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GODDARD SPACE FLIGHT CENTER

## 1970 Produces Major New Findings

The United States space program produced major new scientific findings in 1970 as NASA continued its exploration of the moon and beyond. Following up on the historic Apollo 11 and 12 flights, scientists reached a number of conclusions based on the studies of the lunar rocks returned to earth and data from automatic recorders left on the moon by Apollo 12.

Among the findings it was noted that:

- there is no sign of life, past or present, on the moon.
- rocks returned from the moon are older than any found on earth.
- lunar rocks are composed of the same chemical elements as some found on earth, but in unusual proportions.
- and, a new mineral found on the moon has been named Armalcol for the three Apollo 11 astronauts -- Armstrong, Aldrin and Collins.

NASA's unmanned program also contributed further to our knowledge of the planets. NASA announced, in May, after a study of enhanced photos taken by Mariner spacecraft, that one of Mars' two moons, Phobos, appears to be very dark and potato-shaped.

Another exciting development was the first positive identification of amino acids of extraterrestrial (non-earthly) origin. The find, made at NASA's Ames Research Center is probably the first conclusive proof of extraterrestrial chemical evolution, the chemical processes which precede the origin of life.

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# MSFN Preparing For MM 71

The MSFN will support the Mariner Mars 71 (MM 71) launches on May 6 and May 16; the first spacecraft (Mariner-H, NCG-286) is scheduled to precede the second spacecraft (Mariner-I, NCG 287) by ten days. The two launches will take place at KSC from the AFETR launch complexes 36A and 36B.

The MSFN will provide command, metric, and telemetry ground support to the spacecraft and launch vehicle projects, and will conduct a geodetic station location experiment to more accurately define the coordinates of MSFN USB antennas.

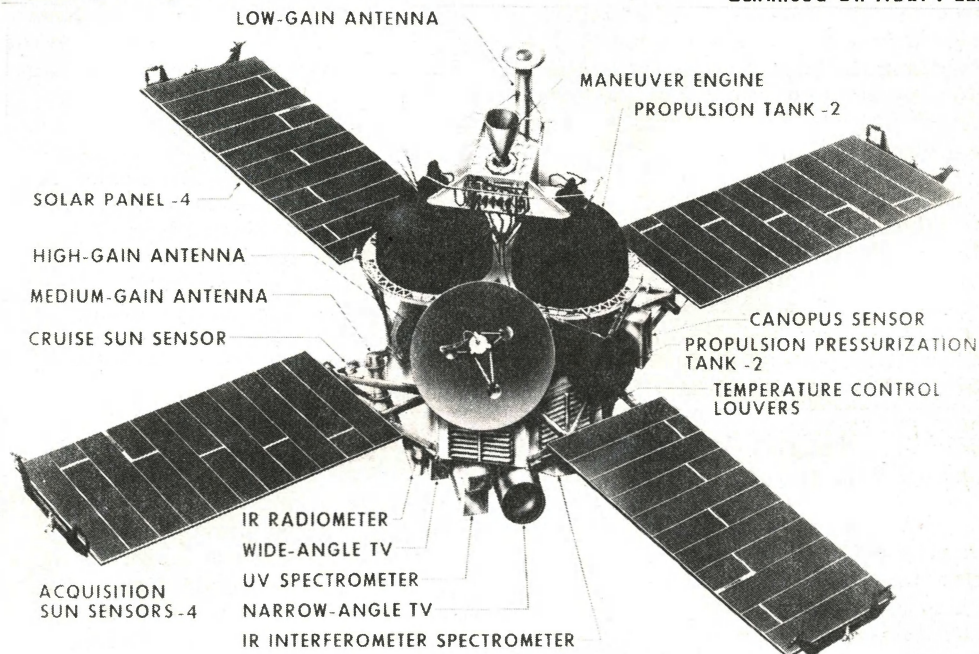
The missions present a unique opportunity to obtain tracking data which can be used to generate improved geodetic coordinates for the 30- and 85-foot prime USB tracking stations. The geodetic mispositioning of the MSFN stations is the major source of error in trajectories presently being determined from MSFN

USB tracking data. Other prime objectives of the experiment will be to prove the 85-foot station capacity to track effectively in deep space, and to place precision frequency standards such as the GSFC experimental hydrogen masers at several DSN stations to obtain frequency comparisons with the DSS primary frequency standards at those stations.

The geodetic experiment will run for six months. Each USB station participating will be used for five or six tracking periods of one week each. The MSFN stations that will support this experiment are: ACN, CRO, CYI, BDA, MIL, TEX, GWM, HAW, MAD, GDS, HSK, and ETC.

Unlike the MM-69 planet flyby missions, the MM-71 are Mars planet orbiter missions. The spacecraft will provide broad topographic and thermal coverage, study seasonal

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Mariner Mars 71 spacecraft top view.

## Apollo And Mariner Mars Will Highlight 1971

Two manned Apollo missions to the moon and two unmanned Mariner Mars launches in late spring will highlight NASA's 1971 space flight program.

In addition to the Apollo and Mariner launches, the NASA 1971 space flight schedule includes a broad range of scientific and applications satellites, aeronautical research, and cooperative space exploration with other countries.

Six months after Apollo 14, on July 25, Astronauts David R. Scott, Alfred M. Worden, and James B. Irwin are

scheduled to be crew members on Apollo 15. On this flight, for the first time, an electric lunar roving vehicle will be taken along to extend the expedition's range. Scott and Irwin will ride the Rover, carrying a color TV camera, over a northern lunar plain cut by the Hadley Rille, which is a broad, deep gorge which runs along the base of the 8,000-foot Apennine Mountains.

They will deploy scientific recorders, collect lunar samples, and attempt

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# Apollo And Mariner Mars Will Highlight 1971 Launches

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to find evidence on the origin of the strange lunar rilles which resemble the dry river beds found on earth. Samples may indicate whether water, not yet found on the moon, was a factor in its formation.

The two Mariner Mars '71 spacecraft will be launched from Cape Kennedy in May, the second approximately ten days after the launch of the first. Each will be assigned separate scientific missions. After injection into orbit around Mars in November, they will send back information via onboard TV cameras and other instrumentation.

The objective of the project is to explore Mars from orbit long enough to observe about 70 percent of the planet's surface from an altitude of about 1,000 miles, and to record the seasonal changing of surface marks such as the wave of darkening as seen from earth.

In the NASA aeronautical program, the supercritical wing, a revolutionary new airfoil that may be used either to permit future subsonic jets to cruise at substantially higher speeds or to permit structural weight savings on moderate-speed aircraft, will receive extensive testing in 1971.

A thin version of the wing has been fitted to a Navy F-8 plane at the NASA Flight Research Center in California, and will get its first flight tryout in the spring. A thick version of the airfoil, fitted to a Navy T2-C, will receive continued flight tests at the North American Rockwell aviation facilities in Ohio.

Other launches tentatively scheduled for 1971 include:

Intelsat (Jan. 25) - a communications spacecraft to be orbited for the International Telecommunications Satellite Consortium to supplement its existing satellite network;

NATO-B (Feb. 2) - a communications satellite which will be operated by the North Atlantic Treaty Organization;

IMP-I (Feb. 25) - Interplanetary Monitoring Platform-I;

Solrad (February) - a Navy scientific satellite;

ISIS-B (March) - a cooperative Canadian/NASA scientific satellite mission;

PAET (March) - Planetary Atmosphere Experiments Test designed to analyze unknown planetary atmospheres;

Barium ion cloud (April) - a cooperative project with West Germany;

OSO-H (April) - Orbiting Solar Observatory-H for sun studies;

SSS-A (May) - Small Scientific Satellite-A to be launched from the San Marco platform off the coast of Kenya;

UK-4 (June) - a cooperative scientific satellite project with the United Kingdom;

Intelsat (July-September);

AFCRL-A (September) - a magnetic storm satellite for the Air Force Cambridge Research Laboratories;

Intelsat (October-December);

OAO-C (late in the year) - Orbiting Astronomical Observatory C;

CAS-A (late in the year) - Cooperative Applications Satellite a cooperative American and French meteorological studies.

## 1970 Produces Major New Findings

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Huge hydrogen clouds were discovered by two NASA satellites. In January, Orbiting Astronomical Observatory-2 found a hydrogen cloud as large as the sun surrounding the comet Tago-Sato-Kosaka. Another enormous cloud, this one 10 times larger than the sun, was located in April by Orbiting Geophysical Observatory-5 around Comet Bennett.

A record amount of data on the 1970 solar eclipse was gathered in March as a result of a rocket barrage from NASA's Wallops Island station. Scientists are still analyzing ground and spacecraft observations as well as data from the 31 rockets fired to record the event.

Albert Einstein's 54-year-old theory of general relativity was upheld by results of radio experiments with two NASA Mariner spacecraft as far out as 254 million miles in space. Measurement of the time delay caused by the sun's gravity, in the round-trip radio signals from the spacecraft, show that

Einstein's predictions were right, to within two to four percent.

During the year, three meteorological satellites [Improved TIROS Operational Satellite-1, Nimbus-4 and NOAA-1 (National Oceanic and Atmospheric Administration)] were successfully launched, returning excellent data.

Three communications satellites were successfully launched, two for COMSAT, and one for DOD.

The final launch of the year was the Small Astronomy Satellite-A which is investigating X-ray sources in the celestial sphere. Launched from the San Marco platform in the Indian Ocean off Kenya, this was the first launch of an American spacecraft by a foreign nation, Italy.

New information on how man's inner ear helps him keep his balance was obtained in a NASA experiment in which two live bullfrogs were orbited about the earth aboard the Orbiting Frog Otolith satellite.

## MM 71

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variations in the atmosphere and the surface, and conduct long-term dynamic observations lasting for a minimum of 90 days. The MM-71 missions will vastly increase our knowledge of the planet Mars, its seasons and atmosphere, and aid in our planning of the first Mars landing in 1975--the Viking mission.

### NEW CAMERA USED ON APOLLO 14

The Apollo 14 astronauts will bring back from their lunar expedition some of the most revealing photos of the moon ever taken. Using a modified aerial reconnaissance camera, CMP Stuart A. Roosa will photograph future candidate Apollo landing sites as his spacecraft swoops within 10 miles of the central highlands near the crater Descartes.

The pictures should show the lunar surface at two or three feet resolution, making it possible to recognize boulders and craters as small as six feet in diameter. This resolution is 10 times greater than that achieved by previous Apollo lunar flights.



Mitchell, Shepard, and Roosa stand in front of Apollo 14 prior to Jan. 31 liftoff.

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