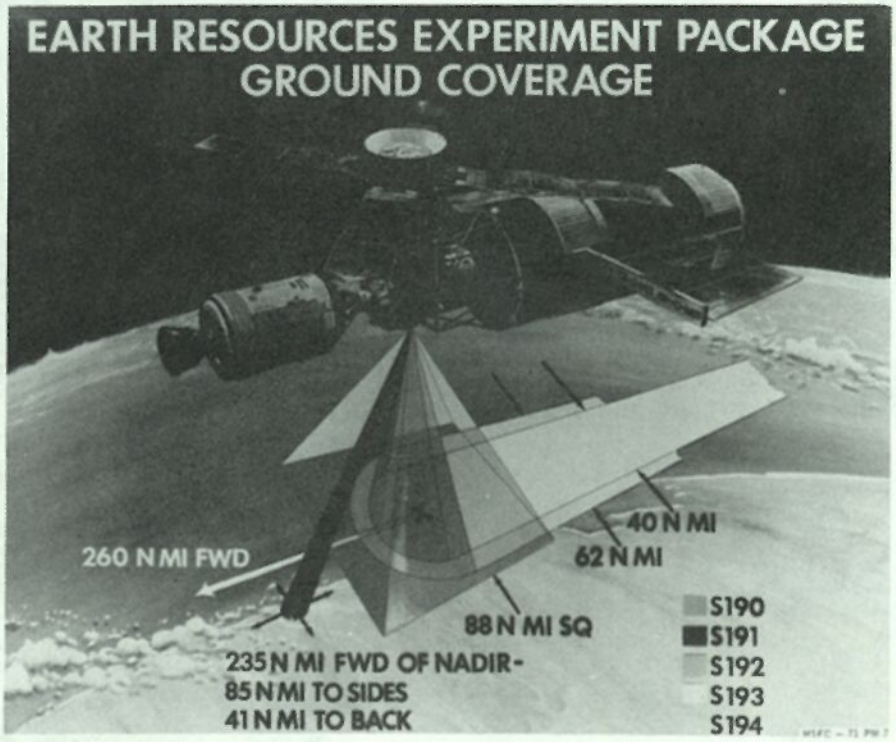
Skylab will carry some relatively large, flexible, and high-performance sensors to expand investigations of remote sensing of the Earth from orbit. Crew members will operate these instruments in laboratory fashion.

Photographic, infrared, and microwave equipment is included. The multispectral cameras will produce about 10 times the photography obtained to date from manned spacecraft, with ground resolution three times better than the past manned photography from space. More than 21,000 photographs will be made during the three missions.

WHY SEND MAN UP ?

Why do we need a manned laboratory in space? Why not send machines to observe and report their findings?

While machines are far superior to man for some space research duties, man is superior in others. Man adds on-the-spot judgment to science in space. He can discriminate, analyze, and interpret information, all in near real-time. He can manipulate instruments, handle tools, and often make repairs and adjustments to malfunctioning equipment. He learns from experience and has remarkable ability to adapt and react to the immediate past. These qualities have made man distinctive in his laboratories on Earth, and they will permit him to continue his advancements in his laboratories in space.



SKYLAB BENEFITS

Major benefits from the Skylab Program will be reflected in the results of the more than 50 experiments to be conducted.

The medical experiments information will be extremely helpful in determining the best role for man and the support he will require on future missions.

The science experiments will increase our knowledge of the Sun, geophysics, and physics of the upper atmosphere.

The Earth resources experiments will help to develop orbital systems for surveying crops, forests, geological formations, global wind, sea, and weather conditions, and other resources and surface conditions on planet Earth.

The technology experiments will test the use of the space environment for such applications as manufacturing unique and valuable products.

And the engineering experiments will test equipment for improving man's performance in space.

Skylab will demonstrate that there is important work to be done in near-Earth space that only mankind can do. Space is an endless new frontier where humanity belongs.

SPACE CENTER ROLES

The Skylab Program has broader objectives than Apollo, more scientific equipment and more diversified experiments, and wider geographic separation of principal investigators. To meet these new challenges to management, NASA assigned responsibilities as follows:

Marshall Space Flight Center – hardware-systems engineering and management

Manned Spacecraft Center – Mission Control and crew operations

Kennedy Space Center – launch operations

The responsibilities for developing hardware and providing other items were divided as follows:

Marshall Space Flight Center – Saturn V and Saturn IB launch vehicles, the Orbital Workshop, Airlock Module, Multiple Docking Adapter, Apollo Telescope Mount, Payload Shroud, and assigned experiments.

Manned Spacecraft Center – Command and Service Modules, spacecraft adaptor, crew systems (pressure suits, etc.), medical equipment, food, and assigned experiments.

To provide this equipment, each NASA center is relying on the services of numerous contractor firms through the United States.

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