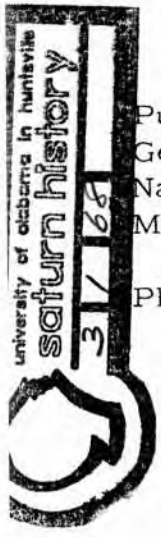


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Public Affairs Office
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Phone: 876-1102, 876 -1959

March 1, 1968

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APOLLO TELESCOPE MOUNT

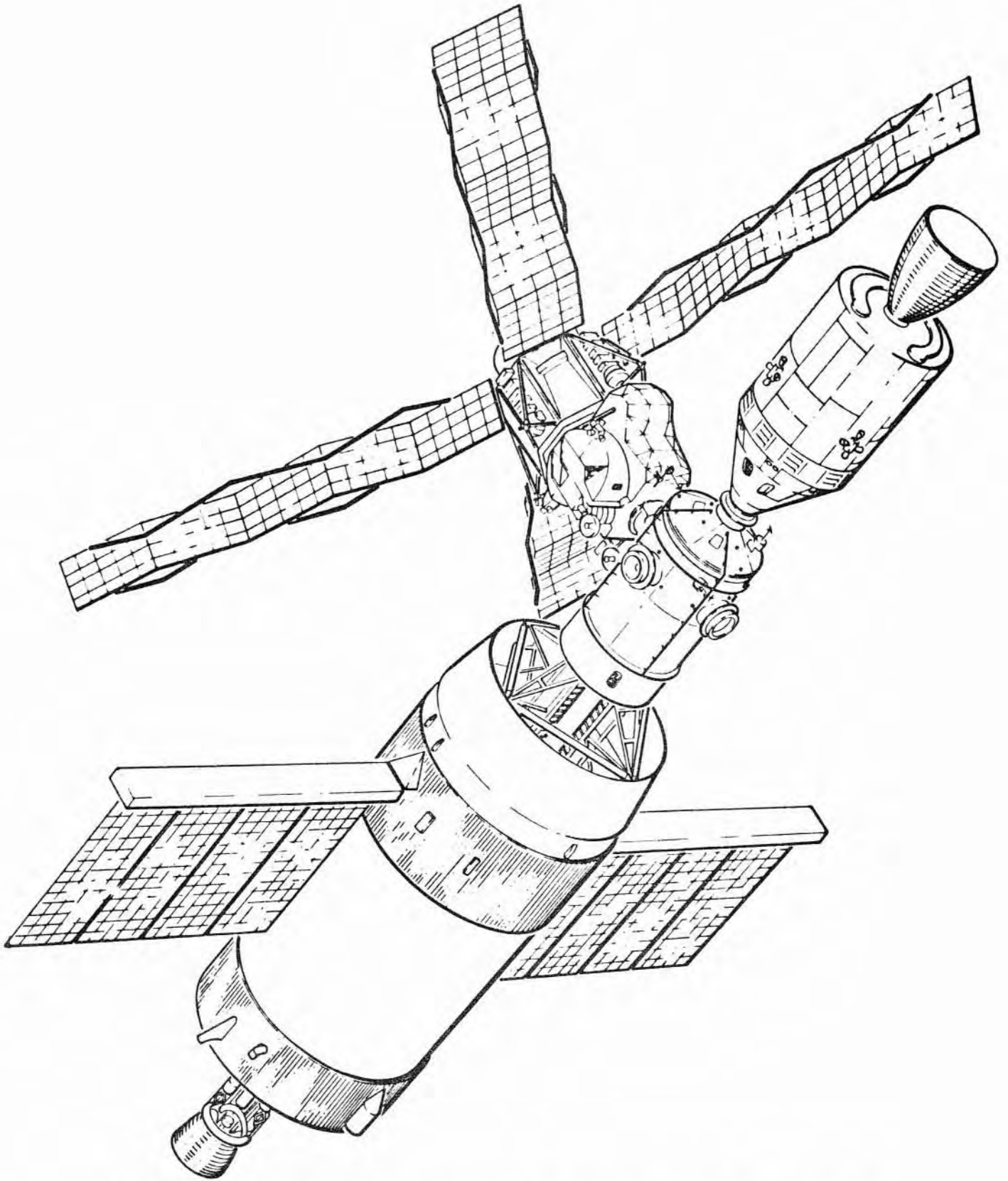
-- Fact Sheet --

The Apollo Telescope Mount (ATM) is being developed to give space scientists a look at the sun's activity unencumbered by the fogging effects of the earth's atmosphere.

The National Aeronautics and Space Administration plans to launch the first of its manned solar observatories, ATM-A, in 1971. The space agency is joined by the scientific community and industry in developing the highly sophisticated satellite.

Five principal investigators, all experts in astronomy and solar physics, have designed five experiments for the first ATM flight. The eight instruments used in these five ATM experiments will obtain measurements of the sun in the extreme ultraviolet and X-ray portions of the electromagnetic spectrum which cannot penetrate the earth's atmosphere and obtain pictures of the sun's corona in the white light portion of the spectrum.

Dr. George E. Mueller, NASA Associate Administrator for Manned Space Flight, has said the ATM "provides a new great capability for a variety of solar and stellar scientific experiments" to be performed above the atmosphere, where the sun and stars can be clearly observed without being obscured by the earth's



AAP CLUSTER -- The Apollo Telescope Mount, shown at top, is one of the principal payloads in the first Apollo Applications flights. Other main elements are the Saturn I workshop, bottom, the airlock/multiple docking adapter and Apollo spacecraft.

atmosphere. The first ATM, one of the early Apollo Applications missions, is a forerunner of more advanced manned solar and stellar observatories which will provide an increased data gathering capability for astronomers.

A proposed follow-on manned orbiting observatory will have a new set of experiment hardware of greater sophistication than the first one. Some of the solar and stellar experiments already are under development.

Ground based scientists "see" the sun in only the visible light, and portions of the infrared and radio frequencies of the electromagnetic spectrum. Instruments carried by unmanned spacecraft and balloons have pioneered in the field of spaceborne solar astronomy.

The manned ATM offers opportunities not available with unmanned spacecraft. The scientist-astronaut will perform operations requiring judgment to select targets of scientific interest and to point the telescopes. He will control all ATM experiment operations in acquiring the data, including retrieval of films. These operations can be augmented by radio contact with scientists on the ground who can redirect the observing program based on ground data or verbal descriptions from the astronaut crew.

Where ATM fits into AAP Sequence

The Apollo Telescope Mount will be a part of a cluster of hardware in orbit which includes the orbital workshop and a manned Apollo command and service module (CSM). Saturn IB launch vehicles will place these payloads into an earth orbit of 300 statute miles.

The orbiting cluster will be assembled in the following manner:

The Saturn I workshop will be placed into space first. A day or so later a manned Apollo spacecraft will be launched and will rendezvous and dock with the workshop which then will be made habitable for a 28-day stay. After this phase of the overall mission has been completed and the first crew has returned to earth, a revisit by another three-man crew will be made. This crew will be conducting medical experiments in the workshop for up to 56 days.

The ATM is planned for the fifth flight. In this dual launch, the lunar module (LM) ascent stage/ATM launch will follow a manned command/service module launch. The two vehicles rendezvous and dock. After this operation, the LM ascent stage is manned and the combined vehicles rendezvous with the workshop which has remained in orbit after completion of the earlier portion of its mission.

The new crew reactivates the workshop. During the remainder of the mission the cluster will be inertially stabilized by the control system on the LM/ATM to maintain the axis of the telescope along the sun line. The control system consists of two main control loops. The outer loop utilizes a coarse sun sensor and is stabilized by three large control moment gyroscopes which provide basic cluster orientation and stability.

The inner loop is a fine pointing system driving the experiment package. This system uses a very precise sun sensor to accurately point the experiment instrumentation to crew-selected areas on the sun. Stability on the order of plus or minus 2-1/2 arc seconds is also provided by this vernier or inner loop control system by counteracting disturbances such as crew motions.

During this flight, which is to last up to eight weeks, the astronauts will observe the dynamic phenomenon on the surface and in the corona of the sun.

ATM Experiments

Five authorities in astronomy and solar physics are designing the five major experiments for the first ATM mission. These experiments are being developed under the direction of the NASA-Marshall Space Flight Center.

Eight major solar instruments are employed in conducting this investigation. The devices are designed to provide high spatial and spectral resolution in the ultraviolet, X-ray, white light and hydrogen-alpha (6563A) bands of the spectrum and are particularly concerned with the active regions on the solar disk or in the corona.

The fairly large telescopes are mounted in a 7-foot diameter cylindrical structure on their unique optical bench structure which is mounted on the ATM structural spar assembly.

The five principal experiments are the High Altitude Observatory (HAO) white light coronagraph, the Naval Research Laboratory (NRL) ultraviolet spectroheliograph and extreme ultraviolet spectrograph, the Harvard College Observatory (HCO) ultraviolet scanning spectrometer, a Goddard Space Flight Center (GSFC) X-ray telescope and an imaging X-ray spectrographic telescope by American Science and Engineering.

Dr. Riccardo Giacconi of American Science and Engineering Co., Cambridge, Mass., is the principal investigator for the X-ray spectrographic telescope. This experiment proposes to obtain X-ray photographs of temporal changes associated with solar activity, including flares, with a spatial resolution of about

two arc seconds and to simultaneously record spectrally dispersed emissions over the range of two to eight angstroms with a resolution of a fraction of an angstrom.

An electronic flare detector, in addition to the main telescope, will give the astronaut a visual indication of flare buildup. This will allow him to select active regions and photograph the flares in the early X-ray rise periods.

James Milligan is the principal investigator for the Goddard Space Flight Center's X-ray telescope experiment.

This experiment uses a glancing incidence X-ray and extreme ultraviolet telescope with a resolution capable of recording the solar X-ray distribution over the complete solar disk and near corona in the 3 to 100 angstroms wavelength region. The information will be recorded on X-ray sensitive 35 millimeter roll film. There are also two proportional counters to monitor the total solar X-ray flux in the spectral regions of two to eight and eight to 20 angstroms. This data will be pulse height sorted and recorded for use by the astronaut for historical observation to identify possible flare precursor activity changes.

There are two Naval Research Laboratory extreme ultraviolet experiments to be flown on the ATM. J. D. Purcell of the NRL, Washington, D. C., is the principal investigator.

The first of the two instruments, Experiment A, is an extreme ultraviolet spectroheliograph and is designed to photograph images of the total disk in the various wavelengths between 160 and 650 angstroms. The main elements of the

extreme ultraviolet spectroheliograph are a concave grating and a film strip camera. Experiment B, an extreme ultraviolet spectrograph, is designed to photographically record line spectrograms of the solar radiation between 1200 and 4400 angstroms from selected small areas on the solar disk and at different levels across the limb of the sun and into the corona.

An additional part of Experiment B is the extreme ultraviolet monitor. Housed in the same case and closely aligned with Experiment B, its purpose is to provide a television representation of the solar image in the extreme ultraviolet, which is used by the astronaut to identify solar ultraviolet features not visible at the longer wavelengths. Experiment B also can be commanded by its astronaut to display a television image of the spectrograph slit in white light.

Dr. Leo Goldberg of the Harvard College Observatory, Cambridge, Mass., is the principal investigator for the HCO ultraviolet scanning spectrometer experiment. This experiment acquires its primary data by photoelectric conversion technique with subsequent periodic data transmission to earth receiving stations. Photographic recording on 70 millimeter film of the spectrometers 30 arc second square slit imaged against a 20 arc minute solar background field in the hydrogen alpha wavelength (6563A) will be used for post mission data correlation. A similar image is available to the astronaut via TV monitor. The instrument spectrally scans 30 arc second square areas of the solar disk in a range of 300 to 1310A, searching the chromosphere, photosphere and corona for quiet sun phenomena, plus perturbations such as plages, flares, filaments and associated active regions. At least 30 arc second spatial and 1.5A spectral resolution is anticipated with a time resolution response of approximately 80

milliseconds.

Dr. Gordon Newkirk, of the National Center for Atmospheric Research, High Altitude Observatory, Boulder, Colo., is the principal investigator for the HAO white light coronagraph. Its purpose is to monitor the brightness, form and polarization of the solar corona between one and one half and six solar radii from the center of the sun.

This instrument consists principally of the three forward (sun direction) external occulting disks, and a modified Lyot coronagraph optical system, drive mechanisms, electronics and 35 millimeter camera.

Four of the five experiments have instrumentation built by industry. Ball Brothers Research Corp., Boulder, Colo., is manufacturing instruments for the High Altitude Observatory and the Naval Research Laboratory. American Science and Engineering is building the equipment for its experiment and the Harvard College Observatory (HCO) experiment. The Marshall Space Flight Center has the responsibility for manufacturing the Goddard experiment equipment. Perkin-Elmer has been awarded the prime contractor building the HCO Hydrogen-Alpha telescopes and the main ATM pointing telescope.

ATM Operation and Control

The LM ascent stage control and display panel will be the primary experiment work station. From this point the crew will control and monitor the experiments, the pointing control system, the instrumentation and communications and the power system.

