NASA, some history (1958 – 1981)

(edited by Franco Mauri)

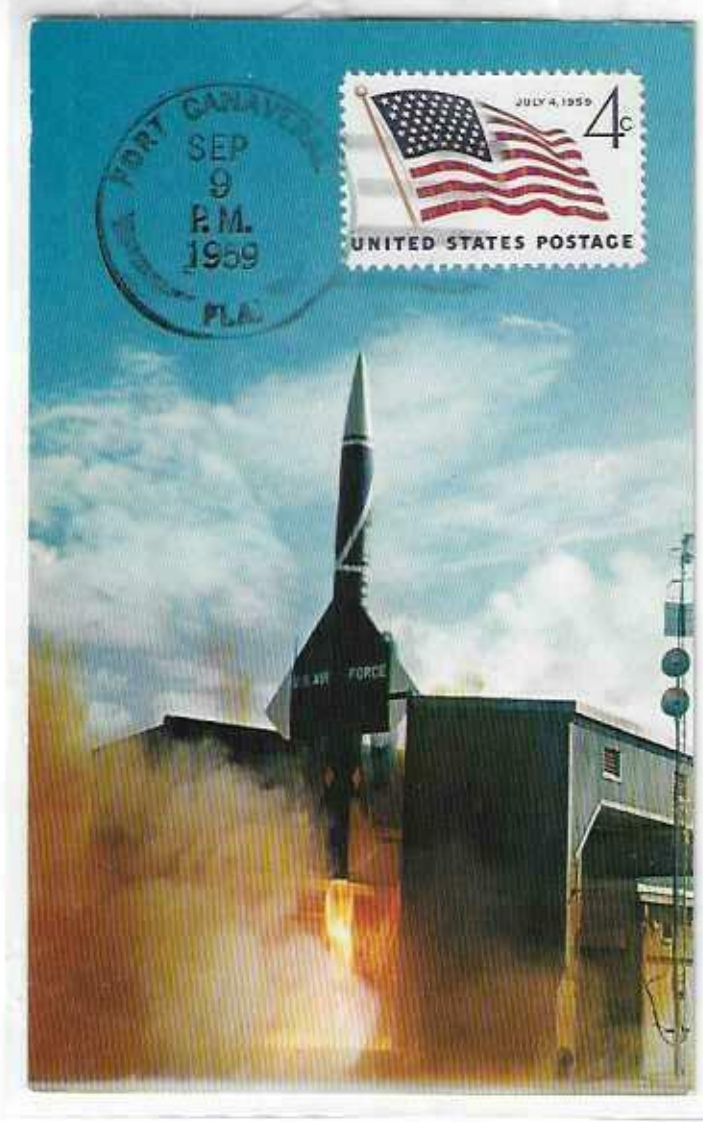
The National Aeronautics and Space Administration (NASA) is an independent agency of the U.S. Federal Government responsible for the civil space program, aeronautics research and space research. It was established by president D. D. Eisenhower on October 1, 1958 and included both the aeronautical acivities of the NACA (National Advisory Committee for Aeronautics), and the space activities which until then were competence of military administrations, to give the U.S. space development effort a distinctly civilian orientation, emphasizing peaceful applications in space science. In the USA, where he emigrated, Wernher von Braun resumed his experiments, together with 200 other experts, developing various vector rockets, including the original Saturn project. NASA has conducted many manned and uncrewed spaceflight programs throughout his history. The uncrewed programs sent scientific probes to explore the planets of the Solar System, beginning from Moon, Venus and Mars, and produced a significant number of satellites, each differentiated according to specific programs, from meteorological satellites to those for navigation, for telecommunications, for technical and scientific surveys, for the study of terrestrial resources, for military uses. The manned programs sent the first Americans into low Earth orbit, won the " race to the Moon, engaged with the Soviets, developed the Space Shuttle, the first vehicle capable of gliding back down to the Earth to be reused later for new missions, from 1981 to 2011. You can see my collection " Technology and Science on the Space Shuttle ", exhibited in Italiafil Genova 2017, on the website of the Federation between Italian Philatelic Societies (www Expo FSFI).

The collection is divided into 7 chapters, each of which takes place in chronological order:

MERCURY Program
GEMINI Program
APOLLO Program
SKYLAB, the US space laboratory
Apollo – Soyuz test project (ASTP)
Interplanetary space probes
Satellites

Information sources:

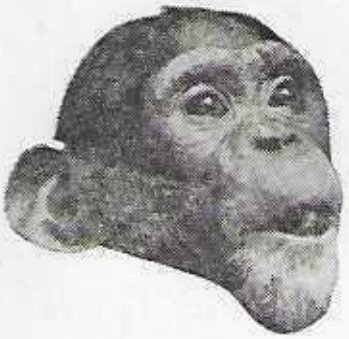
NASA mission archives (www NSSDCA)
" Propaganda e pragmatismo " (Umberto Cavallaro, AS.IT.AF. president)
" American astrophilately the first 50 years " (David S. Ball)



1 MERCURY PROGRAM

Big Joe 1 (BJ-1) mission. SEPTEMBER 9, 1959. Port Canaveral manual cancel on the date and time of launch. It launched an unmanned boilerplate Mercury capsule. It was also the first launch of a spacecraft in Mercury Project. The Mercury capsule flew a 2,408 km ballistic flight to the altitude of 153 km. The boilerplate Mercury, having landed some 500 miles short of target point, was found to have survived the mission in good conditions and verified the ablative shield. Discipline: engineering.

Mercury-Redstone 1A (MR-1A) mission. DECEMBER 19, 1960. Patrick AFB machine cancel on the date and time of launch. The mission objectives of this unmanned suborbital flight were to qualify the spacecraft for space flight and qualify the system for an upcoming primate suborbital flight. The spacecraft tested its instrumentation, posigrade rockets, retrorockets and recovery system. The flight was completely successful. Disciplines: engineering, Earth science.



PORT CANAVERAL
JAN
31
P.M.
1961
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PROJECT MERCURY
FIRST LIVING CREATURE
SPACE FLIGHT

OUR FIRST LITTLE MAN IN SPACE

A highly trained chimp named HAM rocketed into space in our elaborate project Mercury space ship capsule today January 31, 1961. Important preiude to manned space ship flight.

Mercury-Redstone 2 (MR2) mission. JANUARY 31, 1961. Port Canaveral manual cancel on the date and time of launch. It was the penultimate test flight of the Mercury-Redstone launch vehicle prior to the first manned american space mission. Mercury spacecraft (#5) carried Ham the Chimp on a suborbital flight and contained six new systems: environmental control system, attitude stabilization control system, live retrorockets, voice communications system, " closed loop " abort sensing system and a pneumatic landing bag. Disciplines: engineering, Earth science.

PORT CANAVERAL
FEB
21
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1961
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ASTRONAUTS VIEW
SPACE CAPSULE
SUCCESSFUL FIRING
FEB. 21, 1961
Unmanned Space
Capsule Launched
In Difficult Test . . .

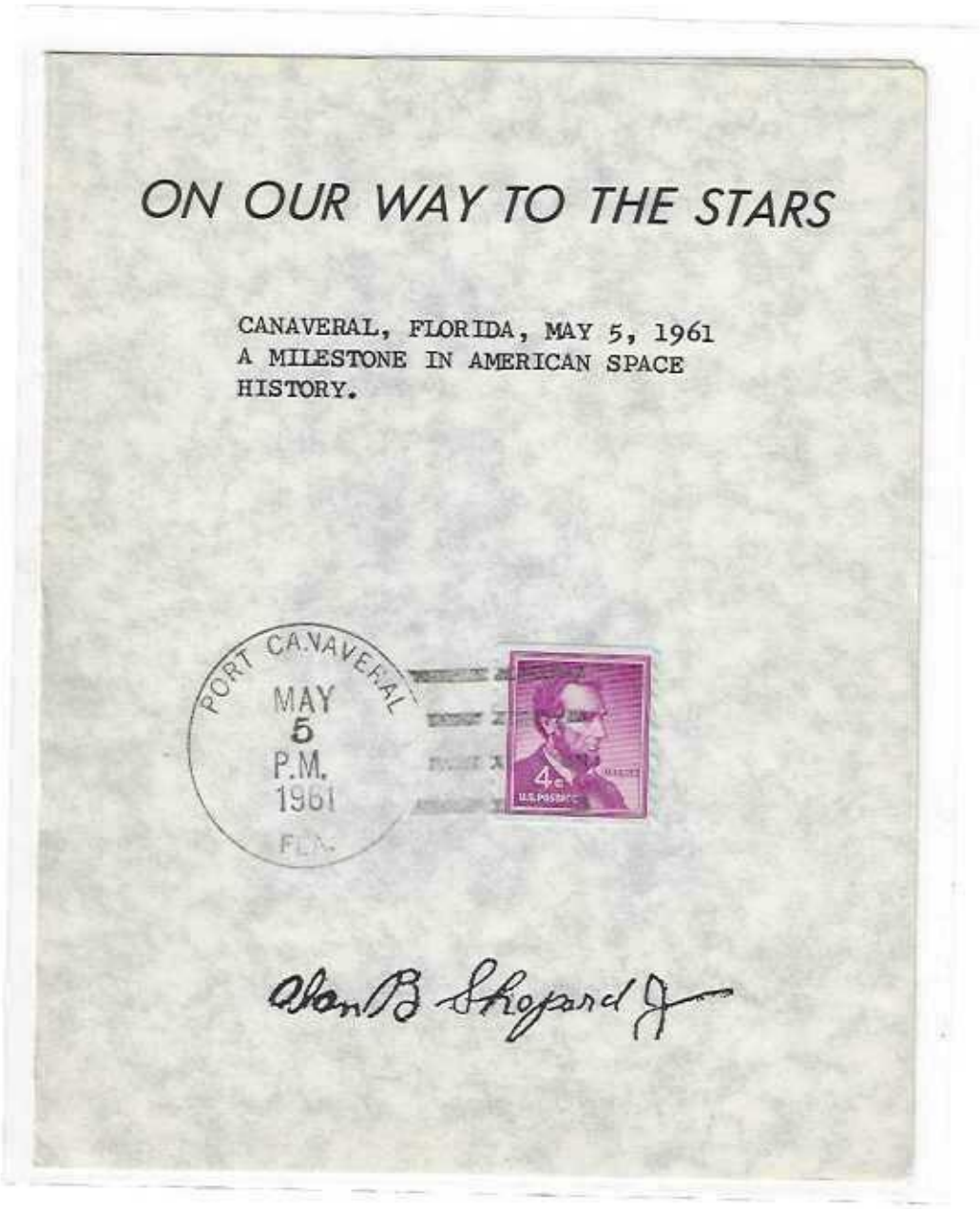
The Seven Astronauts were on hand to view the re-entry of the 2400 Pound Space Cabin. Flown from Canaveral Florida to a spot 400 Miles Northeast of Antigua Island.

CLYDE J. SARZIN
PORT WASHINGTON, L. I.
NEW YORK, U. S. A.

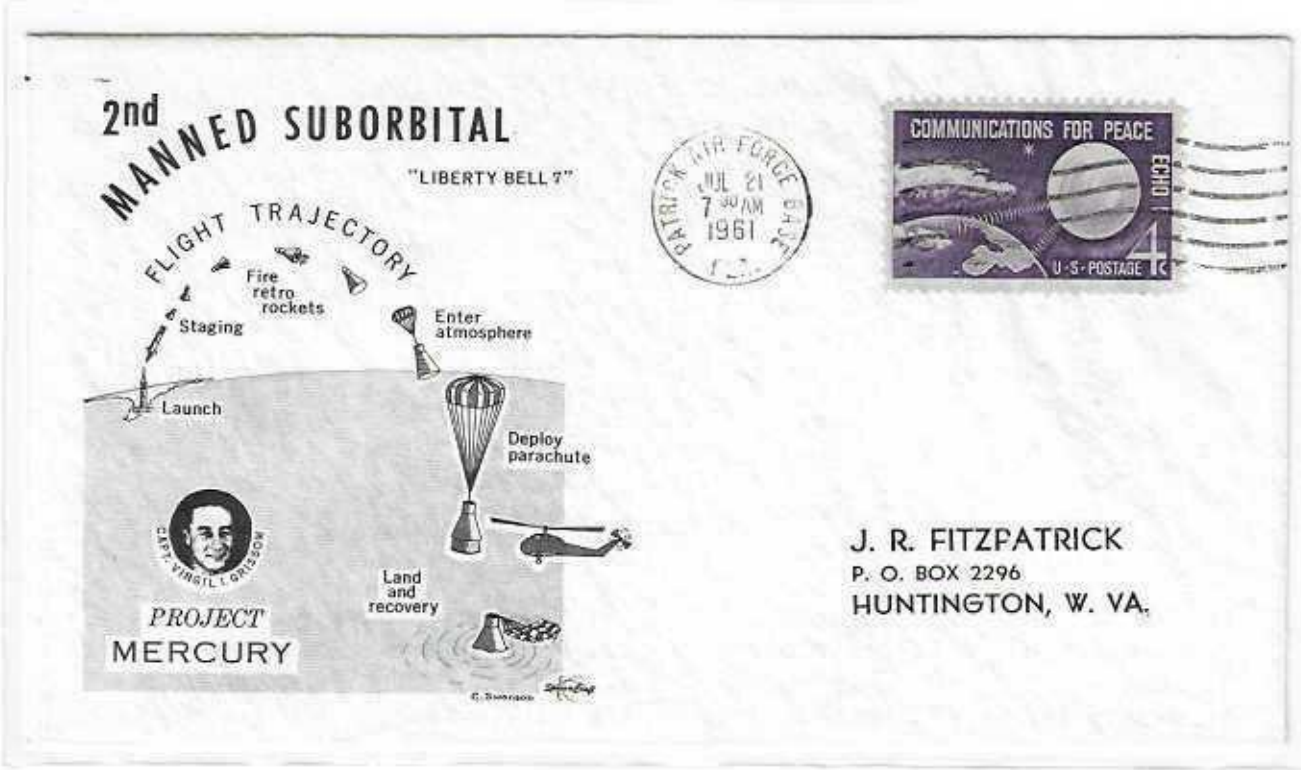
Mercury-Atlas 2 (MA-2) mission. FEBRUAY 21, 1961. Port Canaveral manual cancel on the date and time of launch. Test objectives for this flight were concerned with the ability of the spacecraft to withstand reentry under the temperature critical abort conditions and with the capability of the Atlas to meet the proper injection conditions. MA-2 flew a successful suborbital mission that lasted 17 min., 56 sec. Altitude reached was 183 km, maximum speed 21,287 km/h. Discipline: engineering.

Little Joe 5-B (LJ-5B) mission. APRIL 28, 1961. Wallops Island machine cancel on the date and time of launch. It was an unmanned Launch Escape System of the Mercury spacecraft. Little Joe was the nickname given to the american solid-propellant rocket used in eight launches, from 1959 to 1961, from the base of Wallops Island (Virginia). The Little Joe flew to an altitude of 5 km and a range of 14 km. The mission lasted 5 min., 25 sec. Maximum speed was 2,865 km/h and acceleration was 10g. The mission was a success and the Mercury spacecraft was recovered. Discipline: engineering.

Mercury MR-3 (Freedom 7) mission. MAY 5, 1961. Patrick AFB machine cancel on the date and time of launch. Its objectives were to familiarize man with a brief but complete space flight experience, from the liftoff to the landing phases of the flight; evaluate man's ability to perform as a functional unit during space flight by demonstrating manual control of spacecraft attitude before, during and after retrofire and by use of voice communications during flight; study man's physiological reactions during space flight; recover the astronaut and spacecraft. Disciplines: engineering, human crew.

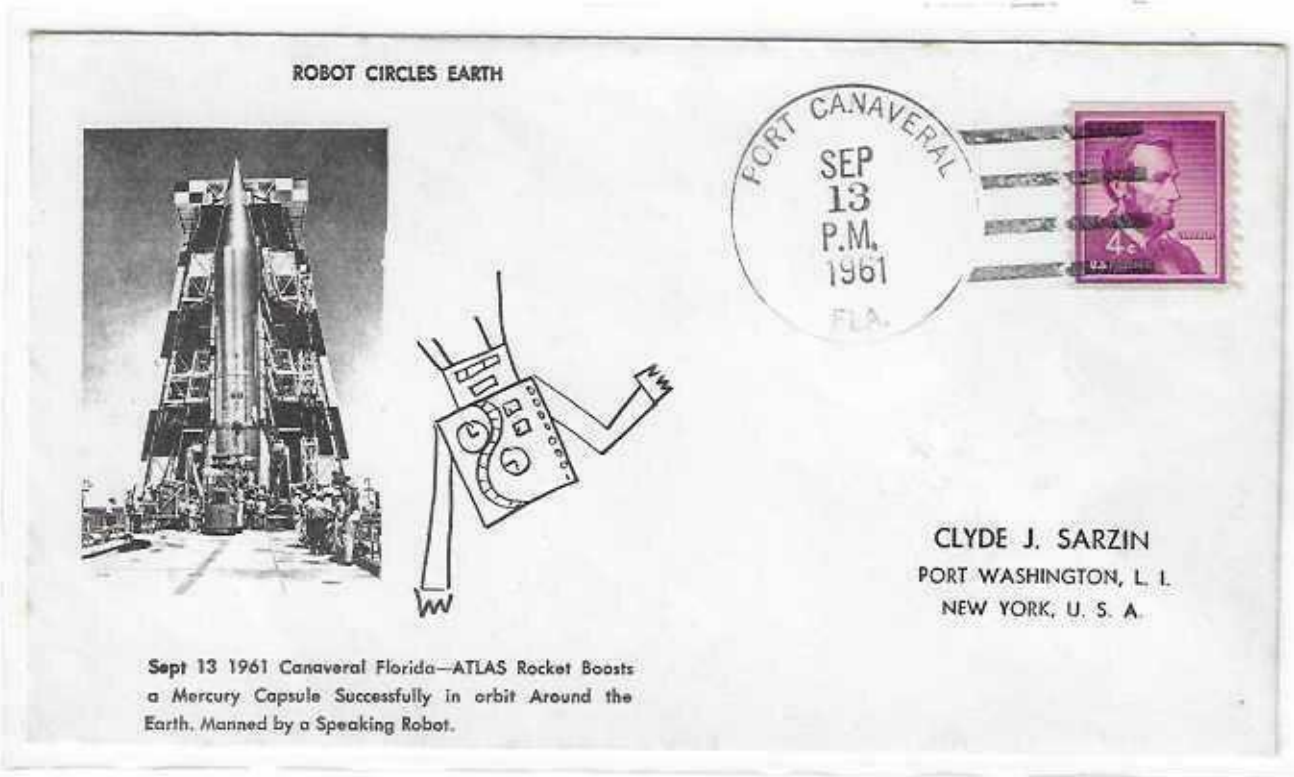


Mercury MR-3 (Freedom 7) mission. MAY 5, 1961. Port Canaveral manual cancel on the date and time of launch. Just 23 days after the flight of Yuri Gagarin, the first man in space, NASA astronaut Alan Shepard, pilot of US Navy, at his first and only spaceflight, becomes the first american in space. His historic flight lasted 15 min., 28 sec., about 5 of which in weightlessness. His spacecraft reached an altitude of 186.4 km recording a top speed of 8,200 km/h, and landed in the Atlantic 483 km from the launch site.



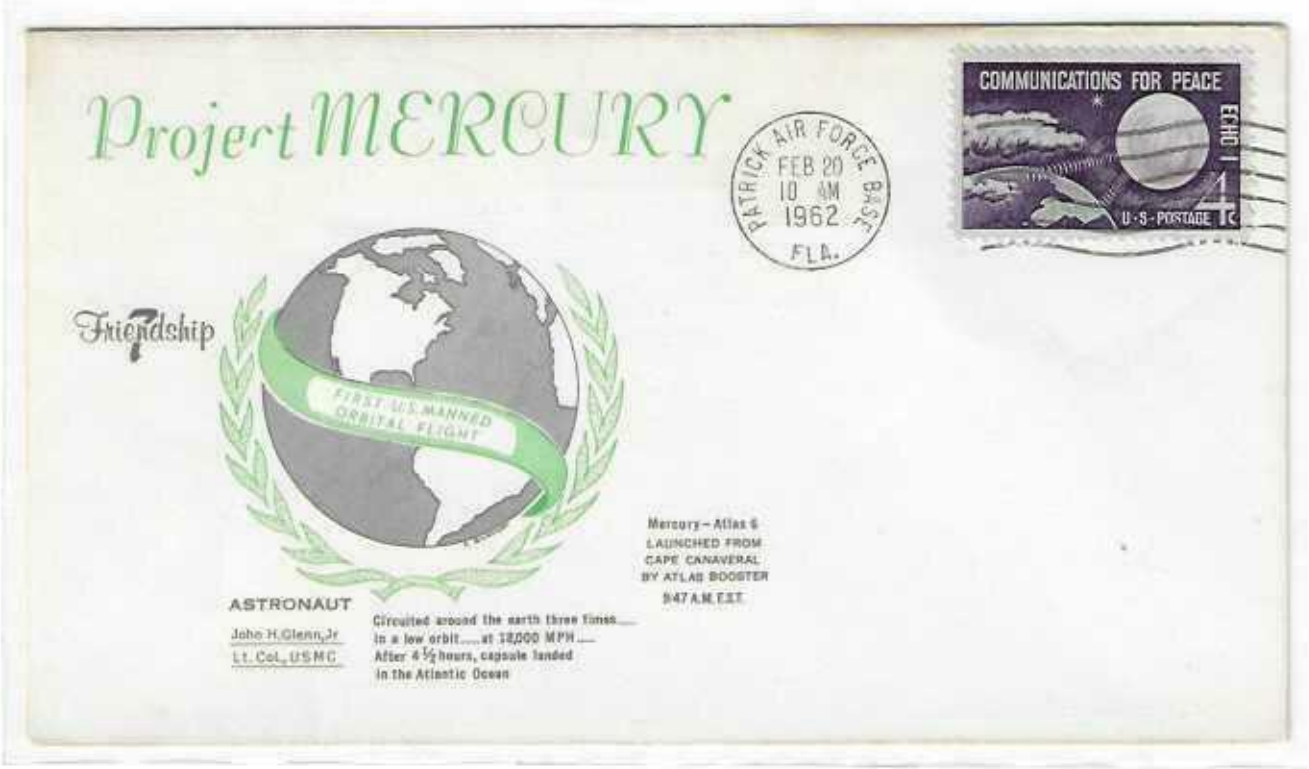
Mercury MR-4 (Liberty Bell 7) mission. JULY 21, 1961. Patrick AFB machine cancel on the date and time of launch. Following Shepard's flight, the mission constitutes the next step in research, development and training to confirm the " man in space " concept. The flight carries the astronaut Virgil Grissom, USAF pilot lieutenant, which will be commander of Gemini 3 and will perish in the Apollo 1 fire (January 27, 1967). The parameters of the mission are similar to those of the previous one; the main configuration differences was the addition of a large viewing window and an explosively actuated side hatch. The spacecraft is lost at sea. Disciplines: engineering, human crew.

Mercury-Atlas 4 (MA-4) mission. SEPTEMBER 13, 1961. Patrick AFB machine cancel on the date and time of launch. This flight was an orbital test of the Mercury Tracking Network, and the first successful orbital flight test of the Mercury Program. It had demonstrated the ability of the Atlas rocket to lift the Mercury capsule into orbit and of the capsule and its systems to operate completely autonomously, and it had succeded in obtaining pictures of the Earth. Disciplines: engineering, Earth science.

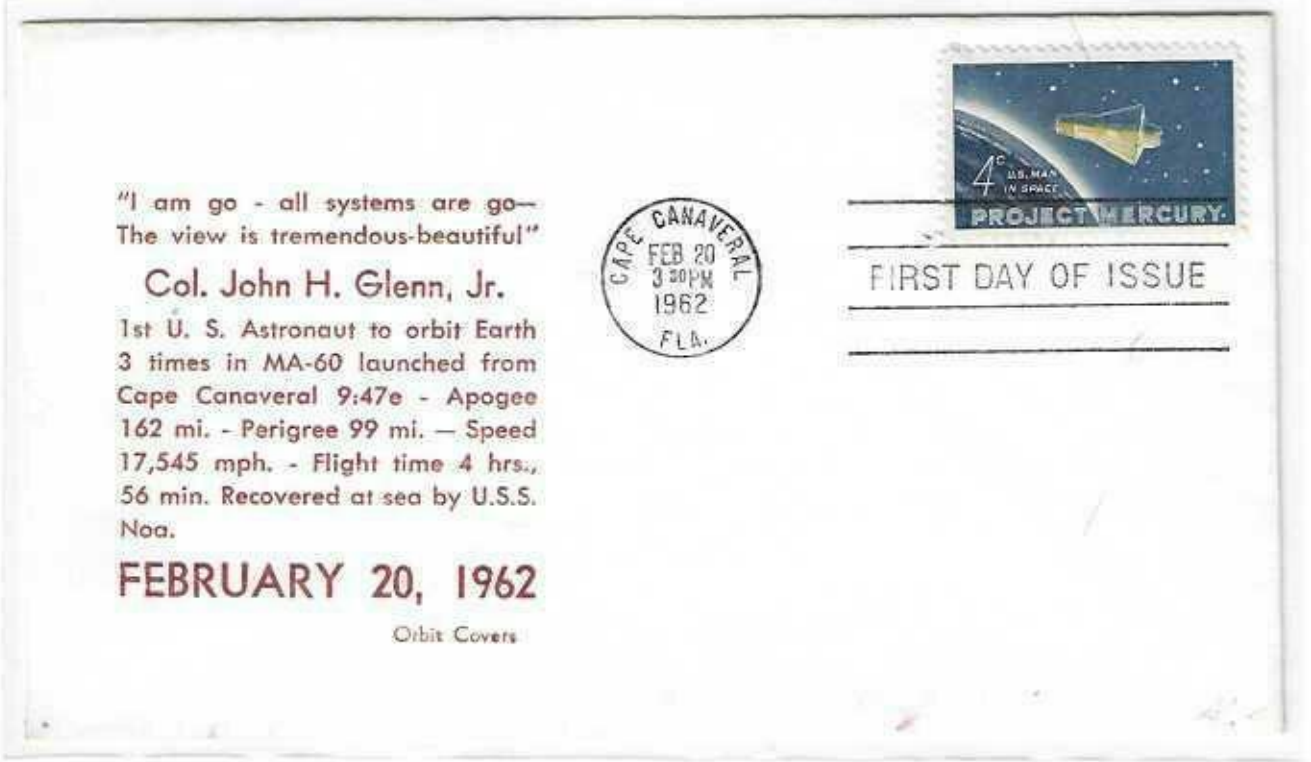


Mercury-Atlas 4 (MA-4) mission. SEPTEMBER 13, 1961. Port Canaveral manual cancel on the date and time of launch. The payload consisted of a pilot simulator, two voice tapes, a life support system, three cameras and instrumentation to monitor levels of noise, vibration and radiation. The Mercury completed one orbit prior to returning to Earth. The capsule was recovered 161 miles east of Bermuda 82 min. after splashdown by the destroyer USS Decatur.

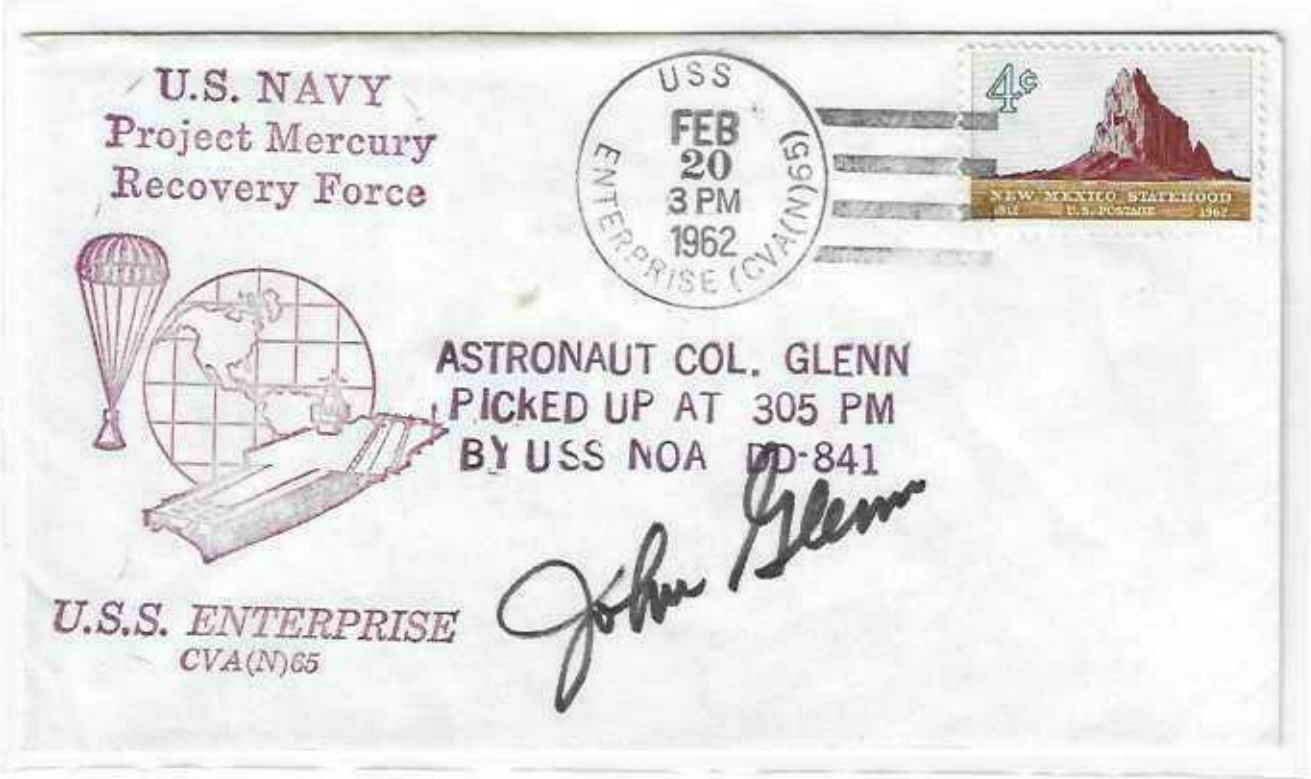
Mercury-Atlas 5 (MA-5) mission. NOVEMBER 29, 1961. Port Canaveral manual cancel on the date and time of launch. This mission was the second and final orbital qualification flight of the Mercury systems prior to manned orbital flight. On board was a 17 kg, five-year-old chimpanzee, named Enos, which performed various psychomotor activities during the flight and was found to be in excellent physical conditions following splashdown 410 km southeast of Bermuda. Disciplines: engineering, Earth science.



Friendship 7 MA-6 mission. FEBRUARY 20, 1962. Patrick AFB machine cancel on the date and time of launch. On January 27 John Glenn, Marines pilot who will return to space at the age of 77 on the STS-95 mission, remained on the launch tower in the capsule atop the Atlas for five hours waiting for a clearing in the cloudy sky. At the end, not without discontents and frictions, once again he is sent down. The objectives of the flight are to evaluate the performance of a manned spacecraft and his support systems on a three-Earth orbit mission and the effects on the astronaut. Disciplines: engineering, human crew, Earth science.

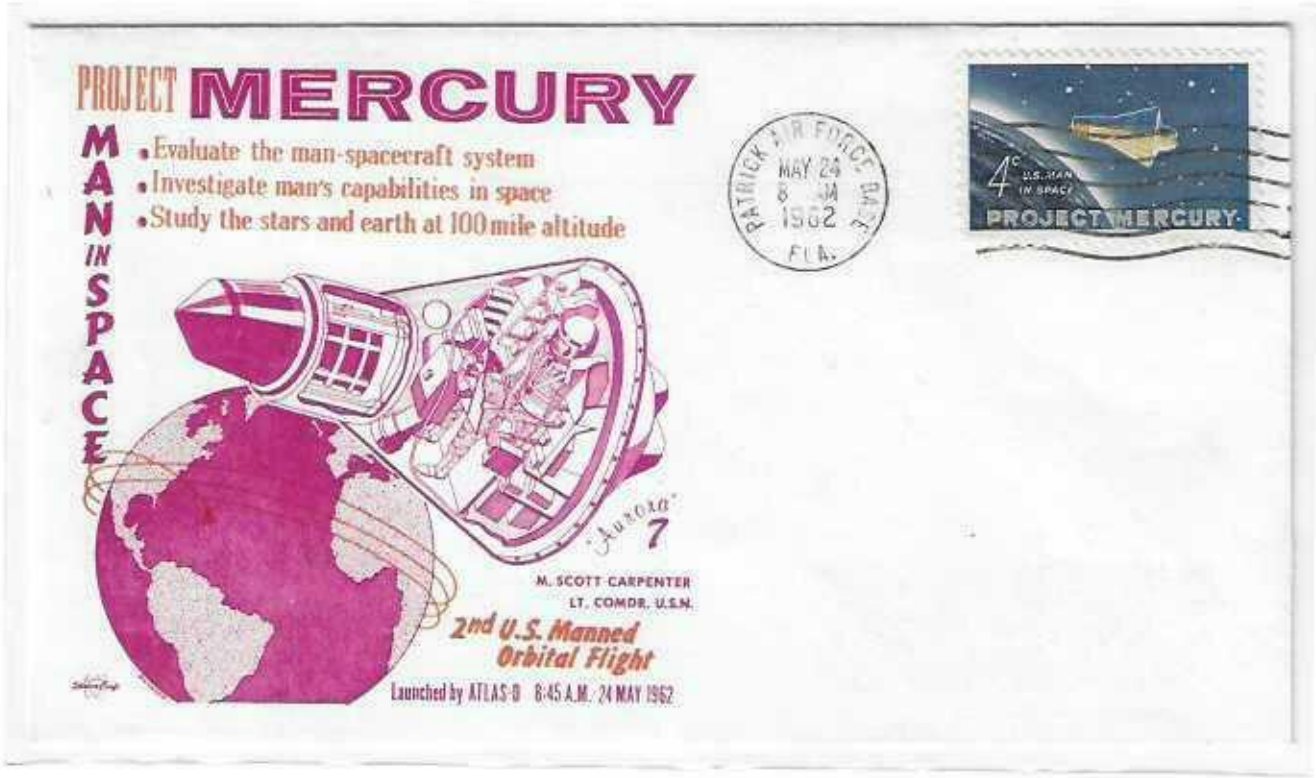


MA-6 mission. FEBRUARY 20, 1962. Cape Canaveral machine cancel on the date and time of launch. A few minutes after the announcement of the successful conclusion of the mission the order is issued to the post offices to remove the seals from the mysterious " top secret " package delivered on previous day. It contains the 4c commemorative stamp which is immediately put on sale for the postage of ordinary first port correspondence.



MA-6 mission. FEBRUARY 20, 1962. Secondary recovery ship USS Enterprise manual cancel on the date and time of splashdown. During the second orbit an error in the on-board telemetry signals a slight detachment of the heat shield. The Control Center then decides not to get rid of the bracking retrorockets to keep the shield in position until the pressure increases during re-entry into the atmosphere. The flight ends happily just 60 km from the established point.

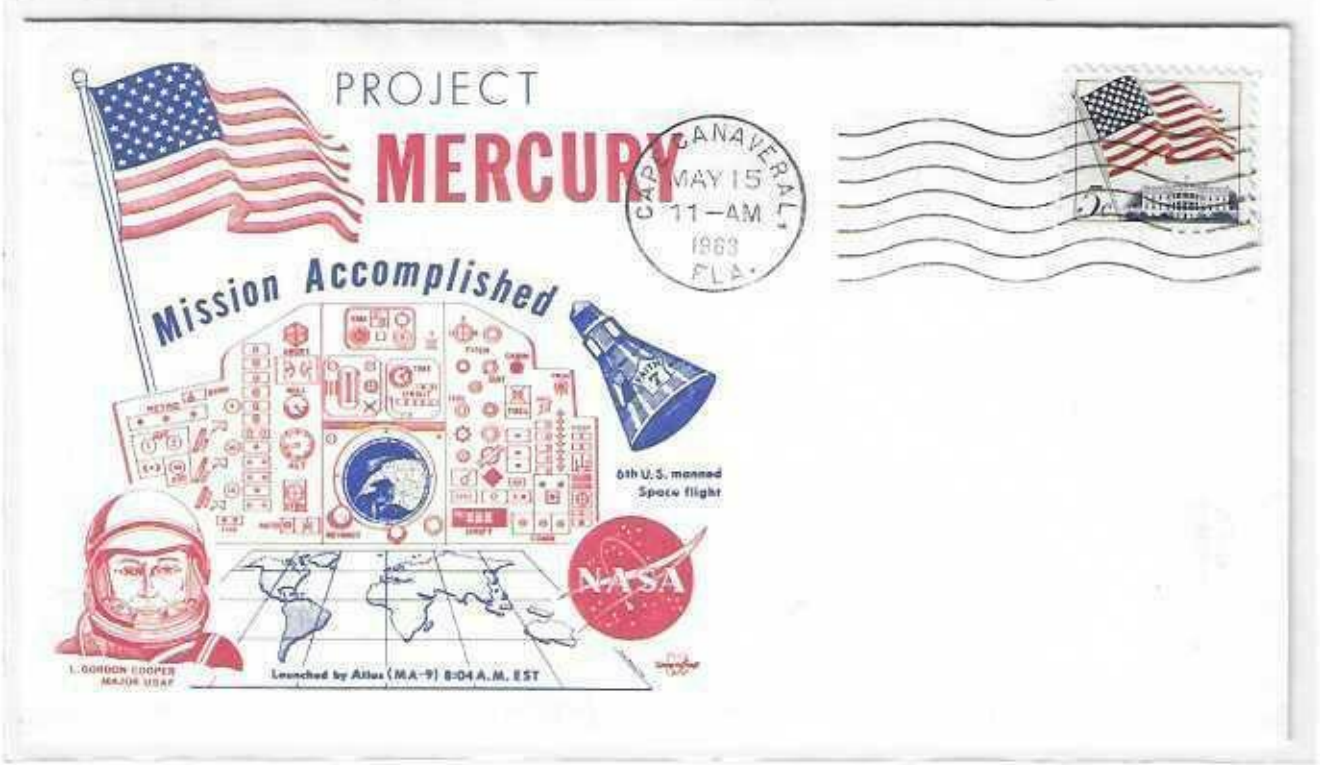
Aurora 7 MA-7 mission. MAY 24, 1962. Port Canaveral machine cancel on the date and time of launch. The mission for which Deke Slayton is assigned, while Walter Schirra has the role of reserve pilot, is planned for the second half of April. Due to hearth rhythm problems the astronaut is forced to the ground, to everyone's surprise, the mission is assigned to Scott Carpenter, US Navy pilot, already reserve pilot for Glenn. There are two experiments on board, a failed inflatable balloon to measure resistence and provide visibility data and a device to study the behavior of liquids in a weightless state. Disciplines: engineering, human crew, Earth science.



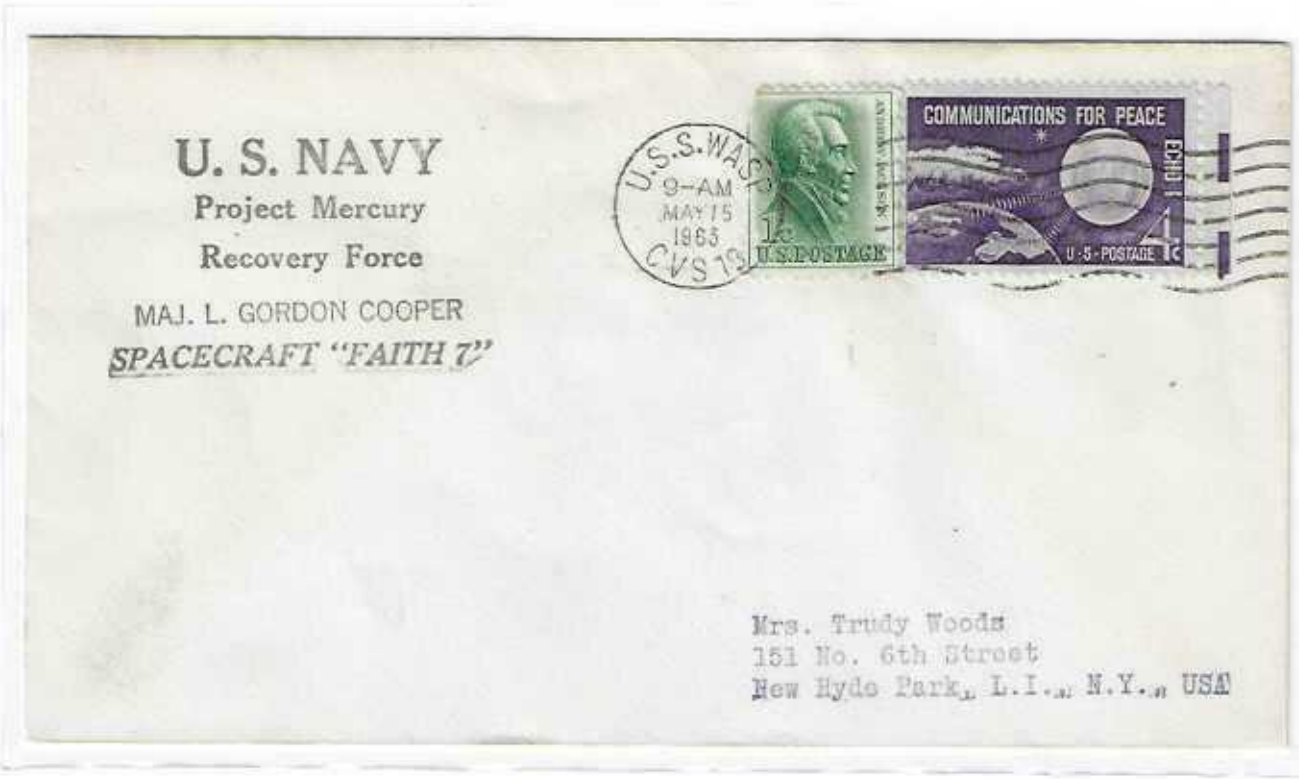
MA-7 mission. MAY 24, 1962. Patrick AFB machine cancel on the date and time of launch. Distracted by the experiments and by a technical problem, Carpenter makes several mistakes in maneuvering the capsule also consuming too much fuel. Aurora 7 lands at a distance of 460 km from the expected point out of reach of radio links. It was the cruiser USS Farragut, lacking the necessary equipment, that reached the capsule first. It was spotted and recovered three hours later by an helicopter departed from the aircraft carrier USS Intrepid. Carpenter will no, never again, be assigned to any other missions.

Sigma 7 MA-8 mission. OCTOBER 3, 1962. Corpus Christi machine cancel on the date and time of launch. The Mercury capsule was not originally designed for long-duration flights. Its " survival systems " must be redesigned and modified. The " support services " include a greater number of recovery ships also located in the Pacific and tracking stations also to deal with unforeseen events such as Carpenter's mission has taught. Disciplines: engineering, human crew, Earth science.

MA-8 mission. OCTOBER 3, 1962. Primary recovery ship USS Kearsarge machine cancel on the date and time of recovery. Walter Schirra, US Navy pilot, performs the one what will go down in the annals of history as a " textbook flight ". Thanks to the professionalism demonstrated he will return to space with the Gemini 6 and Apollo 7 missions becoming the only American astronaut to have participated in all three Programs. During the launch Sigma 7 achieved a new speed record reaching 7,850 meters per second. During the six Earth orbit which lasted 9 hours, 13 minutes, the first american live television broadcast from space is performed using the Telstar 1 satellite. The spacecraft descends just 9 km from the recovery ship. It is the first human flight to land in the Pacific Ocean.



Faith 7 MA-9 mission. MAY 15, 1963. Cape Canaveral machine cancel on the date and time of launch. The new flight program foresees a mission duration somewhat longer than the previous ones, so much so that several Mercury systems have to be perfected and adapted again. The spacecraft will fly over the Earth's surface between the 33rd parallel north and the 33rd parallel south. The coverage of the tracking stations in which, among others, Mercury Program astronauts are normally engaged must therefore be expanded. Disciplines: engineering, human crew, Earth science.

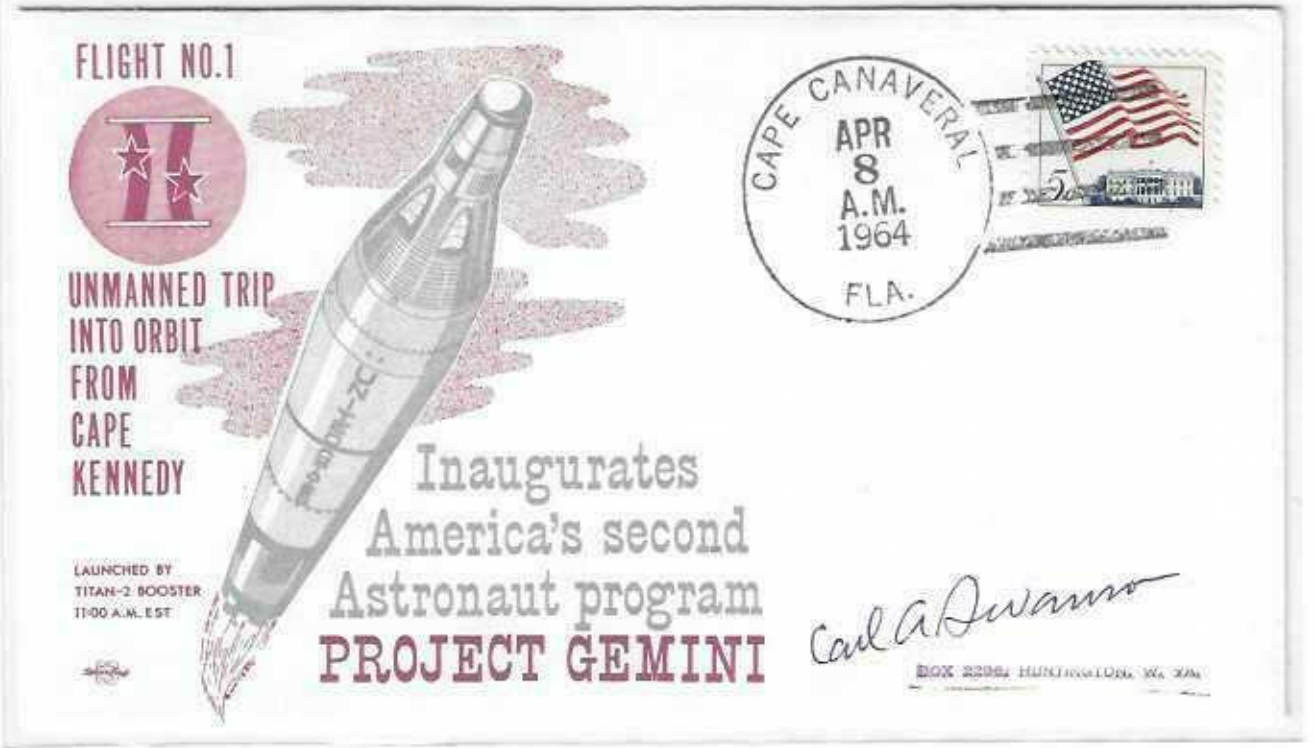


MA-9 mission. MAY 15, 1963. Secondary recovery ship USS Wasp machine cancel on the date and time of flight. Gordon Cooper, USAF pilot and test driver who will return to space on the Gemini 5 mission, is launched on what will be by far the most challenging flight of the Program and will travel 22 Earth orbits in a flight that will last 34 hours, 20 minutes during which traveled for approximately 875,000 km. The capsule reenters the atmosphere under manual control, for the first time, due to a malfunction. The landing point is located near the Midway Islands, in the Pacific, 6,4 km from the recovery ship.

MA-9 mission. MAY 16, 1963. Primary recovery ship USS Kearsarge machine cancel on the date and time of recovery. The mission achieved and far exceeded all assigned objectives so much so that NASA decided to cancel the subsequent MA-10 mission. The Mercury Program achieved great success that exceeded the expectations of 1958 when the Project began. Cooper also sets a new record for time in space.

2 GEMINI PROGRAM

On September 12, 1962, in Cape Canaveral, a Titan 2 rocket was fired. The tests reveal, from the first minutes after launch, dangerous vibrations (" pogo effect ") which could endanger the live of astronauts. It will take over a year and a dozen test launches to identify the causes and remedy them. 253 candidates present themselves, with advanced engineering studies and high experience as a test pilot, from which the second group, the " new Nine ", is selected.



Gemini-Titan 1 (GT-1) mission. APRIL 8, 1964. Cape Canaveral manual cancel on the date and time of launch. The mission plan does not include the separation of the spacecraft from the second stage and provides from only three orbits. Mistakenly launched into a higher orbit, it will make 64 orbits around the Earth. However, Mission Control Center, for the last time at Goddard Space Flight Center, will continue to monitor the spacecraft until splashdown, on April 12, in the Atlantic. Mission objectives do not include recovery. Discipline: engineering.

GT-2 mission. JANUARY 19, 1965. Cape Canaveral manual cancel on the date and time of launch. After various posponements, at the end of 1964, the mission could finally leave. This is a suborbital ballistic flight with the objectives of demonstrating the performance of the thermal protection system, the structural integrity of the spacecraft and the performance of its systems. The mission takes place regularly, but the Mission Control Center is hit by a blackout which practically blocks it for the entire mission. Discipline: planetary science.

GT-2 mission. JANUARY 19, 1965. Primary recovery ship USS Lake Champlain manual cancel on the date and time of recovery. The spacecraft, managed by an automatic sequencer on board, reaches an altitude of approximately 171 km. After about 7 minutes of flight the retrorockets are turned on placing the capsule in the reentry phase. It will be used for a second time during an exercise for the Manned Orbiting Laboratory Project (MOL) and will therefore become the first space vehicle to be reused.

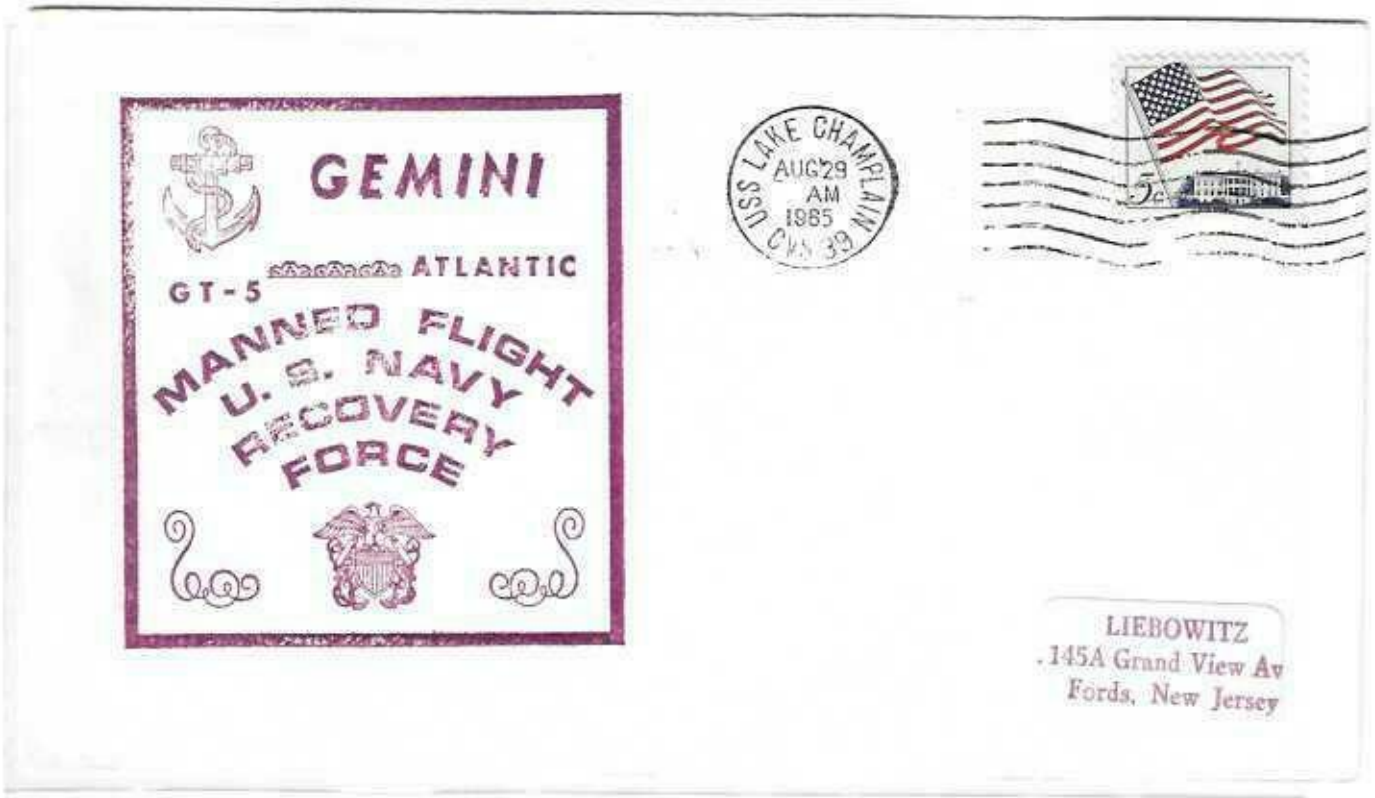
GT-3 mission. MARCH 23, 1965. Corpus Christi machine cancel on the date and time of launch. Proceeding methodically, NASA gives the Gemini Program a rhythm that allows it to launch, in less than 20 months, 10 new generation spacecrafts with men on board, tackling progressively more complex tasks with each flight far exceeding the technological capabilities of the Soviets. On board the Gemini are the veteran Gus Grissom, the first astronaut to fly into space twice in a capsule, and John Young, the first astronaut of the second group. Disciplines: life science, human crew, Earth science.

GT-3 mission. MARCH 23, 1965. Primary recovery ship USS Intrepid machine cancel on the date and time of recovery. The flight, which aims to technically validate the mission, completes only three Earth orbits in 4 hours, 52 minutes, 31 seconds. In addition to the technical checks, the two astronauts carry out some scientific experiments and above all they try out the new equipment that allows them to pilot the spacecraft modifying its orbit. The perigee is lowered to 84 km to allow it to decay from orbit naturally in the event of retrorocket failure. " Molly Brown " lands in the Atlantic, near Grand Turk Island, about a hundred km from the target.

GT-4 mission. JUNE 3, 1965. Cape Canaveral machine cancel on the date and time of launch. First real Gemini mission, with astronauts James McDivitt and Edward White on board on their first flight into space. With this mission the new Houston Control Center becomes operational. A rendezvous experiment in space with the Titan's second stage, for the first time, is attempted in vain. The mission also serves to develop the diet and health techniques to be adopted for long-term missions. White then exits the cockpit moving freely in space with the help of a gas pistol becoming the first American citizen to walk in space. Disciplines: space physics, human crew, Earth science.

GT-4 mission. JUNE 7, 1965. Primary recovery ship USS Wasp machine cancel on the date and time of recovery. The mission, which should have lasted a week, was cut short due to fuel consumption. Due to the failure of a computer a ballistic reentry, similar to that used for the Mercury, is initiated. The capsule descends in the Atlantic after 4 days and 2 hours setting a new record for time spent in space.

GT-5 mission. AUGUST 21, 1965. Cape Canaveral machine cancel on the date and time of launch. The objective of the mission is to evaluate rendezvous and maneuver potential using a REP evaluation target, an optical and electronic duplicate of Agena. The experiment fails and also the demonstration of a controlled reentry to a predetermined landing point. For the first time fuel cells are used instead of simple accumulators (which still reveal many weak points). Disciplines: space physics, human crew, astronomy, Earth science.



GT-5 mission. AUGUST 29, 1965. Primary recovery ship USS Lake Champlain machine cancel on the date and time of recovery. The first trajectory deviations are attempted to practice maneuvering in space. The retrorocket is ignited during 120th orbit; the spacecraft lands in the Western Atlantic. Thanks to Gemini-Titan 5, piloted by Astronauts Gordon Cooper and Pete Conrad in a mission that lasted almost 8 full days, the Americans achieved a new record for time spent in space beating the record of 5 days achieved by the Soviets with Vostok 5.

GT-7 mission. DECEMBER 4, 1965. Cape Canaveral machine cancel on the date and time of launch. Gemini 6 would have been the first spacecraft to attempt a rendezvous and docking maneuver with an Agena satellite previously launched by an Atlas rocket which, however, due to a malfunction, exploded. The mission, scheduled to leave on October 25, is suspended. For the rendezvous Mc Donnel's vice president proposes sending the new ready Gemini 7 into space. Having to wait for Gemini 6A to arrive in orbit this mission is destined to set a new record of 14 days spent in space. Disciplines: space physics, human crew, Earth science.

GT-6A mission. DECEMBER 15, 1965. KSC machine cancel on the date and time of launch. A first launch attempt fails, the propulsion devices turn on and then turn off automatically. Schirra, remaining calm, does not activate the ejection system, which would have ruined both missions. The investigation immediately carried out clarifies that, in the rush of assembly, errors were made that could have led to a tragedy. Disciplines: human crew, Earth science.

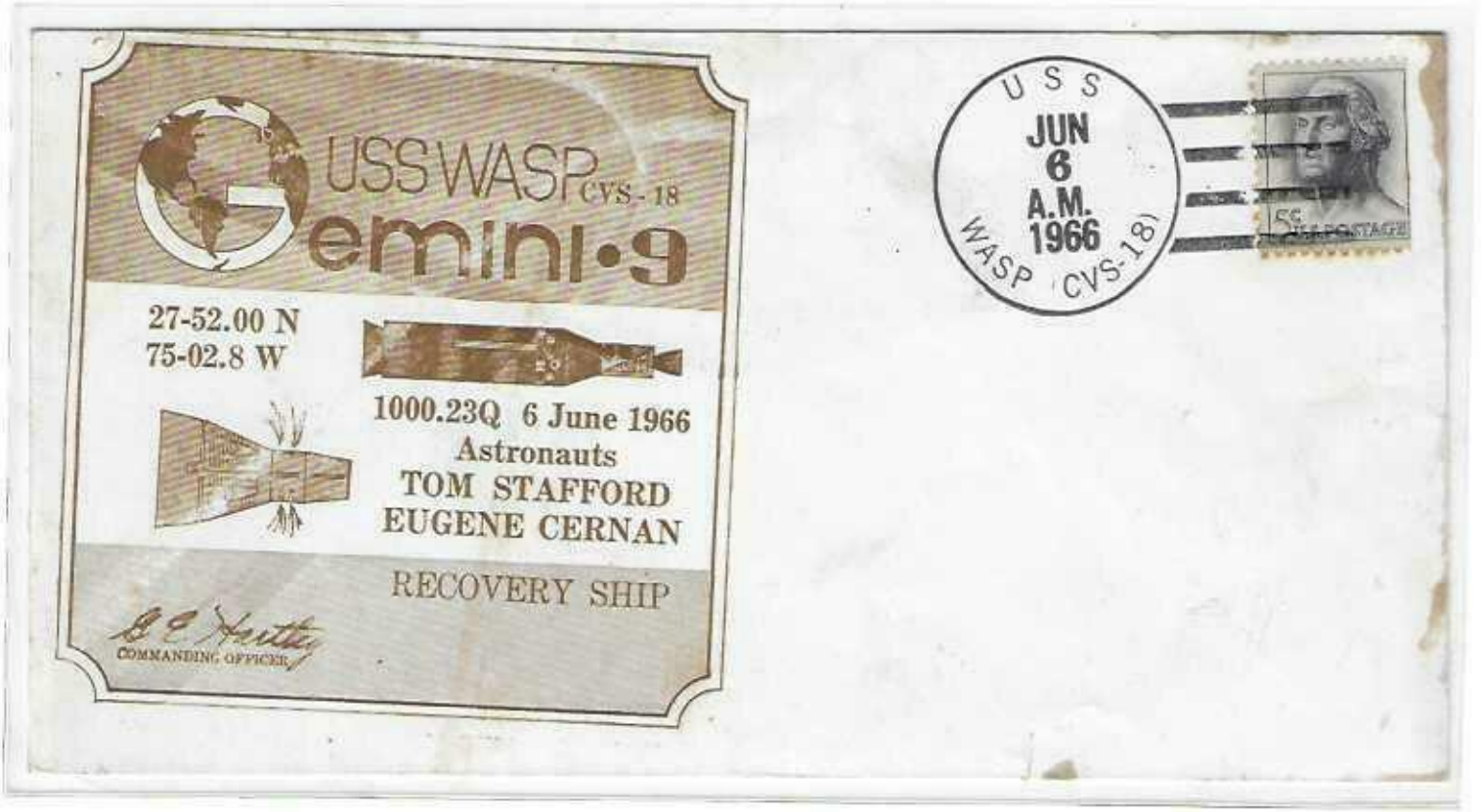
GT-6A mission. DECEMBER 15, 1965. Cape Canaveral manual cancel. The spacecraft chases Gemini 7 for about 1,900 km. The rendezvous, which leads the capsules to approach up to a distance of 30 centimeters, at a speed of only 3 centimeters per second, is technically achieved and the exercise begins with the two Gemini in zero relative motion at a distance of 110 meters and continues for about 5 hours, 19 minutes, over the course of three and half orbits. For the first time Gemini approaches directly piloting the spacecraft. A new tipe of astronaut suit is also tested during the mission. The Gemini 7 mission also includes a relative flight with the Titan's second stage at a distance varying between 6 meters and 80 km.

GT-7 mission. DECEMBER 18, 1965. Primary recovery ship USS Wasp machine cancel on the date and time of recovery. Gemini 6A lands in the Atlantic on December 16, just 13 km from the primary recovery ship USS Wasp. It is the first successfully controlled reentry to a predetermined point in the American manned space program. For the first time the rendezvous section is recovered with the spacecraft. The two missions are the impressive demonstration of the possibility of precise piloting of the Gemini.

GT-8 mission. MARCH 16, 1966. Cape Canaveral machine cancel on the date and time of launch. Is assigned to the mission the objective originally planed for the GT-6 mission, the conjunction with the GATV (Gemini Agena Target Vehicle). The primary objectives of the mission are the execution of rendezvous and four docking tests with the Agena, the execution of a spacewalk and ten experiments. The crew consists of Neil Armstrong, the first civilian astronaut, and Dave Scott, the first Third Group astronaut to fly in space. Disciplines: planetary science, space physics, life science, human crew, astronomy, Earth science.

GT-8 mission. MARCH 17, 1966. Effective recovery ship USS Mason manual cancel on the date and time of recovery. During the 5th orbit the first docking maneuver in space takes place, interrupted after 27 minutes when the combined vehicle begins to go out of control. Following the premature use of the 16 engines of the reentry control system to stabilize the spacecraft whose rotation speed further accelerates, an immediate landing is requested in compliance with safety rules, canceling the planned activities. Retrofire took place on the 7th revolution, just 10 hours after launch, and the crew and spacecraft were picked up by the recovery ship 3 hours after splashdown.

GT-9A mission. JUNE 3, 1966. Eglin AFB (FL) machine cancel on the date and time of launch. The launch, scheduled for May 17, 1966, was posponed when the target vehicle failed to reach orbit. The ATDA replacement launches successfully but telemetry indicates that the fairing missed complete abandonment. The docking maneuver must be abandoned; after 3 orbital maneuvers, the Gemini approaches the adapter up to 8 meters. The crew should have been composed of Elliott See and Charles Bassett, who perished in a plane crash; Thomas Stafford and Eugene Cernan flew in their place. Disciplines: planetary science, space physics, human crew, astronomy, Earth science.



GT-9A mission. JUNE 6, 1966. Primary recovery ship USS Wasp manual cancel on the date and time of recovery. On June 5, Cernan leaves the spacecraft attached to an eight-meters cable that connects him to Gemini's oxygen reserve, and equipped with a 75 kg backpack (AMU) with a 45-meters nylon cable. Due to astronaut's thermal load under stress, his visor fogs up, forcing him to reentry after 2 hours, 8 minutes. The splashdown takes place in the Western Atlantic, 0.7 km from the target.

Perfect takeoff of the United States Gemini 10
with astronauts John Young and Michael Collins.
Purpose a double rendezvous in space. Link up
with Agena 10 and space meeting with Agena 8.

Michael Collins

John Young

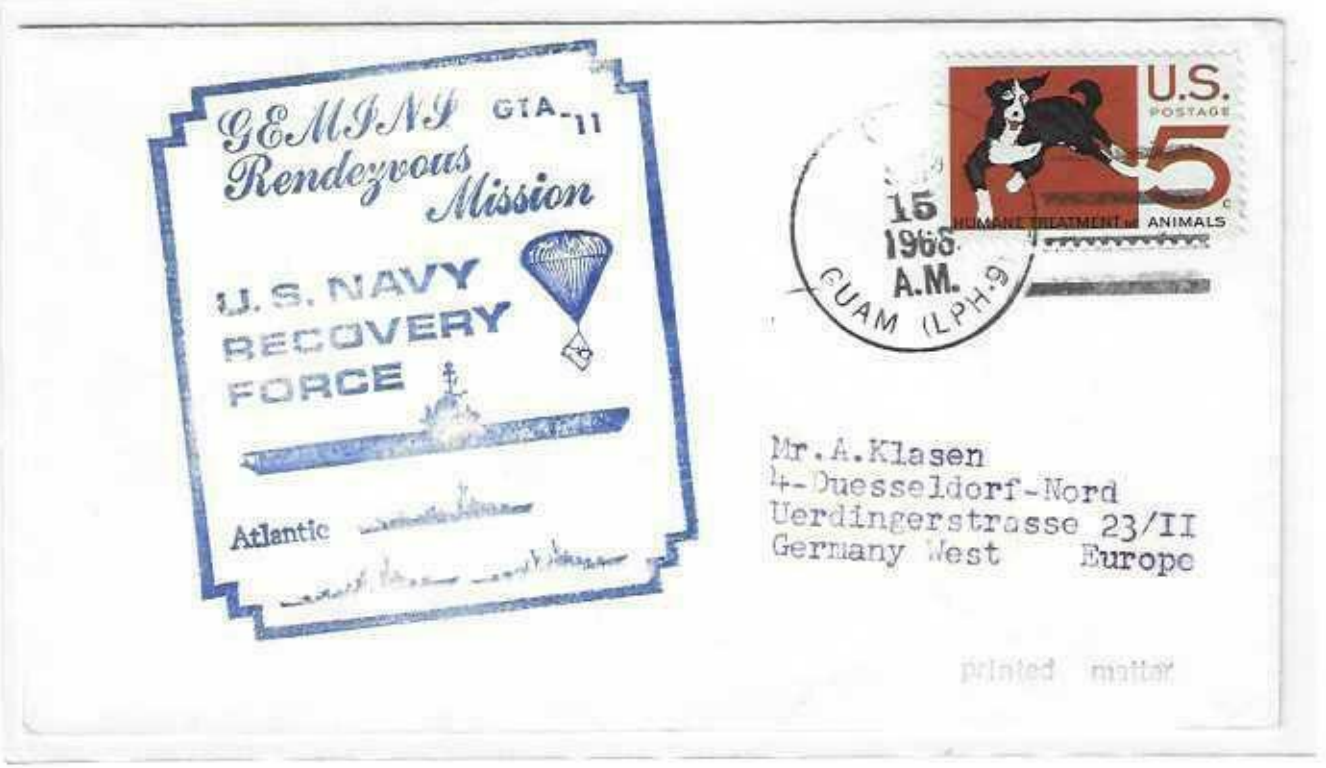
Electro-Voice
c/o Sarzin
Port Washington, N. Y.

GT-10 mission. JULY 18, 1966. Cape Canaveral machine cancel on the date and time of launch. Due to excessive fuel consumption the mission plan is revised: Gemini 10 remains attached for the next 39 hours using GATV's propulsion system. Taking advantage of the Agena thrusters, it raises the apogee to 763 km. Collins realizes the first stand-up EVA; once the hatch is opened, he remains standing in the spacecraft and takes several shots of the Earth and the stars. On July 20, a series of maneuvers brought the Gemini to about 15 meters from Agena 8. Disciplines: planetary science, space physics, human crew, astronomy, Earth science.

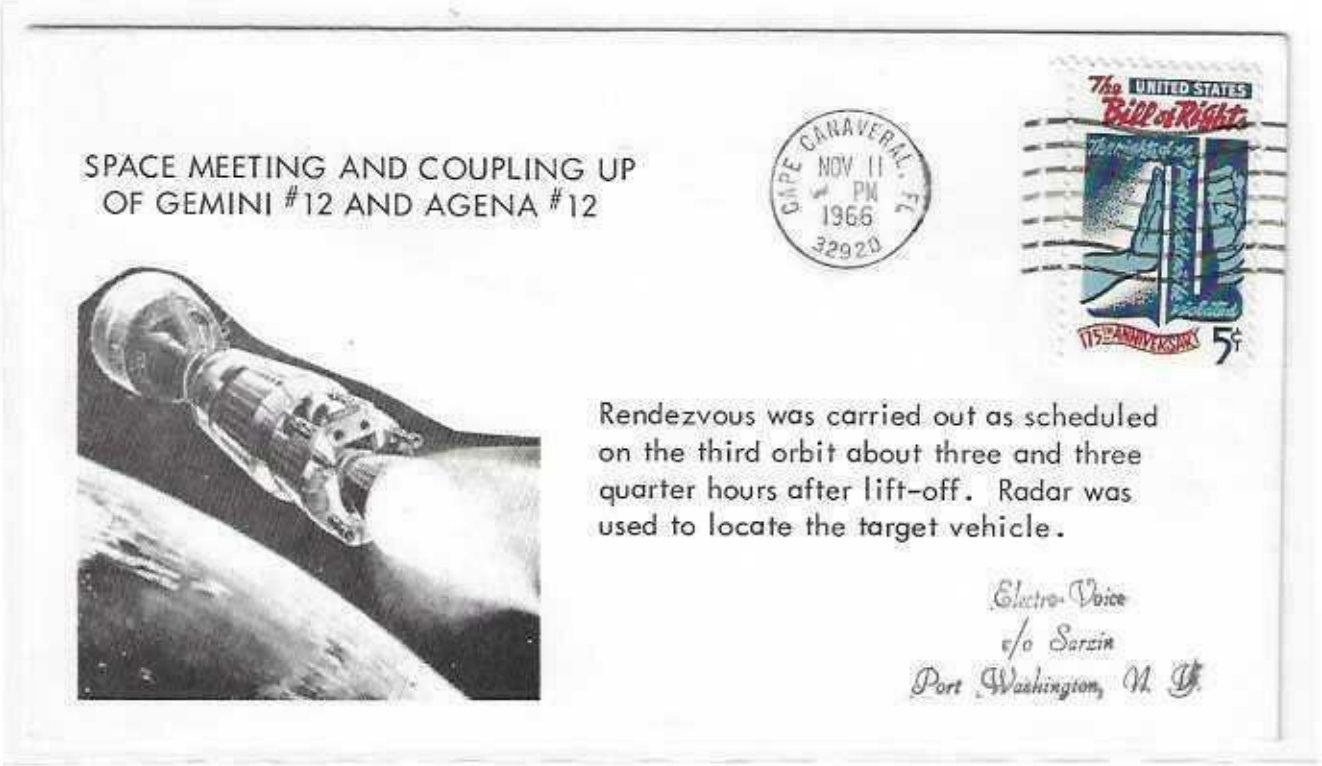
RUTH E. BROWN
14917 BLEDSOE STREET
SYLMAR, CALIFORNIA 91342

GT-10 mission. JULY 21, 1966. Primary recovery ship USS Guadalcanal manual cancel on the date and time of recovery. The first spacewalk is aborted by Young after 49 minutes due to eyes irritation in both astronauts. Collins' second EVA is limited to 25 minutes due to fuel deficiency. Landed in Atlantic, about 6 km from the target, the GT-10 capsule is recovered by a helicopter which takes it aboard the recovery ship.

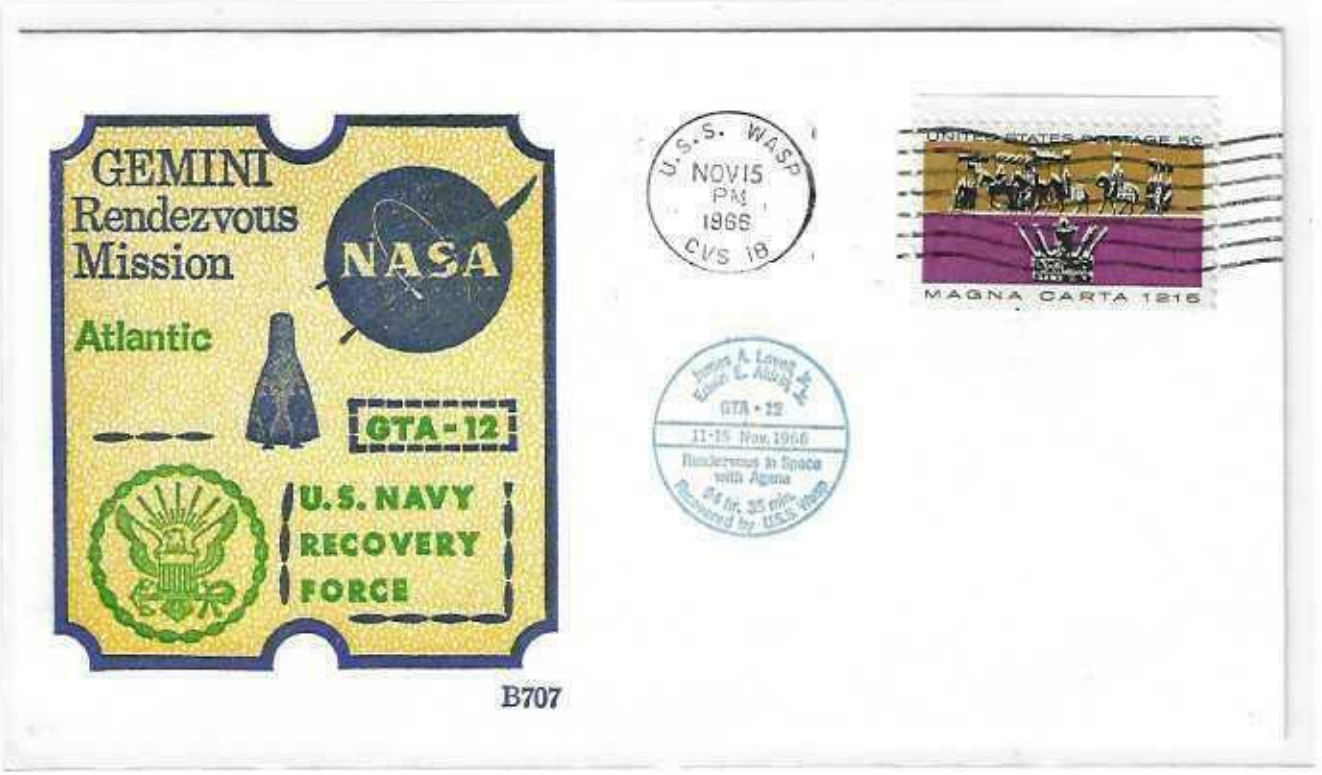
GT-11 mission. SEPTEMBER 12, 1966. Patrick AFB machine cancel on the date and time of launch. Docking with a new Agena satellite is expected on the first orbit. The operation, which requires a high precision launch, in an interval of just 2 seconds, succeeds perfectly, in record time, with minimal fuel consumption. This allows the crew to practice this important maneuver twice each. Gordon's first spacewalk is very tiring and, once again, has to be interrupted due to excessive fogging of the visor. Disciplines: space physics, life science, human crew, astronomy, Earth science.



GT-11 mission. SEPTEMBER 15, 1966. Primary recovery ship USS Guam manual cancel on the date and time of recovery. After separation from the Agena satellite, which remains connected with a 30 meter cable, using special piloting maneuvers, the pair of " tethered spacecrafts " is rotated to create an artificial gravitational force. Using Agena's thrusters the record height of 1,374 km was reached. Landed in Atlantic, about 5 km from the target, the GT-11 capsule is recovered by a helicopter which takes it on board the recovery ship.

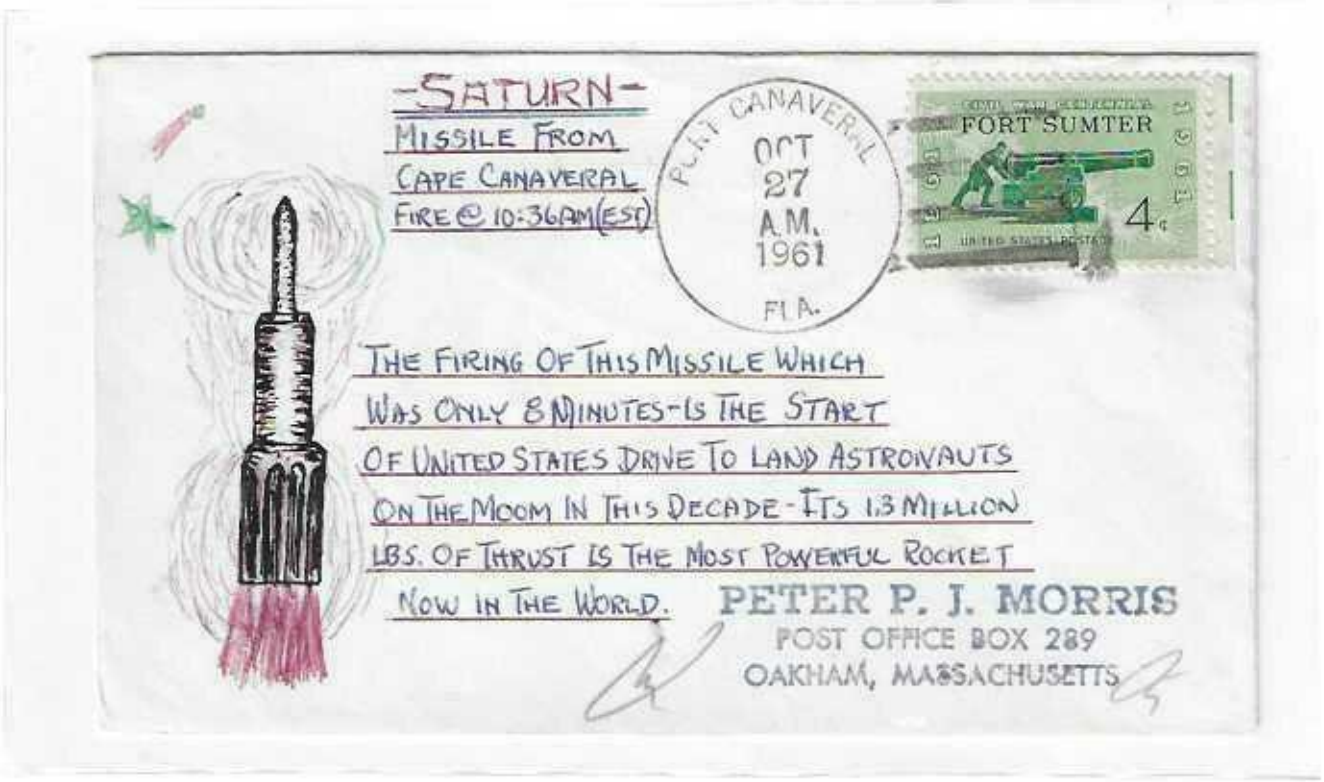


GT-12 mission. NOVEMBER 11, 1966. Cape Canaveral machine cancel on the date and time of launch. The mission commander is Jim Lovell, flanked by Buzz Aldrin. This mission also has, among its objectives, a docking with an Agena satellite. Despite the fact that due to a failure of the on-board radar, the maneuver must be piloted visually with the help of the sextant, fuel consumption is limited and the reserves are sifficient to repeat the docking several times. But, above all, the objective of the mission is to test the new " EVA approach ", completely rethought by NASA engineers, after the failure of the last missions. Disciplines: space physics, life science, human crew.



GT-12 mission. NOVEMBER 15, 1966. Primary recovery ship USS Wasp machine cancel on the date and time of recovery. After an initial stand-up EVA, Aldrin performs a real spacewalk of 2 hours, 20 minutes, during which he carries out various jobs both on the Gemini capsule and on the Agena satellite which in the meantime have been adequately equipped with appropriate handles and supports. He then performs a further stand-up EVA; the 3 extravehicular activities last a total of 5 and a half hours. The spacecraft lands in the Atlantic, about 5 km from the target.

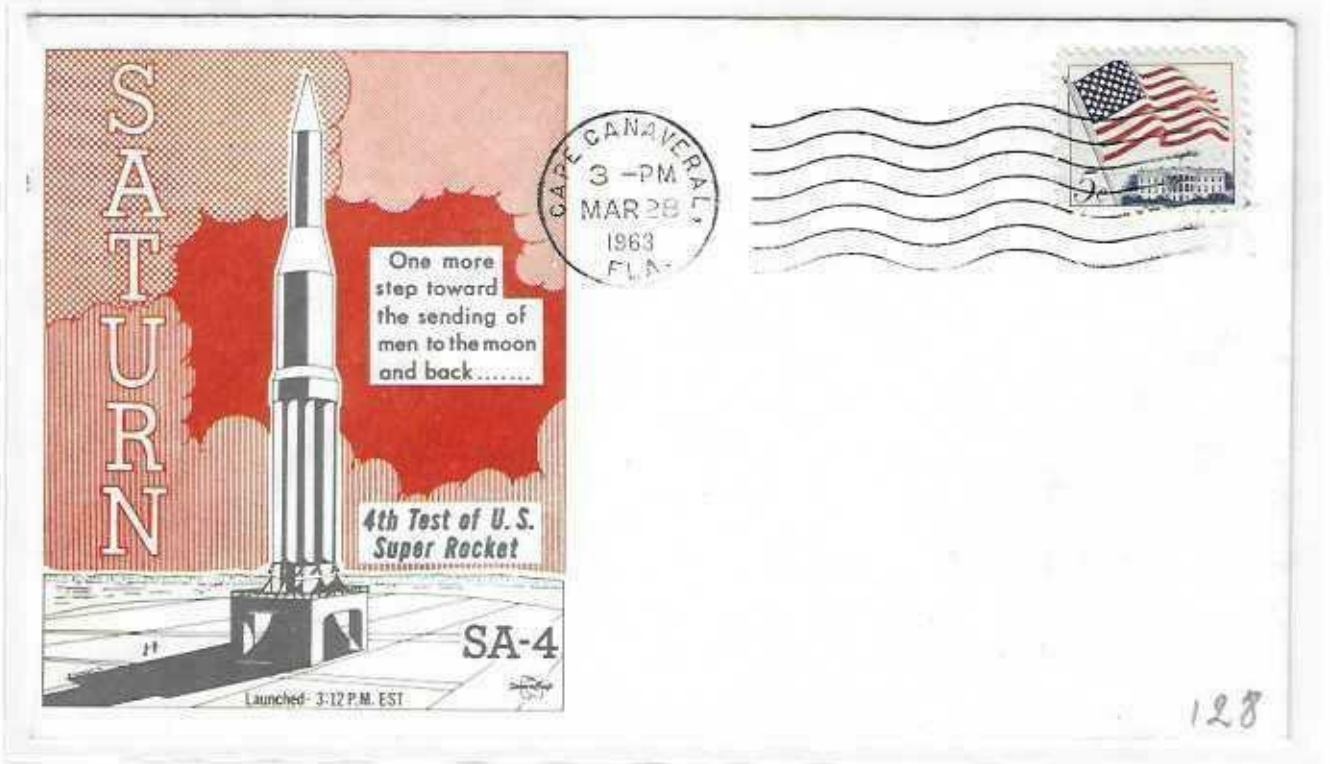
3 APOLLO PROGRAM



Saturn-Apollo 1 (SA-1) mission. OCTOBER 27, 1961. Port Canaveral manual cancel on the date and time of launch. This was the first flight of the Saturn 1 space launch vehicle, the first in the Saturn family. The booster was a huge increase in size and power over anything previously launched. NASA planned to test each rocket stage in separate launches, so for SA-1 the only live stage was the first stage, which launches in a simulated flight the upper stages filled with water at an altitude of 136.5 km and a range of 345,7 km. Discipline: planetary science.

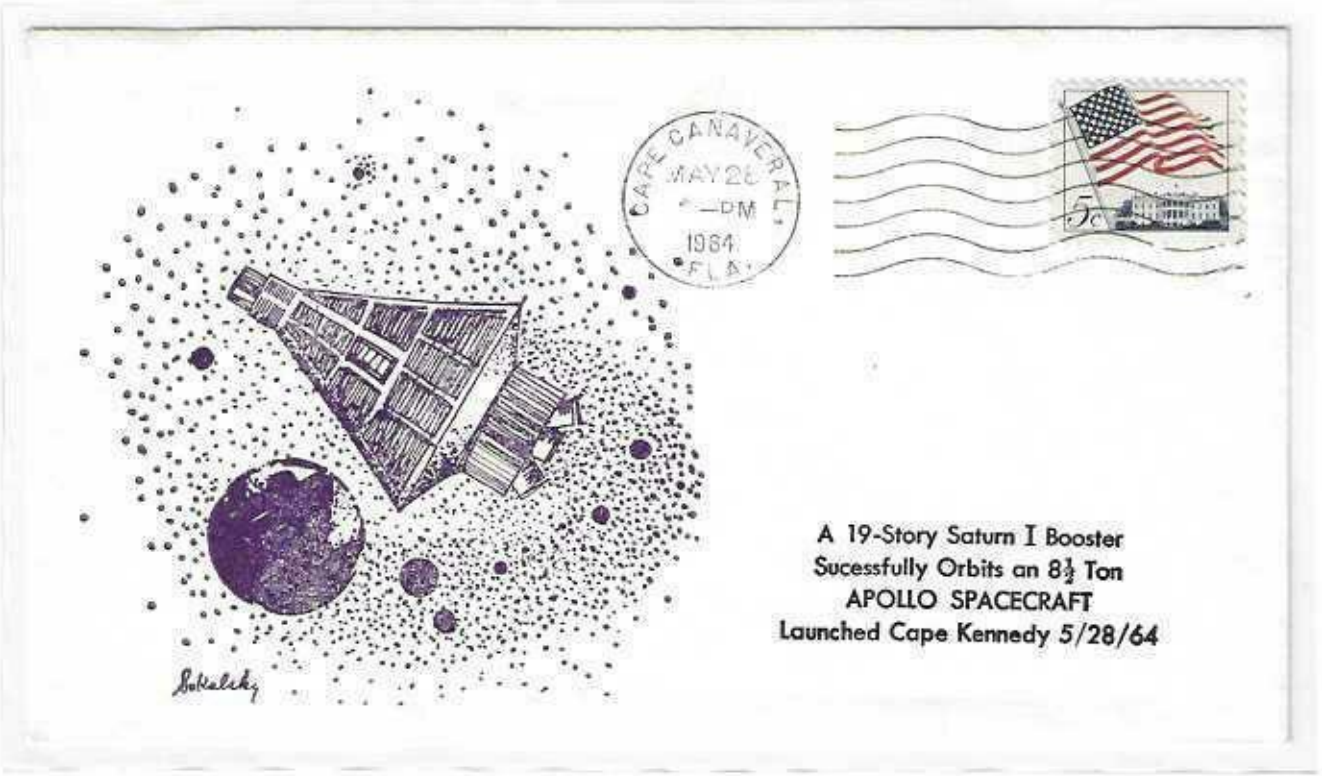
SA-2 mission. APRIL 25, 1962. Patrick AFB machine cancel on the date and time of flight. The first payload was called " Project Highwater ". The inert S-IV and S-V stages carried 109,000 liters (30,000 gallons) of ballast water for release in the upper atmosphere; this was used to study the effects on radio transmissions and changes in local weather conditions.

SA-3 mission. NOVEMBER 16, 1962. Cape Canaveral manual cancel on the date and time of launch. This was the first flight with a fully fueled first stage which carried upper stages filled with 87,000 liters (23,000 gallons) of water. The flight verification tests were all meet. This cloud experiment, " Project Highwater II ", was hoped to provide data on atmospheric physics, but poor telemetry made the results questionable. Discipline: engineering.

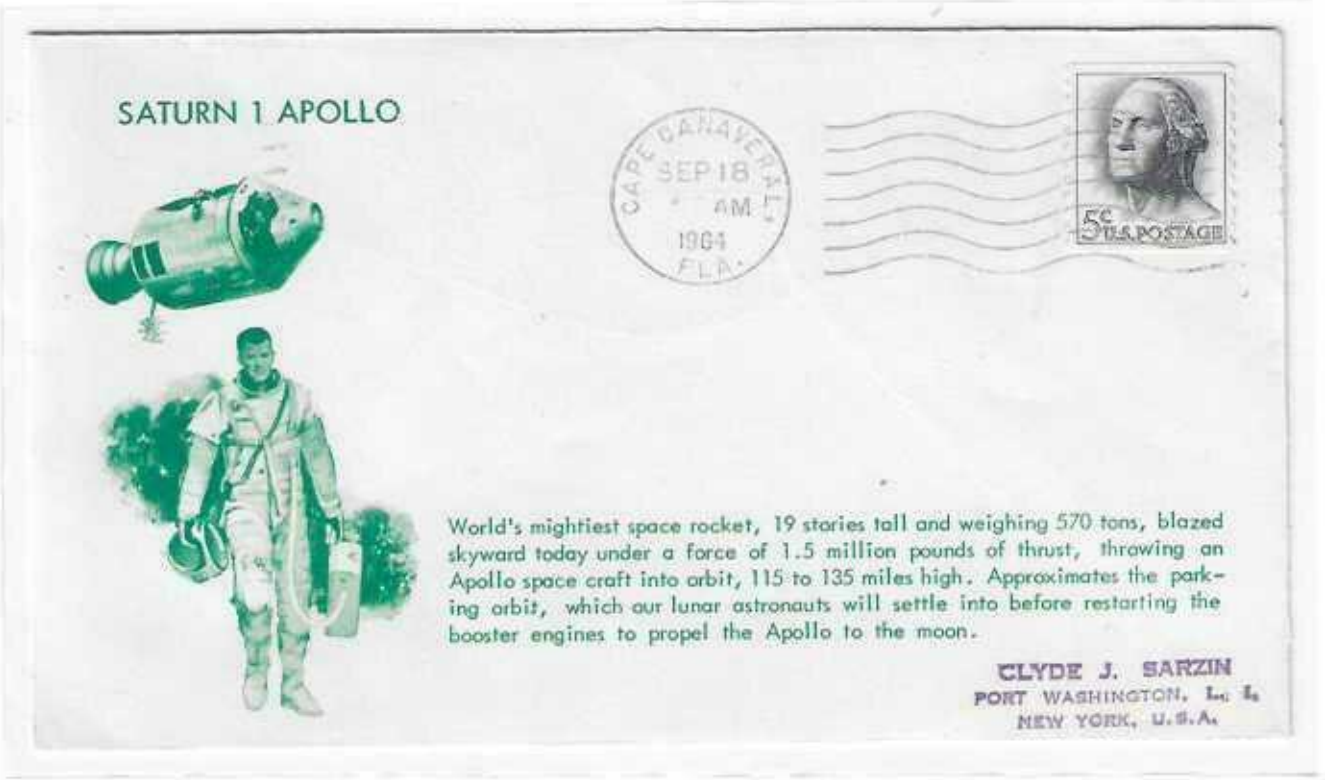


SA-4 mission. MARCH 28, 1963. Cape Canaveral machine cancel on the date and time of launch. This was the final of a series of four tests of the Saturn 1st stage and completed the Block 1. After 100 seconds of flight, a pre-set timer cut off engine n° 5, as planned, to test " engine-out " capability of the booster. The rocket then continue to operate properly, the propellant system rerouting the fuel to the other seven engines and the flight continue. Discipline: engineering.

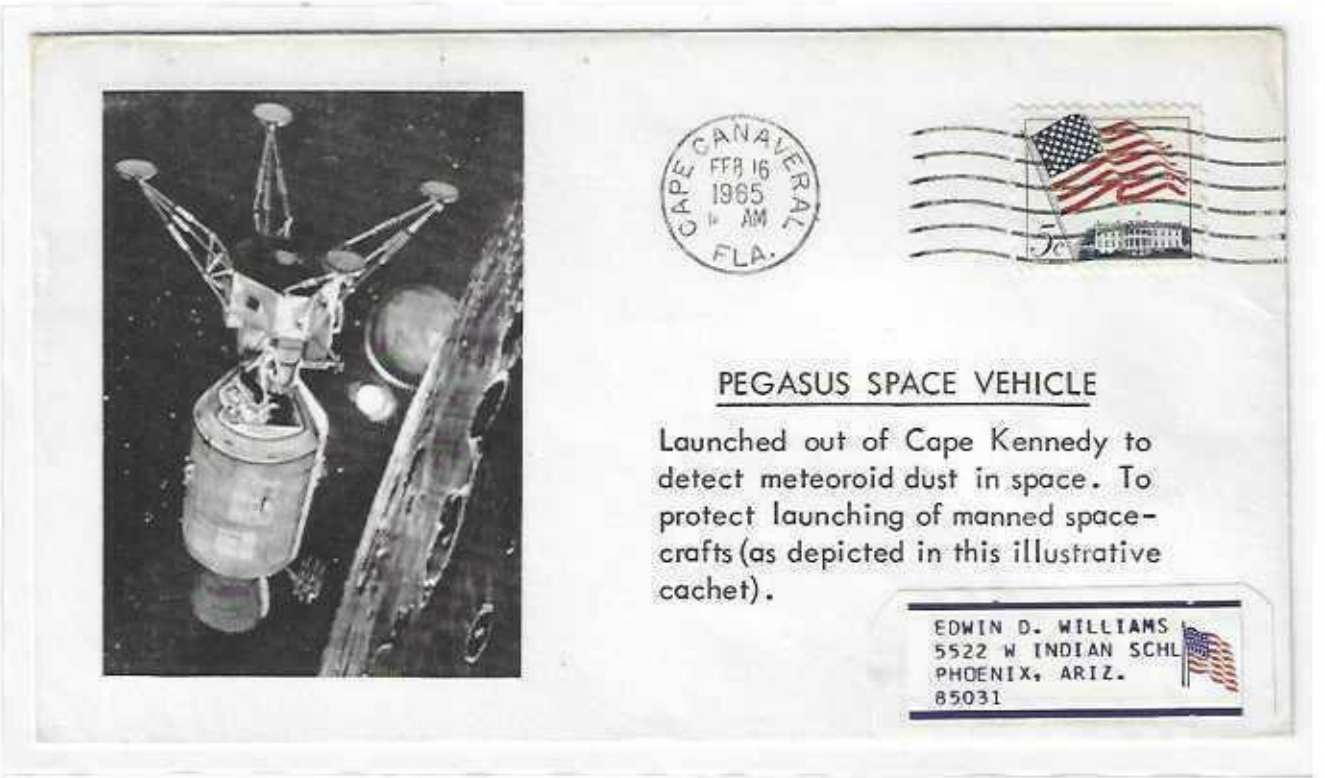
SA-5 mission. JANUARY 29, 1964. Cape Canaveral machine cancel on the date and time of launch. First flight of the Block II Saturn. For the first time in Apollo program, this flight would be an orbital mission; it was also the first live flight of the LOX/LH2 (liquid oxygen/liquid hydrogen) fueled second stage (S-IV). More than 11,000 measurements were taken. Discipline: engineering.



SA-6 mission. MAY 28, 1964. Cape Canaveral machine cancel on the date and time of launch. The Apollo payload was a 7,700 kg boilerplate CSM, attached to the S-IV second stage. The primary objective was further qualification of the Saturn 1 launch vehicle and continued development of the technology necessary to build the more powerful Saturn 1B and Saturn 5. Discipline: engineering.

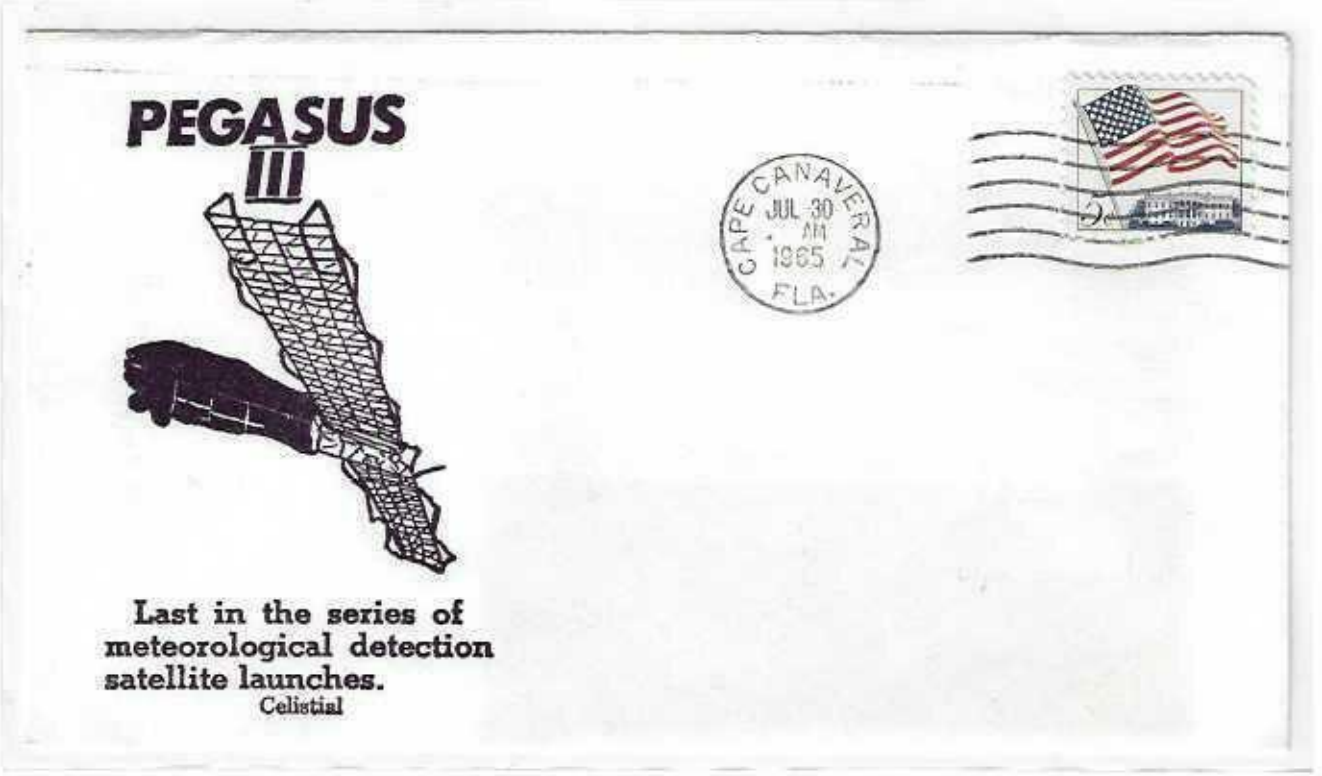


SA-7 mission. SEPTEMBER 18, 1964. Cape Canaveral machine cancel on the date and time of launch. The Saturn 1 demonstrated launch vehicle / spacecraft compatibility and tested the LES. It carried a boilerplate model CSM and an instrument unit to Earth orbit similar to the interim orbit planned for the future Apollo astronaut mission. The spacecraft was instrumented for 133 measurements such as heat rates, temperatures, aerodynamics and static loads. Discipline: engineering.

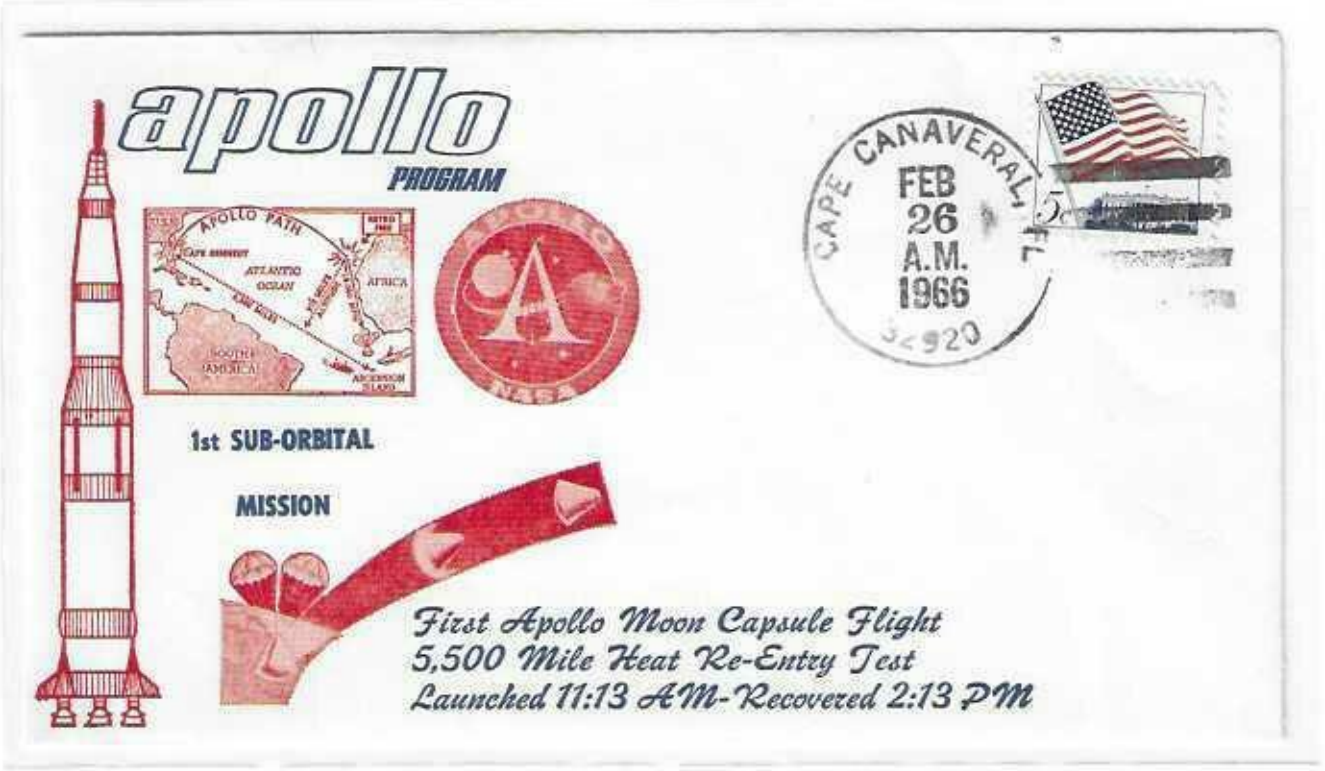


SA-9 (Pegasus 1) mission. FEBRUARY 16, 1965. Cape Canaveral machine cancel on the date and time of launch. It was the first active payload launched by the Saturn system. The spacecraft was equipped with winglike appendages that extended to form a plane 29.3 meters long by 4.3 meters wide. After second stage attained orbit, the 4,500 kg payload was jettisoned into a separate orbit. Disciplines: planetary science, space physics.

SA-8 (Pegasus 2) mission. MAY 25, 1965. Cape Canaveral manual cancel on the date and time of launch. The Saturn 1 had a boilerplate Apollo CSM. It acted as a shroud to hold the Pegasus satellite in its stored position with panels folded inside the Apollo SM. The spacecraft was 5.3 meters high, 2.1 meters wide and 28 centimeters deep. Disciplines: planetary science, space physics.

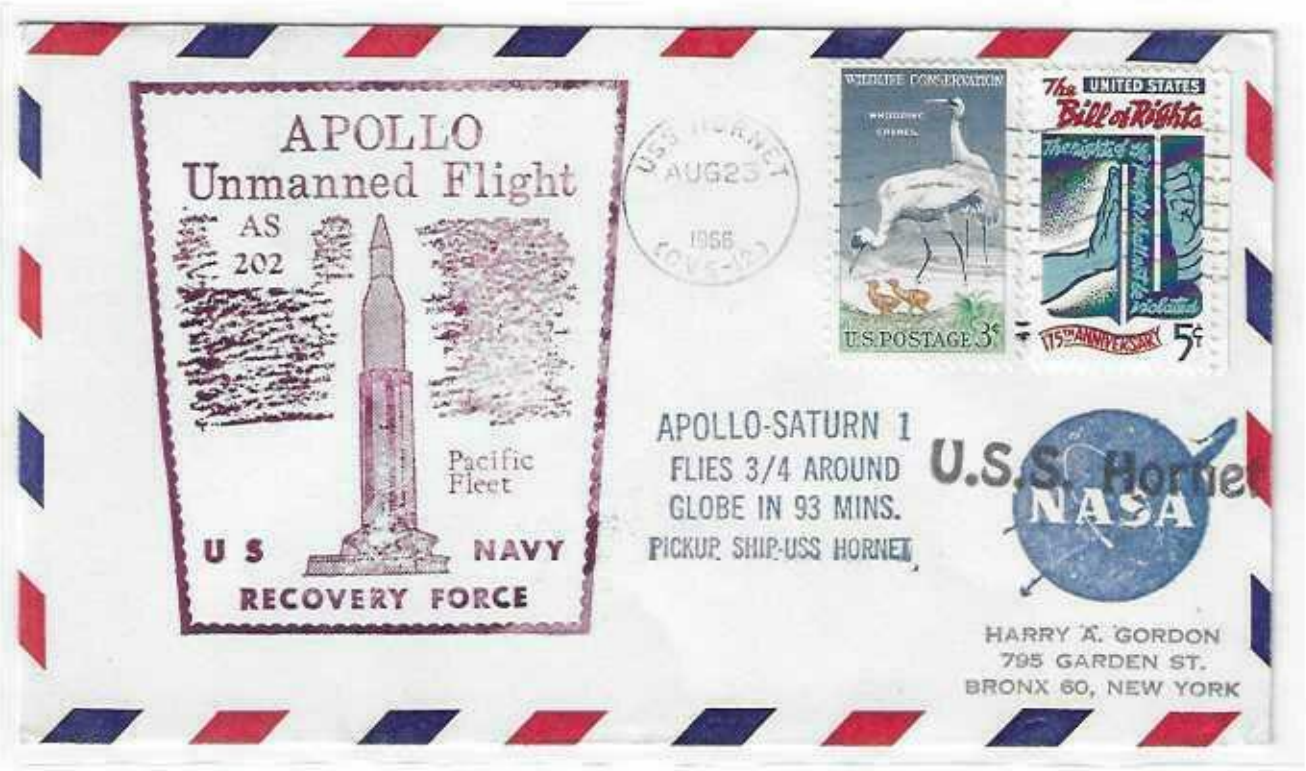


SA-10 (Pegasus 3) mission. JULY 30, 1965. Cape Canaveral machine cancel on the date and time of launch. The mission of this spacecraft was to measure meteoroid abundances in the region near the Earth. The Pegasus satellite remained with the second stage in Earth orbit as planned and deployed its winglike panels. For this mission the orbit was adjusted to a nearly circular one. Disciplines: planetary science, space physics.



Apollo-Saturn 201 (AS-201). FEBRUARY 26, 1966. Manual cancel (" plugged 9) on the date and time of launch. First flight of the two stages Saturn 1B. The objectives of the mission were to verify the structural integrity, launch loads, stage separation, operation of subsystems, evaluate heat shield (not achieved) and mission support facilities. The CSM reached a maximum altitude of 499 km over the Atlantic; the SM was jettisoned and the CM reentered generating a reentry heat of roughly 2,200°C. Discipline: engineering.

AS-203 mission. JULY 5, 1966. Patrick AFB machine cancel on the date and time of launch. The mission was a test of the S-IVB second stage and the IU (Instrument Unity) of the Saturn 5 to obtain flight information under orbital conditions. The engine's capability to restart after coast was demonstrated. During the fourth orbit internal pressure build up in the S-IVB stage while a pressure differential test was being performed. Discipline: engineering.

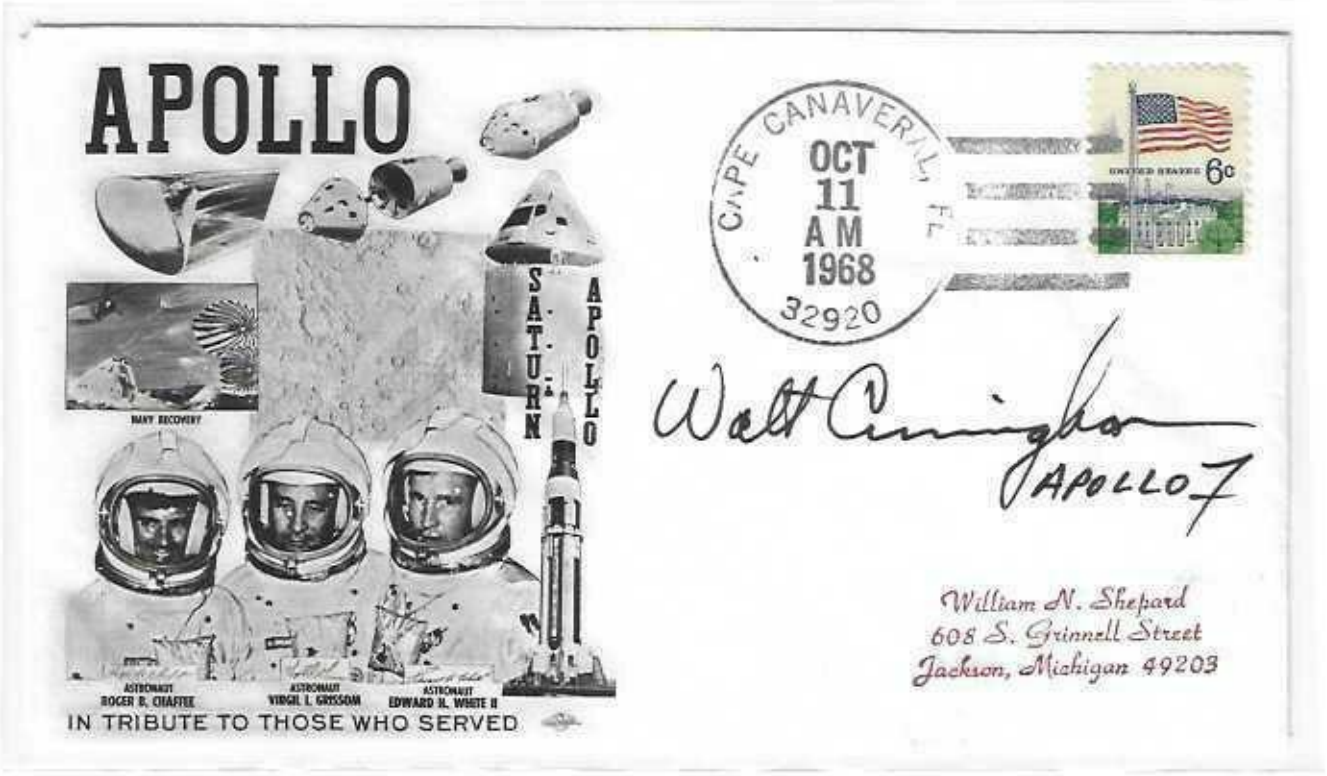


AS-202 mission. AUGUST 25, 1966. Primary recovery ship USS Hornet machine cancel on the date and time of recovery. After both stages completed their burns and separated, the SM propulsion engine burned to boost the spacecraft to a peak altitude of 1,128 km. The rapid restart capability of the SM's engines was tested, the last separating the two modules. The firing also accelerated the CM reentry to greater than 32,000 km/hr. Temperature registered in cabin was 21°C. Discipline: engineering.

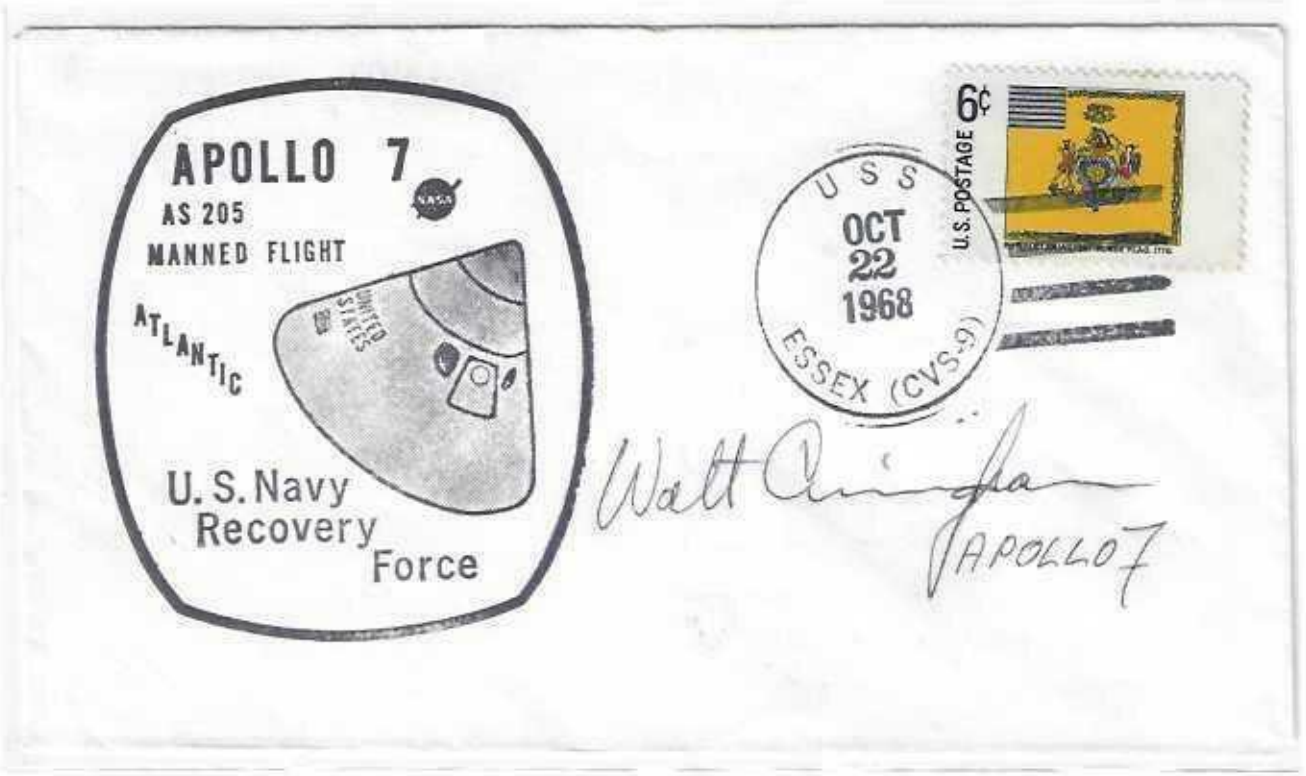
Apollo 4 (AS-501) mission. NOVEMBER 9, 1967. KSC machine cancel on the date and time of launch. Official cachet. The mission was the first all-up test of the three stage Saturn 5 rocket. It carried a payload of an Apollo CSM into Earth orbit. The S-IVB stage was reignited for a simulated translunar injection burn, reaching an apogee of 17,346 km. Later the SPS (Service Propulsion System) was reignited to accelerate the CSM to beyond lunar trajectory return velocities. Discipline: engineering.

Apollo 5 (AS-204) mission. JANUARY 22, 1968. Fairbanks machine cancel on the date and time of launch. First flight of the Lunar Module (LM). The S-IVB stage ignited to insert the spacecraft into an Earth orbit. The Descent Propulsion System (DPS) was cut short after only 4 seconds; the Ascent Propulsion System (APS) was ignited simultaneously with the DPS being shut down. The APS burn lasted 60 seconds, followed by a 6 minutes, 23 seconds firing which depleted APS fuel. Discipline: engineering.

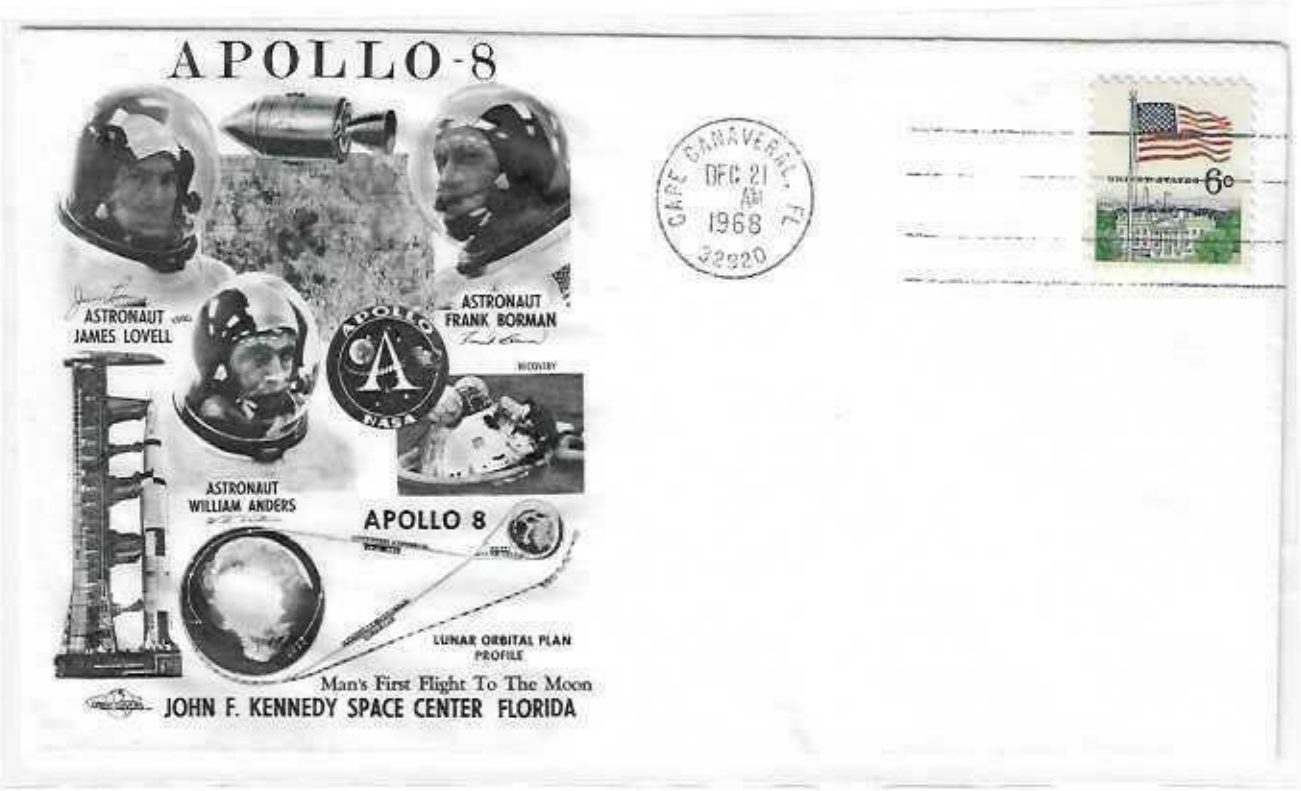
Apollo 6 (AS-502) mission. APRIL 4, 1968. Primary recovery ship USS Okinawa manual cancel on the date and time of recovery. The unmanned mission was designed as the final qualification of three stage Saturn 5 and Apollo spacecraft for manned missions. The payload includes an Apollo CSM and a boilerplate LM; mission plan includes CM recovery. The 3rd stage failed to reignite as planned, so the SM propulsion system was used to boost the spacecraft on a apogee of 22,225 km, from which the planned lunar reentry simulation took place at 36,025 km/hr. The CM splash down 80 km from the target point. Discipline: engineering.



Apollo 7 (AS-205) mission. OCTOBER 11, 1968. Cape Canaveral manual cancel on the date and time of launch. Resume crew flights after the tragedy of Apollo 1. The flight carries the astronauts Walter Schirra, commander, Donn Eisele, CM pilot and Walter Cunningham, LM pilot. A cold is uncomfortable enough on the ground, but in weightlessness it presents a different problems during the mission. The primary objectives were demonstrate CSM and crew performance, crew, space vehicle, rendezvous capability and mission support facilities. Disciplines: Earth science, human crew.



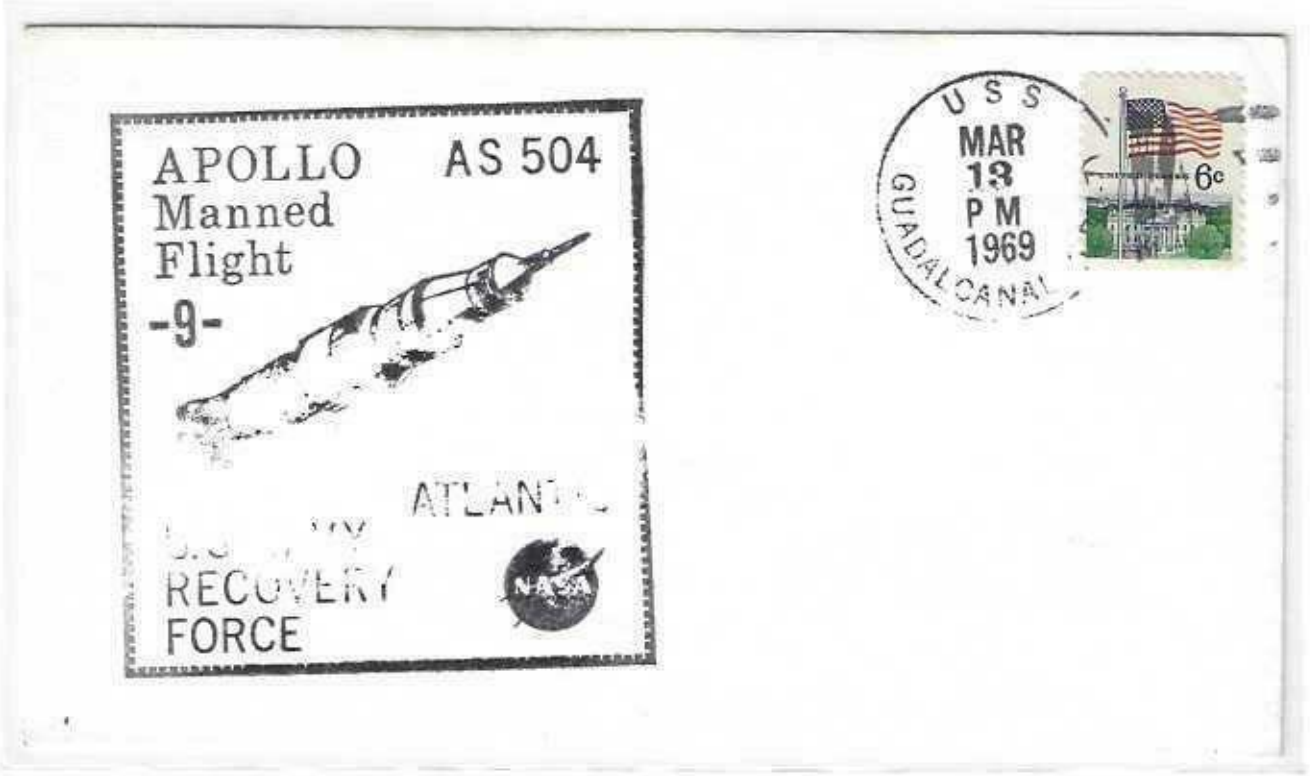
Apollo 7 mission. OCTOBER 22, 1968. Primary recovery ship USS Essex manual cancel on the date and time of recovery. The Apollo vehicle and the CSM Apollo performed superbly: Schirra turned the spacecraft around the S-IVB stage to simulate docking as would be necessary to extract an LM for a Moon landing. The mission also allows to thoroughly test the SPS, the engine that will have to bring Apollo to the lunar orbit and will then have to reposition in the Earth's orbit. The engine is restarted eight times.



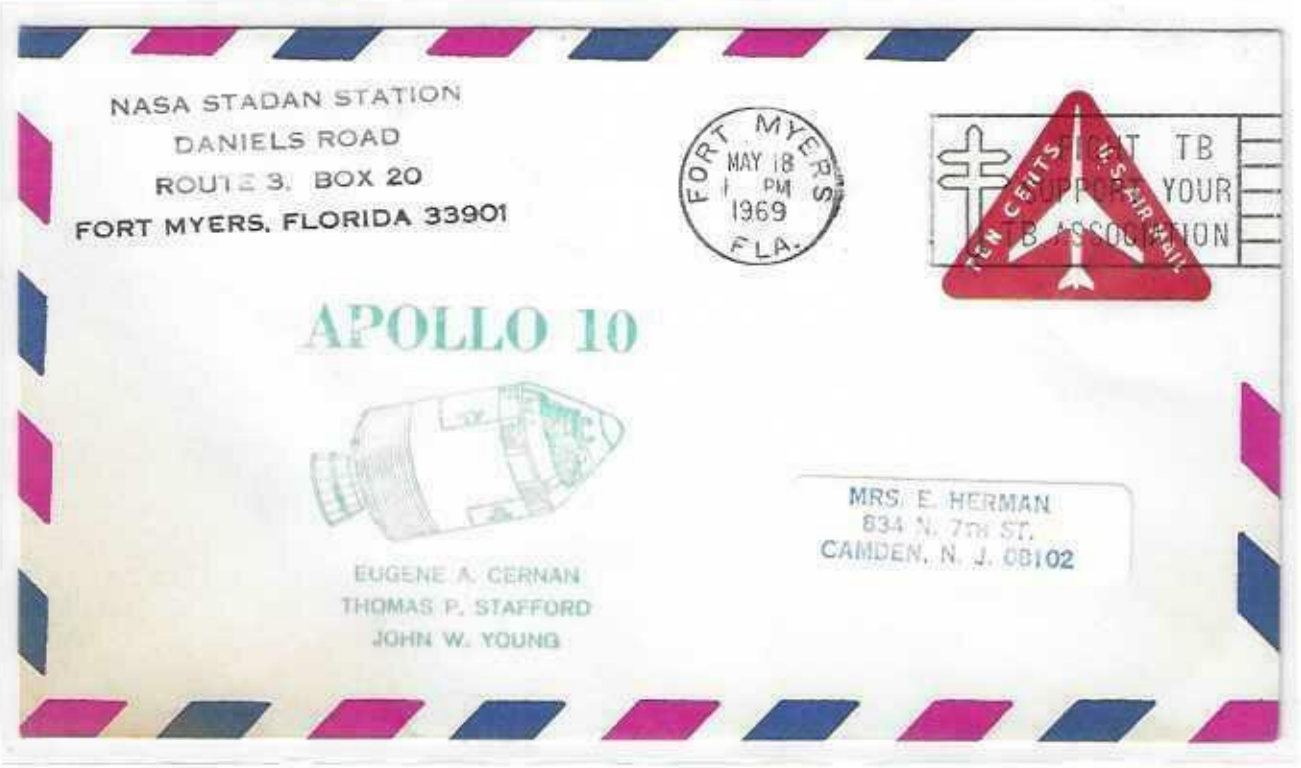
Apollo 8 (AS-503) mission. DECEMBER 21, 1968. Cape Canaveral machine cancel on the date and time of launch. Mission objectives were to demonstrate mission support facilities during a manned Saturn 5 / CSM mission, translunar injection, CSM navigation, communications and midcourse corrections, consumable assessment and passive thermal control. The NASA's three astronauts became the first humans to see the Moon far side. Disciplines: human crew, planetary science.

Apollo 8 mission. DECEMBER 24, 1968. Vandenberg AFB machine cancel. During the 20 hours period in lunar orbit the crew conducted a full sleepless schedule of tasks including landmark and landing site tracking, vertical stereo photography, stereo navigation photography and sextant navigation. Six telecast were conducted during the mission. It were telecast worldwide and in real time to all five continents. On Christmas eve the crew read verses from the first chapter of the Genesis and wished viewers.

Apollo 9 (AS-504) mission. MARCH 3, 1969. KSC machine cancel on the date and time of launch. The flight carries the astronauts James Mc Divitt, commander, David Scott, CM pilot, and Russell Schweickart, LM pilot. The primary objective was a Earth orbital test of the first crewed LM, including operation of the LM as an independent self-sufficient spacecraft and performance of docking and rendezvous maneuvers. On March 6, Mc Divitt and Schweickart, through the tunnel, for the first time in history, moved in the LM. Schweickart, through the garret, get out to the outside and he return after 47 minutes. Disciplines: engineering, human crew, Earth science.

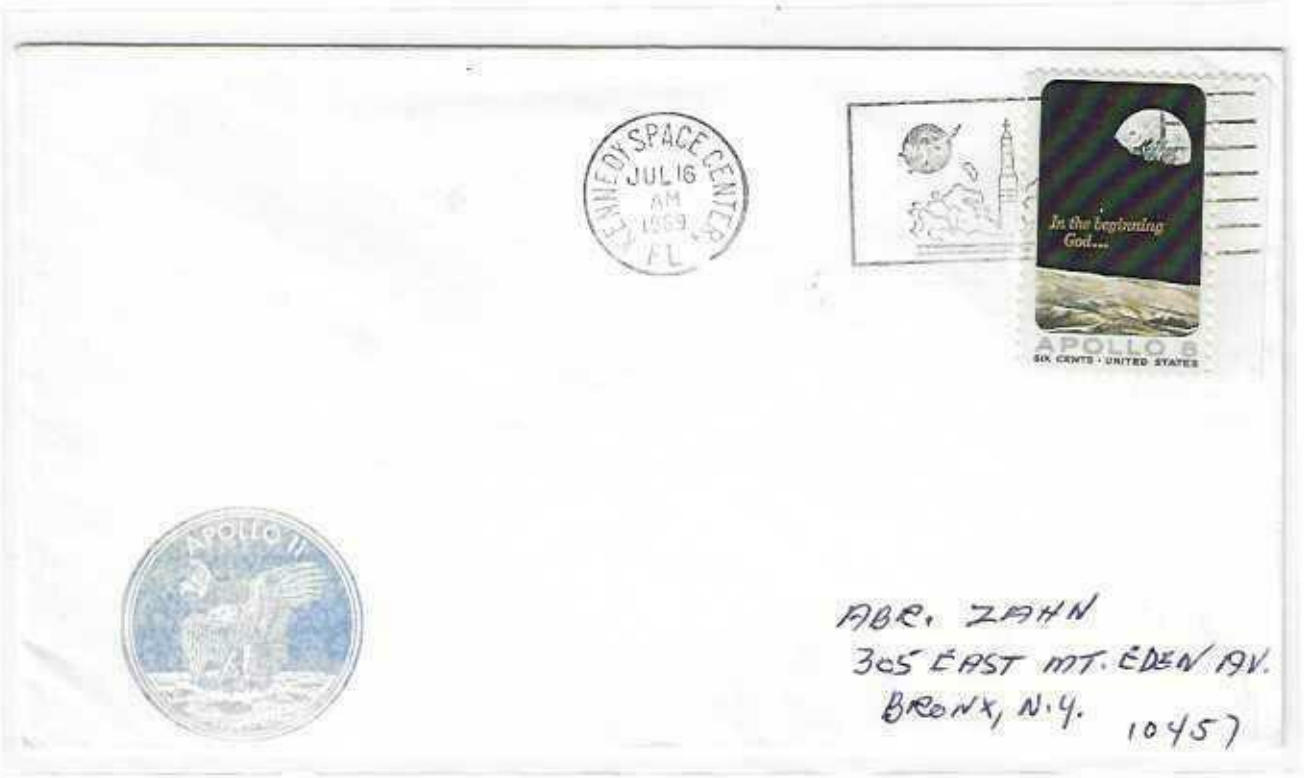


Apollo 9 mission. MARCH 13, 1969. Primary recovery ship USS Guadalcanal manual cancel on the date and time of recovery. On the 5th day the LM breaks away and travels 180 km away. After 6 hours and 22 minutes it returns and reattaches to the CM, and the astronauts are reunited with Dave Scott.The LM's thrusters engines are remotely restarted until the fuel runs out imparting a thrust that will allow " Spider " to remain in Earth orbit until 1981, when it will reenter the atmosphere and be destroyed.

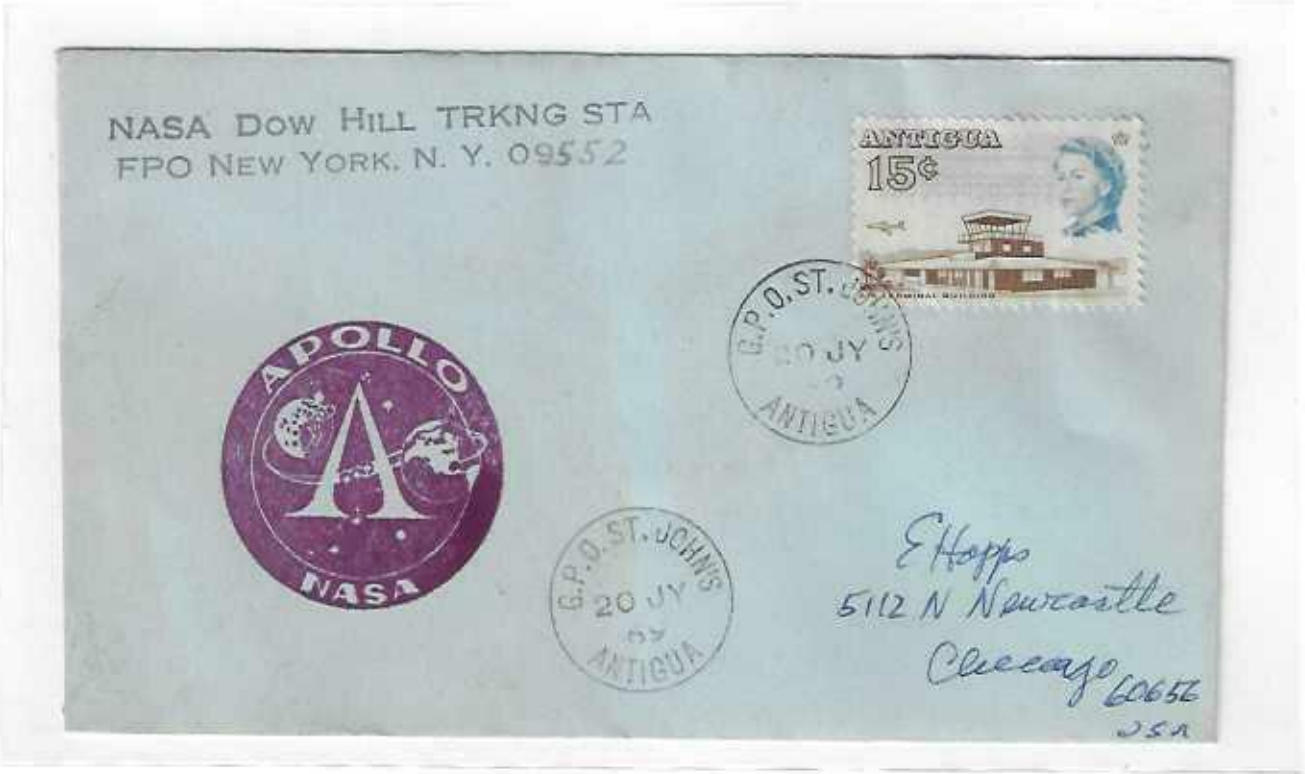


Apollo 10 (AS-505) mission. MAY 18, 1969. Fort Myers machine cancel on the date and time of launch. Thomas Stafford is mission commander, John Young CM pilot, Eugene Cernan LM pilot. Second Apollo mission to orbit the Moon and first mission to travel to it with the complete Apollo spacecraft, in which all operations, except the actual moonlanding, are accomplished. On May 22, the LM, with Stafford and Cernan, was placed in low lunar orbit which allowed close passes within 14 km above the lunar surface, photographing it. Reconnection with CSM takes place 8 hours after separation. Disciplines: planetary science, human crew.

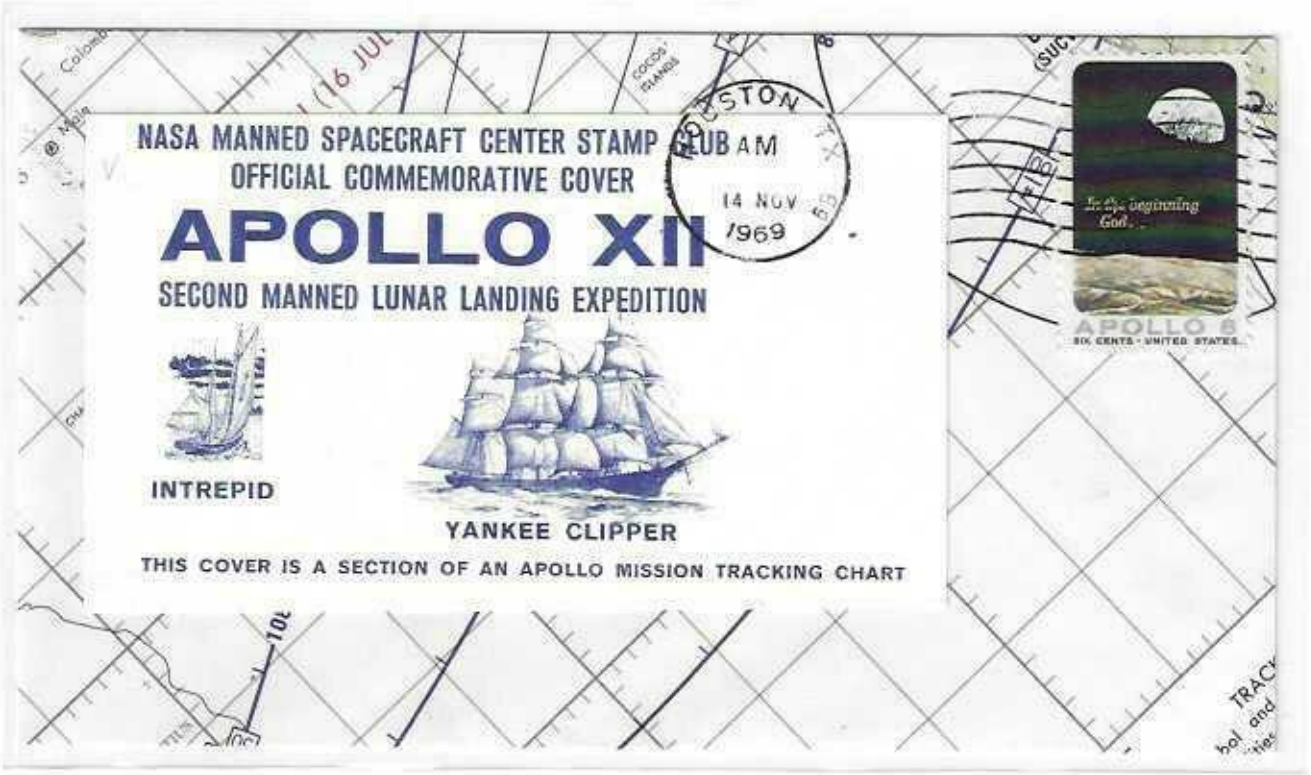
Apollo 10 mission. MAY 26, 1969. Primary recovery ship USS Princeton machine cancel on the date and time of recovery. During reentry into the atmosphere the capsule reaches the record speed of almost 40,000 km/hr; the mission ends in the Pacific 741 km east of American Samoa, about 5.5 km from the recovery ship.



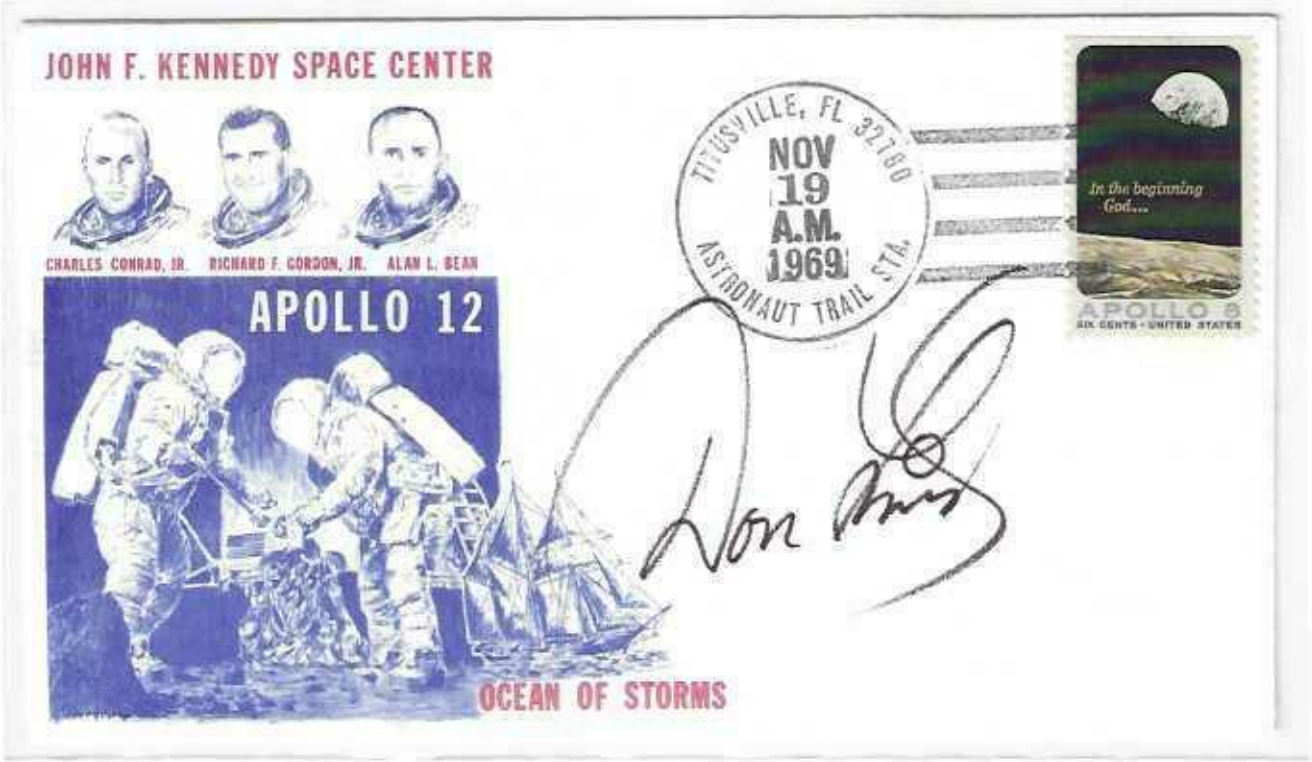
Apollo 11 (AS-506) mission. JULY 16, 1969. KSC machine cancel on the date and time of launch (official cachet). Mission commander is Neil Armstrong, destined to become the first man to walk on the Moon; his traveling companions are Edwin " Buzz " Aldrin, LM pilot, and Michael Collins, CM pilot. Lunar orbit insertion is achieved while the spacecraft is behind the Moon and out of contact with the Earth. The LM's descent engine is turned on for the first time placing the spacecraft into an orbit of 14,5 km and then restarted to begin the final descent. Disciplines: human crew, planetary science.



Apollo 11 mission. JULY 20, 1969. St. John's postal office manual cancel on the date and time of moonlanding. The first Apollo landing site, in the south of the Sea of Tranquillity, was chosen because it was considered quite flat and smooth from the surveys carried out by the Rangers and Surveyors and from the maps drawn by the Lunar Orbiters. Armstrong and Aldrin deployed the EASEP experiment on the soil, collected about 22 kg of rocks and samples and took photographs. Lunar liftoff begins after 21 hours, 36 minutes of stay on the Moon.



Apollo 12 (AS-507) mission. NOVEMBER 14, 1969. Houston machine cancel on the date and time of launch. The flight carries the astronauts Charles " Pete " Conrad, mission commander, Alan Bean, LM pilot, and Richard Gordon, CM pilot. The spacecraft is struck by lightning 36 seconds after launch and again 52 seconds later, an incident that momentarily interrups electrical power and telemetry contact. On November 19 Conrad and Bean separate from CSM. The descent engine is turned on for 29 seconds and the LM lands in the Ocean of Storms, on the edge of a crater, about 180 meters from the Surveyor 3 that landed on April 20, 1967. Disciplines: human crew, planetary science, space physics.



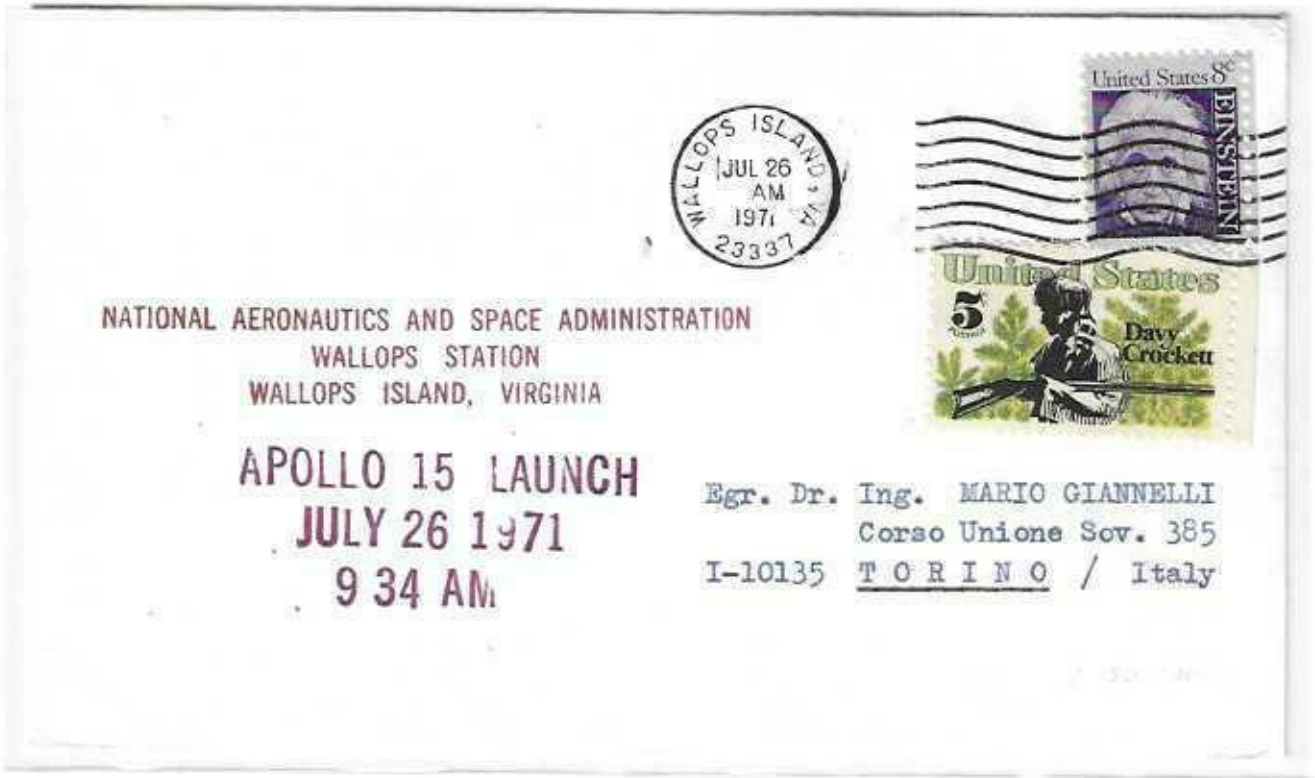
Apollo 12 mission. NOVEMBER 19, 1969. Titusville manual cancel on the date and time of moonlanding. Conrad and Bean make two lunar traverses lasting a total of 7 hours, 45 minutes, covering a distance of 1.35 km. They set up scientific experiments, including ALSEP, take photographs, collect 34 kg of soil samples and recover some pieces of Surveyor 3 for later ground examinations. The LM is abandoned and intentionally addressed to the Moon creating the first artificial lunar earthquake recorded in space. Apollo 12 lands on November 24 near American Samoa and is recovered by USS Hornet.

Apollo 13 (AS-508) mission. APRIL 14, 1970. Colorado Springs (Cheyenne Mountain region) machine cancel. The mission carries astronauts James Lovell, commander, Fred Haise, LM pilot and Jack Swigert, CM pilot. Second spacecraft of H series, intended for exploration of the hilly plateau of the Fra Mauro region, selenological inspection and survey, deployment and activation of experiments, photography and further development of the human ability to work in space. Disciplines: human crew, planetary science.

Apollo 13 mission. APRIL 17, 1970. Primary recovery ship USS Iwo Jima manual cancel on the date and time of recovery. On April 13, 1970 the explosion of one of the oxygen tanks and consequent damage to the other systems forced the mission to be aborted, leaving the world with bated breath. With oxygen reserves depleted the crew moves into the LM deactivating the CM. A course-changing maneuver is performed using the descent propulsion system to place the spacecraft on a convenient return trajectory that would take it around the Moon and back to Earth. The mission ends happy in the Pacific, southeast of American Samoa, 6.5 km from the recovery ship.

Apollo 14 (AS-509) mission. JANUARY 31, 1971. KSC machine cancel on the date and time of launch (official cachet). Mission commander is Alan Shepard, Edgar Mitchell LM pilot and Stuart Roosa CM pilot. On February 1, 1971 five attempts were made to attach the LM to the CSM, all of wich failed; the operation is completed on the sixth attempt. The LM lands in the hilly plateau region 24 km north to the Fra Mauro crater on February 5. Disciplines: astronomy, human crew, planetary science, space physics.

Apollo 14 mission. FEBRUARY 9, 1971. Houston machine cancel on the date and time of splashdown. The astronauts perform two lunar walks totaling 9 hours, 23 minutes, in which the ALSEP experiment is installed, 42 kg of surface samples are collected and photographs are taken. At the end of second EVA Shepard hits two golf balls. The LM lifts off from the Moon on February 6 after 33 hours, 31 minutes of stay and impacts the Moon on February 8. The Apollo CM lands in the Pacific 1,417 km south of American Samoa and is recovered by USS New Orleans.



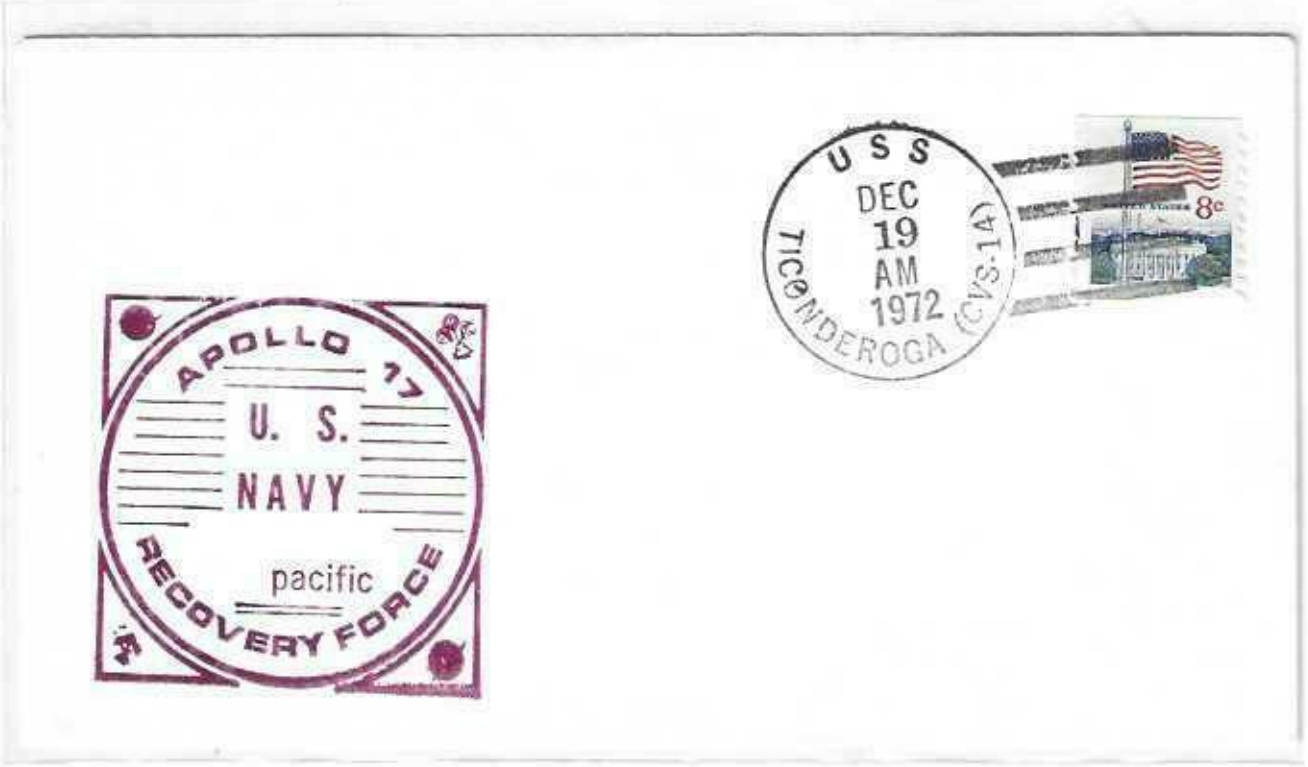
Apollo 15 (AS-510) mission. JULY 26, 1971. Wallops Island machine cancel on the date and time of launch. Mission commander is David Scott, LM pilot James Irwin, CM pilot Alfred Worden. First mission of the J series, a group of missions that include a longer stay on the Moon and greater attention to scientific activity. The LM Falcon lands in Mare Imbrium, at the foot of the Apenin mountain range. Scott and Irwin, between July 31 and August 2, performed three moonwalks, totaling 18 hours, 35 minutes, covering a distance of approximately 28 km. This is the first mission to employ the Lunar Roving Vehicle (LRV), a lunar off-road, within 5 km. Disciplines: Earth science, human crew, planetary science, space physics.

Apollo 15 mission. JULY 30, 1971. Houston manual cancel on the date and time of moonlanding. Aboard the CSM Worden performs scientific experiments. The LM takes off from the Moon after a 66 hours, 55 minutes stay. A small scientific satellite is mechanically launched from SIM bay. On August 5, 1971 Worden conducts the first deep space walk venturing onto the rear to retrieve films. During the descent one of the three main parachutes failed to fully open increasing the speed by 4.5 km.

Apollo 16 (AS-511) mission. APRIL 20, 1972. Houston manual cancel on the date and time of moonlanding. The three astronauts aboard Apollo are John Watts Young, mission commander, Charles Duke, LM pilot and Ken Mattingly, CM pilot. The launch is posponed from the originally scheduled data, March 17, due to a malfunction. The second firing of the Auxiliary Propulsion System (APS) of the S-IVB stage could not be performed due to a previous problem. Stage monitoring is lost on April 17 following transponder failure. It will impact the Moon on April 19. The descent of the LM is posponed by approximately 6 hours following a malfunction in the CSM backup system. Disciplines: astronomy, engineering, human crew, life science, planetary science, microgravity, solar physics.

Apollo 16 mission. APRIL 23, 1972. Houston manual cancel on the date and time of lunar liftoff. Orion lands in the Descartes plateau region, north of the Dolland crater. Between April 21 and 23 Young and Duke performed three moonwalks, totaling 20 hours, 14 minutes. The LM lift off from the Moon after 71 hours, 2 minutes of stay. Due to a problem in guidance and navigation system the planned deorbit and lunar impact could not be attempted; the LM will remain in lunar orbit of an estimated life time of 1 year. A subsatellite is launched mechanically. Mattingly begins a cislunar EVA to recover films and inspect SM. With two walks it will take a time of 1 hour, 24 minutes.

Apollo 17 (AS-512) mission. DECEMBER 7, 1972. KSC machine cancel on the date and time of launch. Mission commander is Eugene Cernan, LM pilot Harrison Schmitt, Ron Evans CM pilot. The mission was the final in a series of three J-tipe missions. Apollo 17 was indeed a fitting capstone to the Apollo missions. Its awesome and magnificent midnight launch, its flawless operation, its 72 hours lunar stay time, its deployment of scientific instrumentation, its return of the richest collection of lunar samples, its orbital science coverage and its glorious splashdown in the Pacific surely marked Apollo 17 as the mission most impressively exemplifying the Apollo Program. Disciplines: astronomy, human crew, life science, planetary science.



Apollo 17 mission. DECEMBER 19, 1972. Primary recovery ship USS Ticonderoga manual cancel on the date and time of recovery. Between 11 and 13 December Cernan and Schmitt carried out three lunar walks covering a distance of 30 km, using the lunar rover. They use a special drill that allows sampling up to 3 meters deep. On the way back, after the transterrestrial injection, on 17 December Evans began a series of three cislunar EVAs toward the SM's SIM science module bay totaling 67 minutes. The Apollo capsule lands 6.5 km from the recovery ship, 648 km south-east of the Samoan Islands.

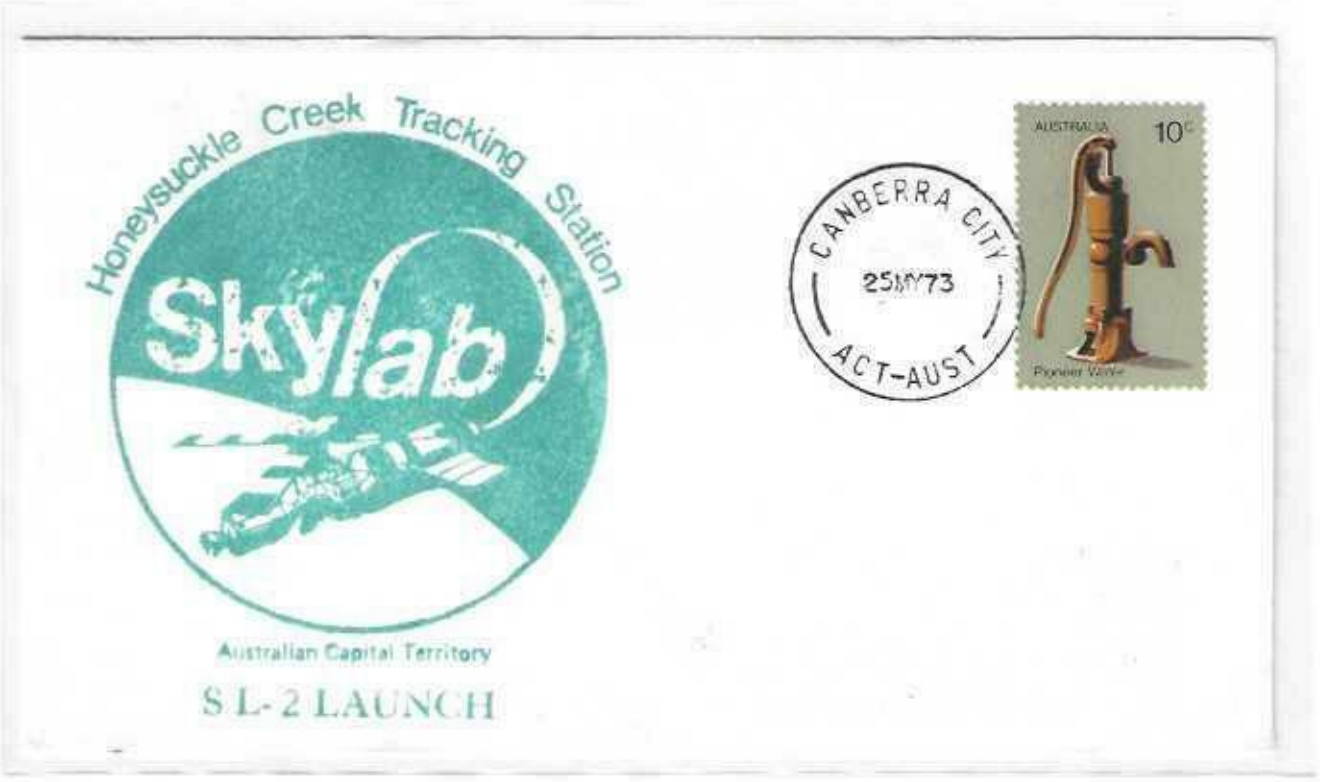
4 SKYLAB, the US space laboratory

Skylab 1 mission. MAY 14, 1973. Cape Canaveral manual cancel on the date and time of launch. When the Saturn rocket was developed, in the mid-'60s, enabling some heavy lifting into space, the Skylab Program began to take shape. At first, there were two competing concepts for a space station: the first, called " wet concept ", designed for launching a Saturn 1B rocket, venting the S-IVB upper stage, and refurbishing it, converting it to space station while in orbit; the second, or " dry concept ", designed for outfitting the S-IVB while still on the ground and launching in atop a Saturn 5. While the Apollo 11 astronauts were actually on the Moon, the decision was made to go with the " dry concept ". Disciplines: astronomy, engineering, Earth science, human crew, life science, planetary science, solar physics, space physics.

Skylab 1 mission. MAY 14, 1973. KSC machine cancel on the date and time of launch. Following cancellation of Apollo 18, 19 and 20, we had a lot of hardware lying around gathering dust, so we put it use some remarkably good use. 1 minute and 3 seconds into launch of Skylab 1 the meteorite schield / sunshade was torn loose by the aerodynamic forces, destroying one of the solar arrays and damaging the other.

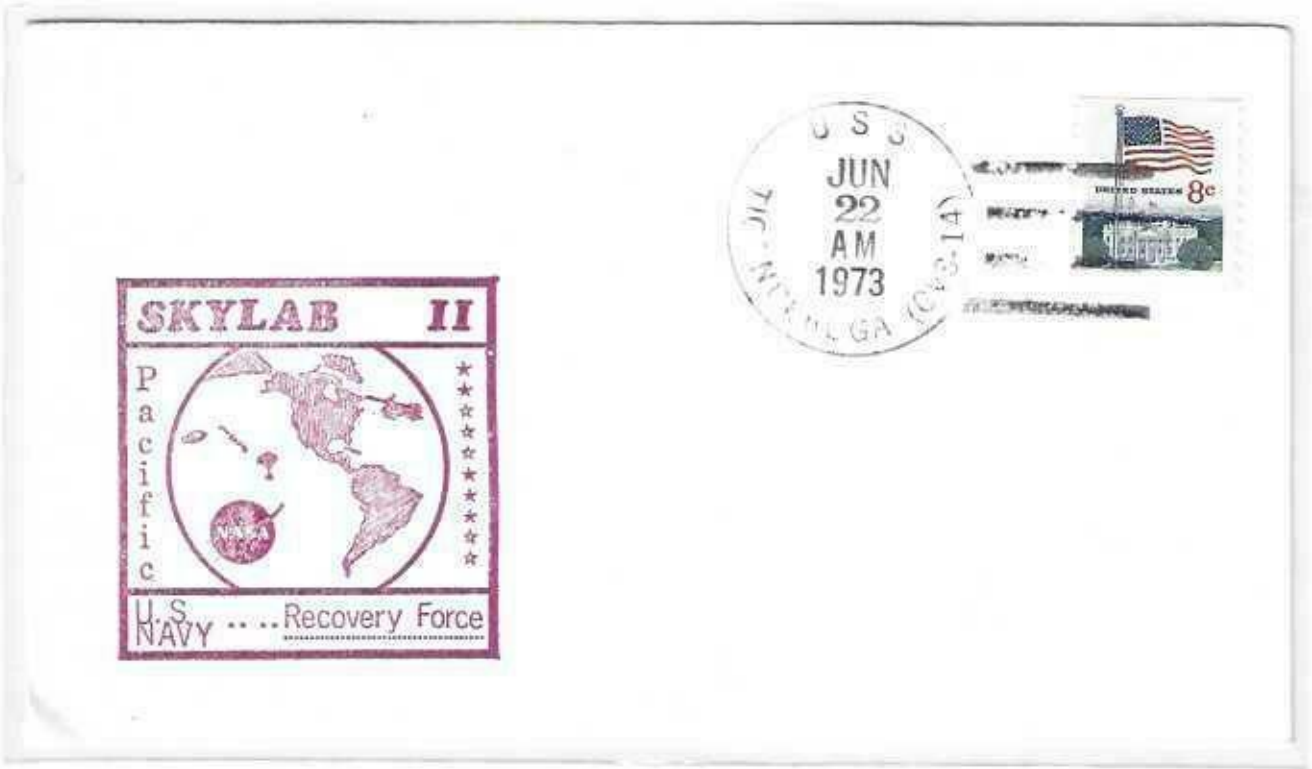
Skylab I (SL-2) mission. MAY 25, 1973. KSC machine cancel on the date and time of launch. The first crew, Skylab I, which was supposed to launch the next day, was delayed for 10 days while mission personnel devised a method to repair the crippled station. The mission was launched on a Saturn 1B rocket and carried three-person crew to the station: Charles Conrad, mission commander, Paul J. Weitz, pilot, Joseph Kerwin, scientist. They were the first space station occupants ever to return safety to Earth after the 1971 Soyuz 11 mission that had manned the Salyut 1 station for 24 days and killed during reentry. Disciplines: engineering, human crew, life science, microgravity, space physics.

Skylab I mission. MAY 25, 1973. Houston machine cancel on the date and time of launch. Without the shield, which was designed to also provide thermal protection, Skylab baked in the Sun and rising temperatures inside the workshop released toxic materials into the Station's atmosphere and endangered on-board film and food. Ground controllers purged the atmosphere with pure nitrogen four times before refilling it with the nitrogen/oxygen atmosphere for the crew.



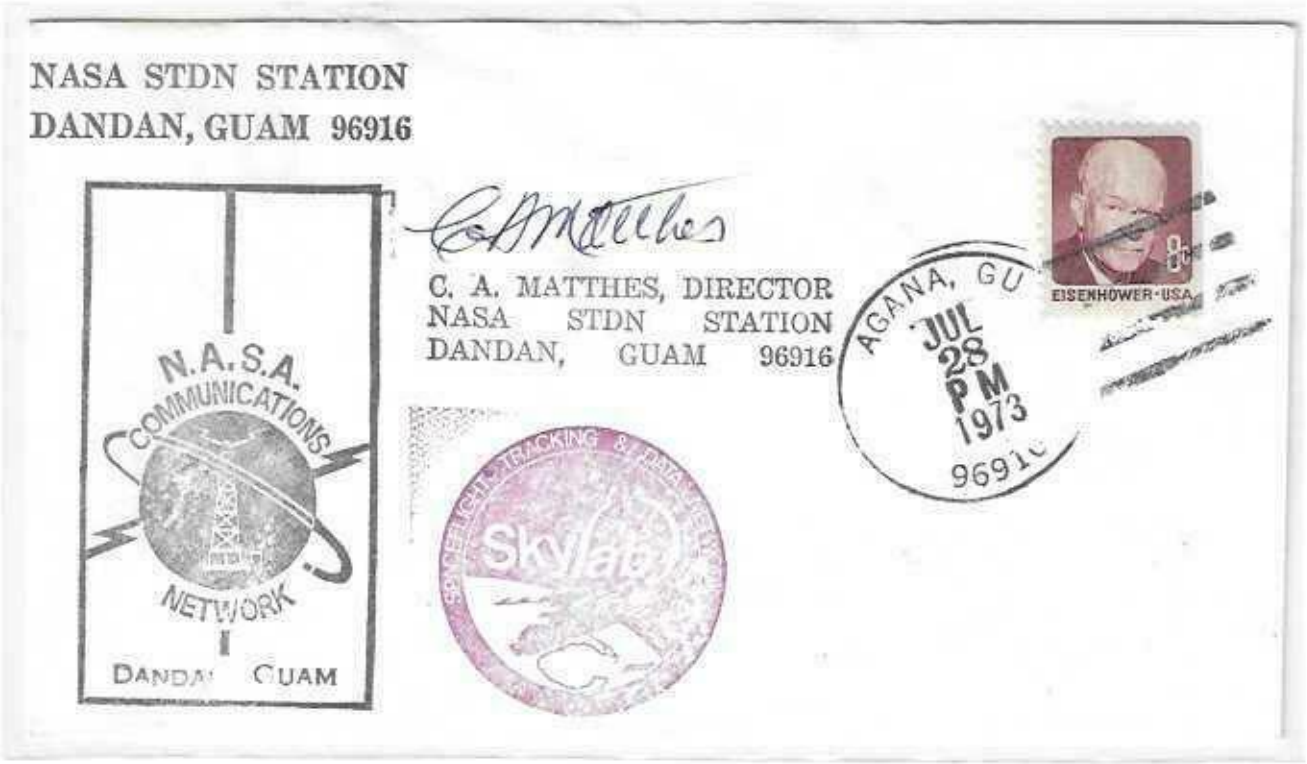
Skylab I mission. MAY 25, 1973. Canberra manual cancel on the date and time of launch. The crew's first priority was to fashion some kind of sushield. While staying in the more pleasant Apollo CM, they made a " parasol " out of foil to shield the Skylab from the sunlight, and the temperature dropped enough that they were able to enter. Two weeks later they performed a spacewalk and freed the damage solar panel, which finally gave the Station electrical power, and Skylab was in business. Y'know how hard it is to get an electrician here in the neighborhood ? Well, this crew started up with some heavy-duty do-it-yourself repairs to make on the Skylab that had been badly damaged during launch. For the remainder of their month-long stay, the astronauts performed other handyman cores, conducted many medical experiments and took over 29,000 pictures.

Skylab I mission. JUNE 22, 1973. Houston manual cancel on the date and time of reentry.



Skylab I mission. JUNE 22, 1973. Primary recovery ship USS Ticonderoga manual cancel on the date and time of recovery

Skylab II (SL-3) mission. JULY 28, 1973. KSC machine pictorial cancel on the date and time of launch. The flight carries the astronauts Alan Bean, mission commander, Jack Lousma, pilot, and Owen K. Garriott, scientist. Continued maintenance of the Space Station and extensive scientific and medical experiments. Completed 858 Earth orbits and 1,081 hours of solar and Earth experiments. The mission once again more than doubled the previous endurance record in space, just set by the astronauts of Skylab I, just a month earlier.



Skylab II mission. JULY 28, 1973. Agana Guam manual cancel on the date and time of launch. After an early bout with motion sickness, the crew settled down for their two-month mission, deployed a second Sun shield on a space walk lasting 6 hours, 30 minutes. They conducted many experiments, and brought with them live spiders to conduct a student-designed experiment to see what kinds of webs the spider would spin in weightlessness. The largest piece of scientific equipment was the ATM (Apollo Telescope Mount), which had its own solar panels for electricity generation and was used to make spectrographic analyses of the Sun without interference from Earth's atmosphere.

Skylab II mission. JULY 28, 1973. Houston manual cancel on the date and time of docking. Skylab weighed about 100 ton. and had a volume of 283.17 cubic meters, separated into two floors. The floors consisted of an open gridwork that fit cleats on the bottom of the astronauts' shoes. The upper floor contained storage lockers and a large empty space for conducting experiments, and two airlocks; the lower floor was divided into rooms including a dining room with a table, three bedrooms, a work area, a bath room and a shower.

Skylab II mission. SEPTEMBER 25, 1973. Houston manual cancel on the date and time of undocking. Also on this mission the astronauts finally got to test the AMU (Astronaut Maneuvering Unit) which had initially been carried into space aboard Gemini 9, but could not be tested then because of problems with the old Gemini space suit. The AMU experiments assisted engineers in designing the manned maneuvering unit which was first flown aboard the Shuttle flight STS-41B in February, 1984.

Skylab II mission. SEPTEMBER 25, 1973. Primary recovery ship USS New Orleans manual cancel on the date and time of recovery.

Skylab III mission. NOVEMBER 16, 1973. KSC machine cancel on the date and time of launch. The flight carries the astronauts Gerald Paul Carr, mission commander, William Pogue, pilot, and Edward G. Gibson, scientist. To help keep the crew in physical conditions, during their almost three months in orbit, they walked treadmills and rode an o-board stationary bicicle, and came home in far better conditions that had the previous Skylab crews. Among the thousands of experiments they conducted during this long flight, the astronauts took four spacewalks, including one on Christmas Day to observe the Comet Kohoutek.

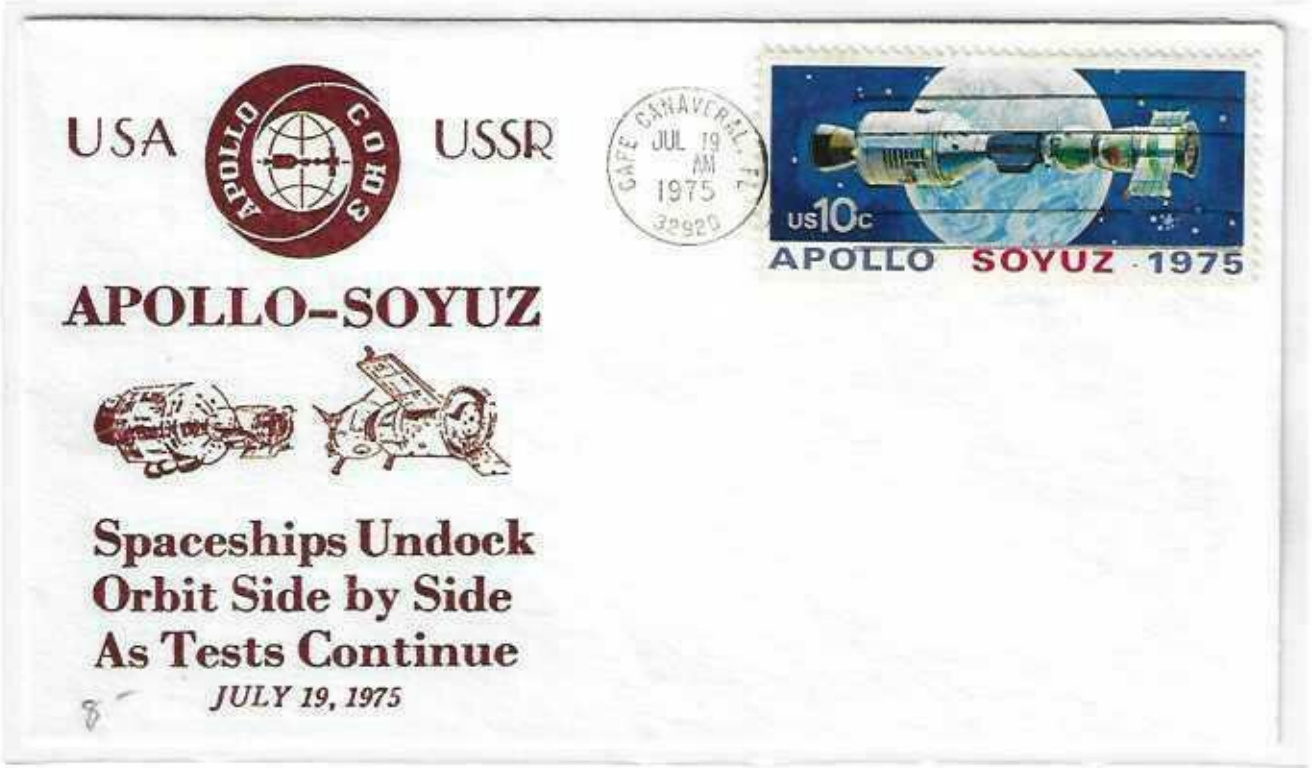
Skylab III mission. FEBRUARY 8, 1974. Norfolk manual and machine cancel on the date and time of recovery. In all, three crews were launched, each in turn setting a record for longest human space flight. The all-time american record, which stood until Norm Thagard broke it aboard MIR in 1995, was set by Skylab III at over 2,017 hours and 1,214 orbits of the Earth. The Skylab Program totalled 513 man-days in orbit.

5 Apollo-Soyuz test project (ASTP)

ASTP mission. JULY 15, 1975. KSC machine cancel on the date and time of Apollo launch. The existing american Apollo and soviet Soyuz spacecraft were used. The Apollo was nearly identical to the one that orbited the Moon and later carried astronauts to Skylab; the Soyuz was the primary soviet spacecraft used for manned flight since its introduction in 1967. A docking module was designed and constructed by NASA to serve as an airlock and transfer corridor between the two crafts. The Soyuz was launched just over 7 hours prior to the launch of the Apollo CSM.

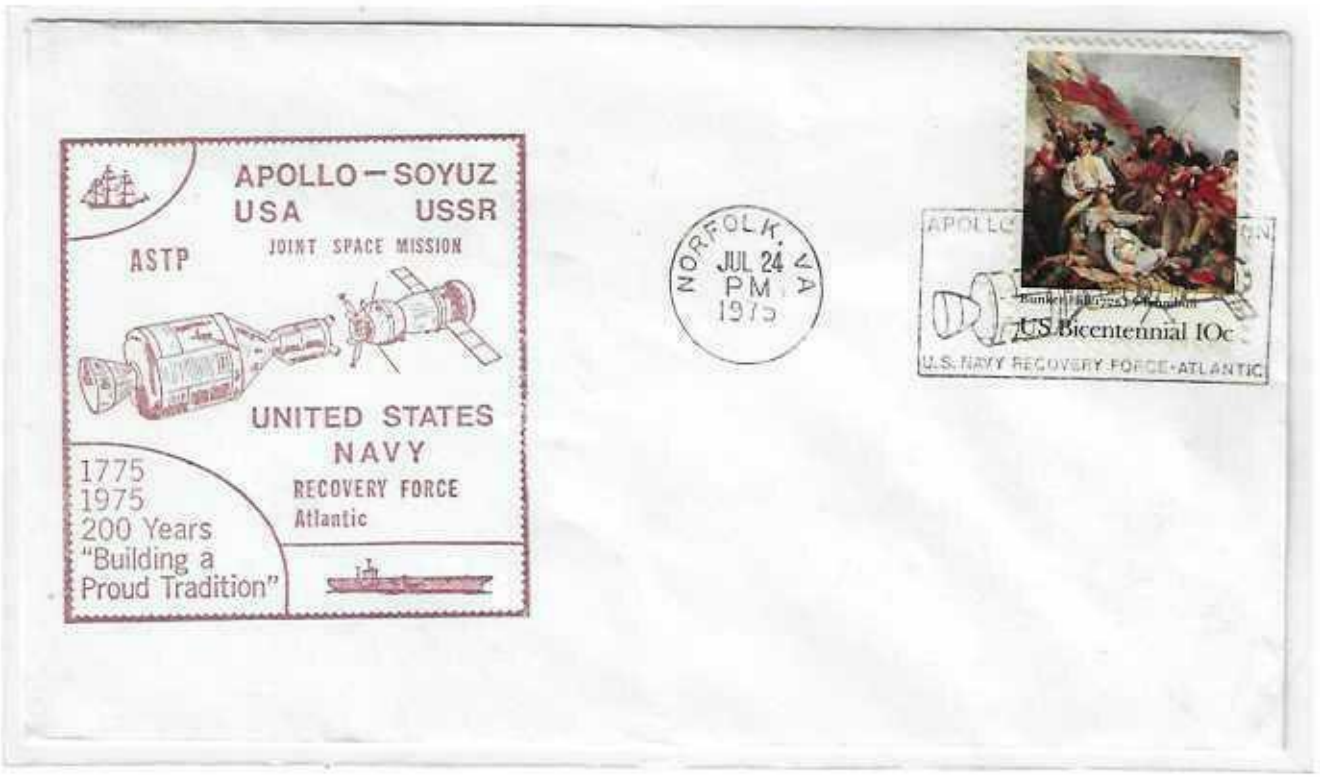
ASTP mission. JULY 15, 1975. St. John's (Newfoundland tracking station – Canada) machine cancel on the date and time of Apollo launch. While the flight itself lasted only 9 days, the planning for it stretched back to 1970. Mission commander Tom Stafford is on board the american spacecraft, flanked by astronauts Vance Brand and Deke Slayton.

ASTP mission. JULY 17, 1975. Madrid machine cancel on the date and time of docking, 52 hours after the Soyuz launch.



ASTP mission. JULY 19, 1975. Cape Canaveral machine cancel. Primary ASTP objectives were to evaluate the docking and undocking and determine the adequacy of the onboard orientation lights and docking target; the ability of astronauts and cosmonauts to make inter-vehicular crew transfer and the ability of spacecraft systems to support the transfer; the Apollo's capability of maintaining attitude-hold control of the docked vehicles and performing attitude maneuvers; measure quantitatively the effect of weightlessness on the crew's height and lower limb volume, according to lenght of exposure to zero-g; obtain relay and direct synchronous-satellite navigation tracking data to determine theyr accuracy for applications to Space Shuttle navigation system design. The objectives were successfully completed and the mission was adjudged successful on August 15, 1975.

ASTP mission. JULY 20, 1975. Patrick AFB manual cancel.

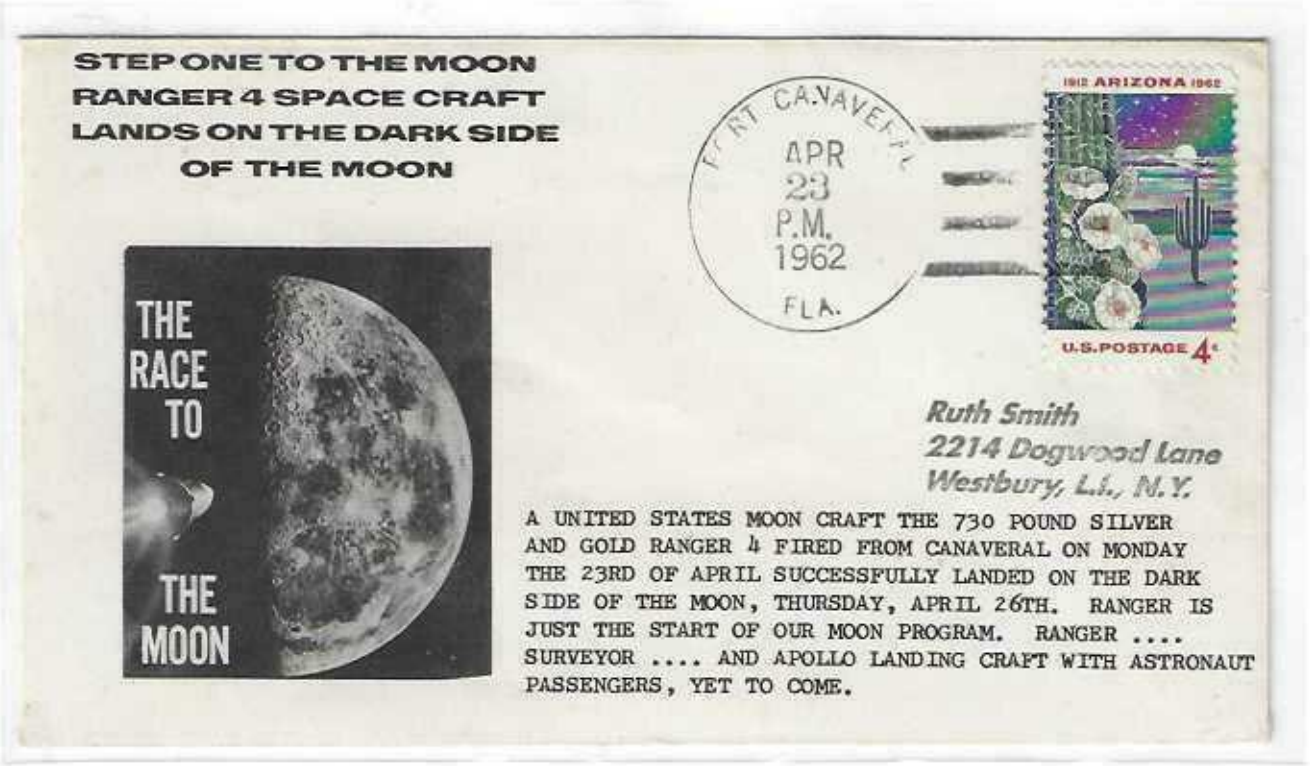


ASTP mission. JULY 24, 1975. Norfolk machine cancel on the date and time of recovery. After separation Apollo remained in space an additional 6 days; Soyuz returned to Earth approximately 43 hours after separation.

6 INTERPLANETARY SPACE PROBES

Pioneer 1 mission. OCTOBER 11, 1958. Port Canaveral manual cancel on the date and time of launch. Pioneer 1, the second and most successful of three Project Able space probes, and the first spacecraft launched by the newly formed NASA, was intended to study the ionizing radiation cosmic rays, magnetic fields and micrometeorites in the vicinity of the Earth, and in a lunar orbit. The spacecraft did not reach the Moon due to an incorrectly set valve in the upper stage. This resulted in a ballistic trajectory with a peak altitude of 113,800 km. Discipline: planetary science, space physics.

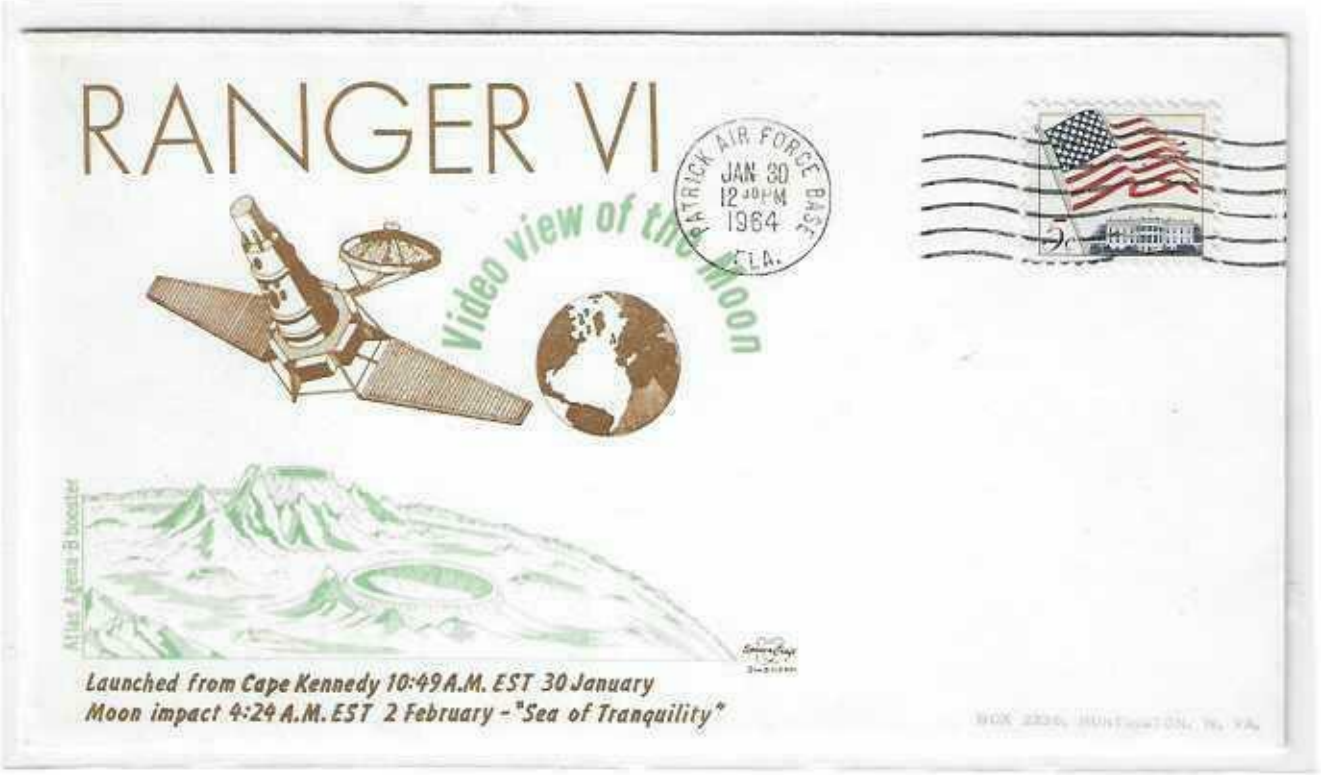
Ranger 3 mission. JANUARY 26, 1962. Patrick AFB machine cancel on the date and time of launch. The spacecraft was designed to continue testing for development of lunar and interplanetary spacecraft, to transmit pictures of the lunar surface during a period of 10 min. prior to impacting on the Moon. Because a malfunction in the booster guidance system, Ranger 3 missed the Moon by approssimately 36,000 km. Discipline: planetary science.



Ranger 4 mission. APRIL 23, 1962. Port Canaveral manual cancel on the date and time of launch. An onboard computer failure caused failure of the deployment of the solar panels and navigation systems. The spacecraft impacted on the far side of the Moon, without returning any scientific data, on April 26, after 64 hours of flight. Disciplines: planetary science, space physics.

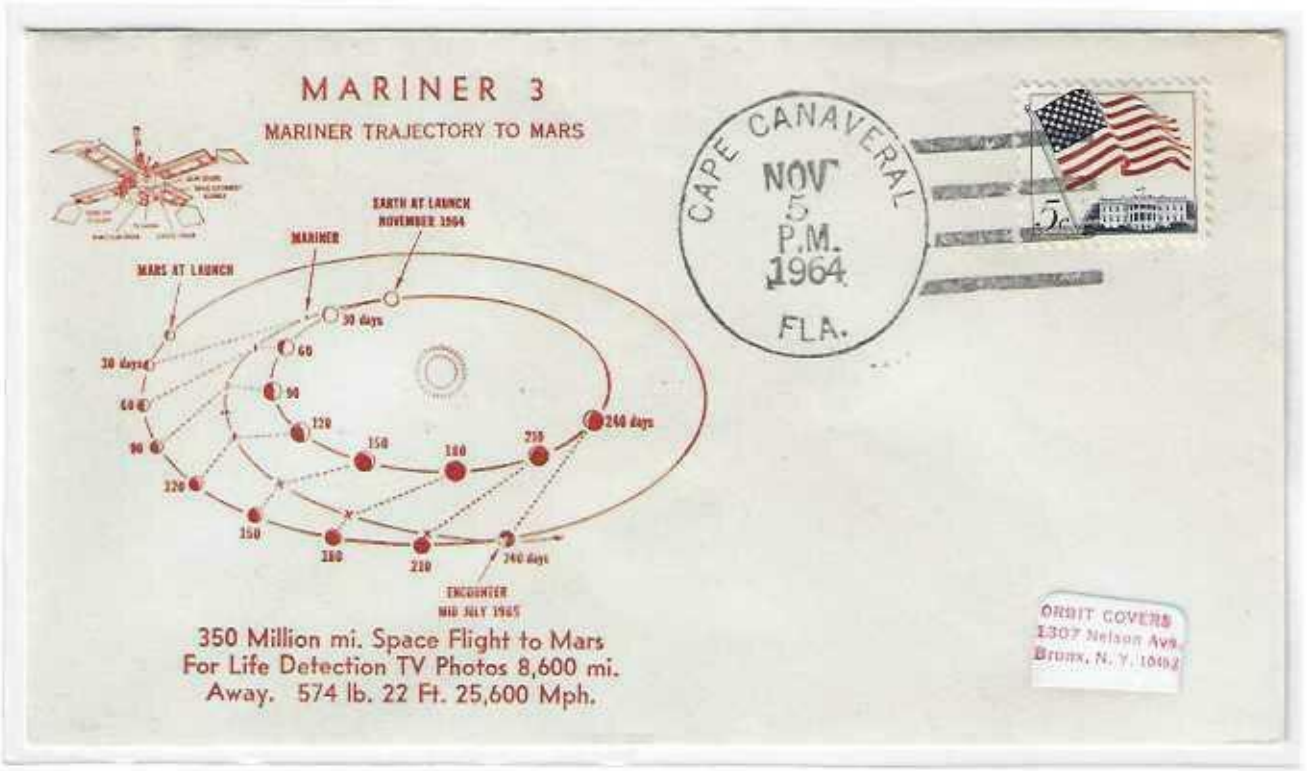
Mariner 2 mission. AUGUST 27, 1962. Port Canaveral manual cancel on the date and time of launch. It was the first spacecraft to successfully encounter another planet. It was a backup for the Mariner 1 mission which failed shortly after launch to Venus. The objective of the mission was to fly by Venus and return data on the planet's atmosphere, magnetic field, charged particle environment and mass. The spacecraft passed below the planet at its closest distance of 34,773 km on December 14, 1962. Disciplines: astronomy, planetary science, space physics.

Ranger 5 mission. OCTOBER 18, 1962. Cape Canaveral manual cancel on the date and time of launch. It was designed to transmit pictures of the lunar surface on Earth stations during a period of 10 min. of flight prior to impacting on the Moon, to rough-land a seismometer capsule, to collect gamma-ray data, to study radar reflectivity. After injection into lunar trajectory, the batteries ran down rendering the spacecraft inoperable. Ranger 5 missed the Moon by 725 km. Gamma-ray data were collected for 4 hours prior to the loss of power. Disciplines: astronomy, planetary science.

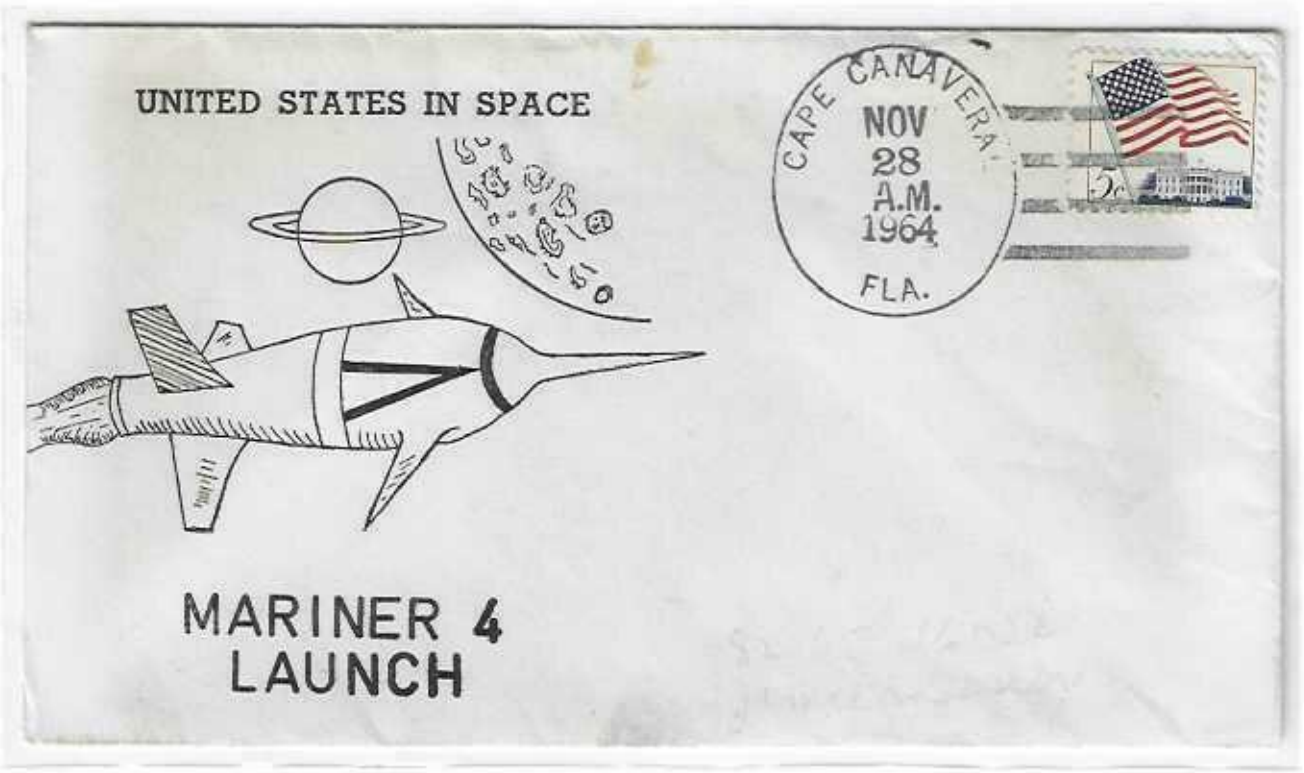


Ranger 6 mission. JANUARY 30, 1964. Patrick AFB machine cancel on the date and time of launch. The spacecraft carried six television vidicon cameras, two full-scan cameras and four partial scan cameras. A review board determined the most likely cause of failure was due to an arc-over in the TV power system when it inadvertently turned on for 67 sec. approximately 2 min. after launch, during the period of booster-engine separation. Discipline: planetary science.

Ranger 7 mission. JULY 28, 1964. Cape Canaveral machine cancel on the date and time of launch. The spacecraft reached the Moon on July 31. It impacted in an area between Mare Nubium and Oceanus Procellarum. The F-channel began its one minute warm up 18 min. before impact. Transmission of 4,308 photographs of excellent quality occurred over the final 17 min. of flight. Discipline: planetary science.



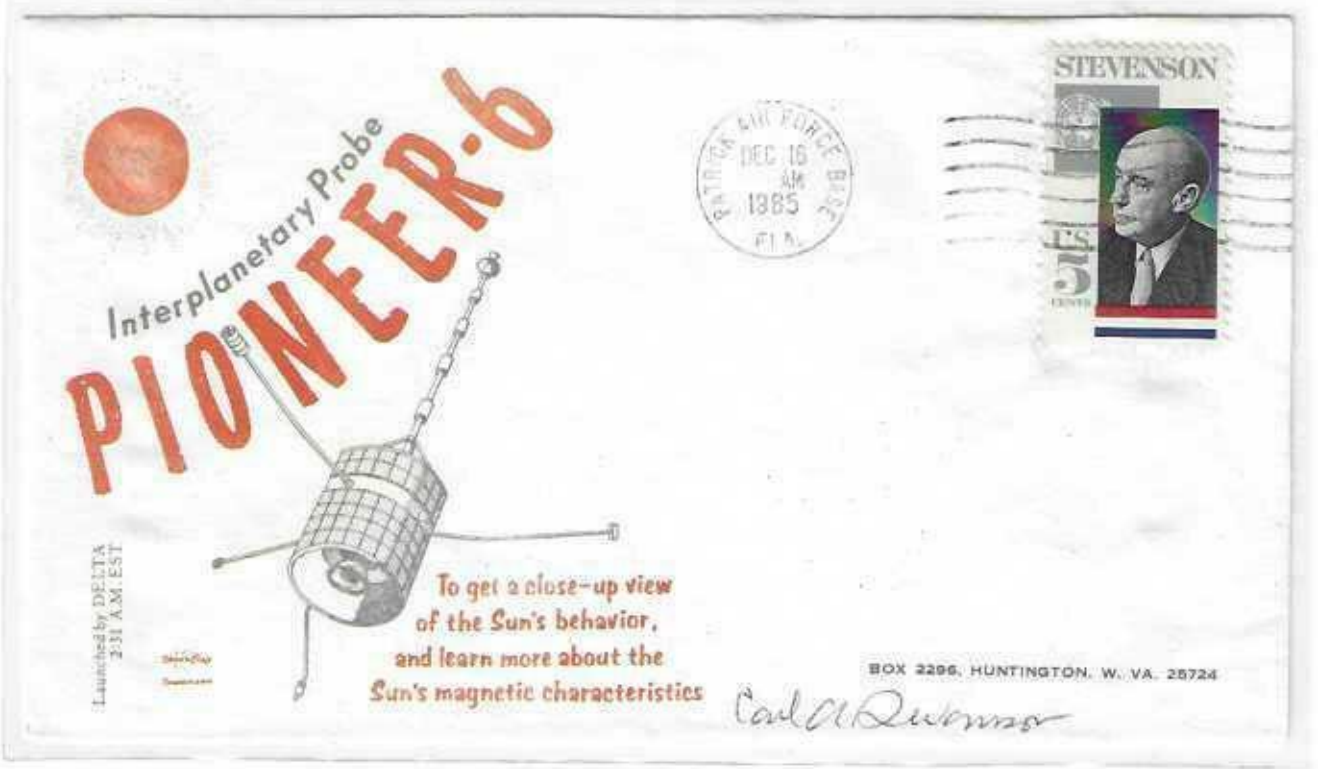
Mariner 3 mission. NOVEMBER 5, 1964. Cape Canaveral manual cancel on the date and time of launch. It was a 260 kg solar-cell and battery powered spacecraft designed to make scientific measurements in the vicinity of Mars and to obtain photographs of the planet's surface. A protective shield failed to eject after the spacecraft had passed through the atmosphere preventing the spacecraft from attaining its prescribed Mars trajectory. Disciplines: planetary science, space physics.



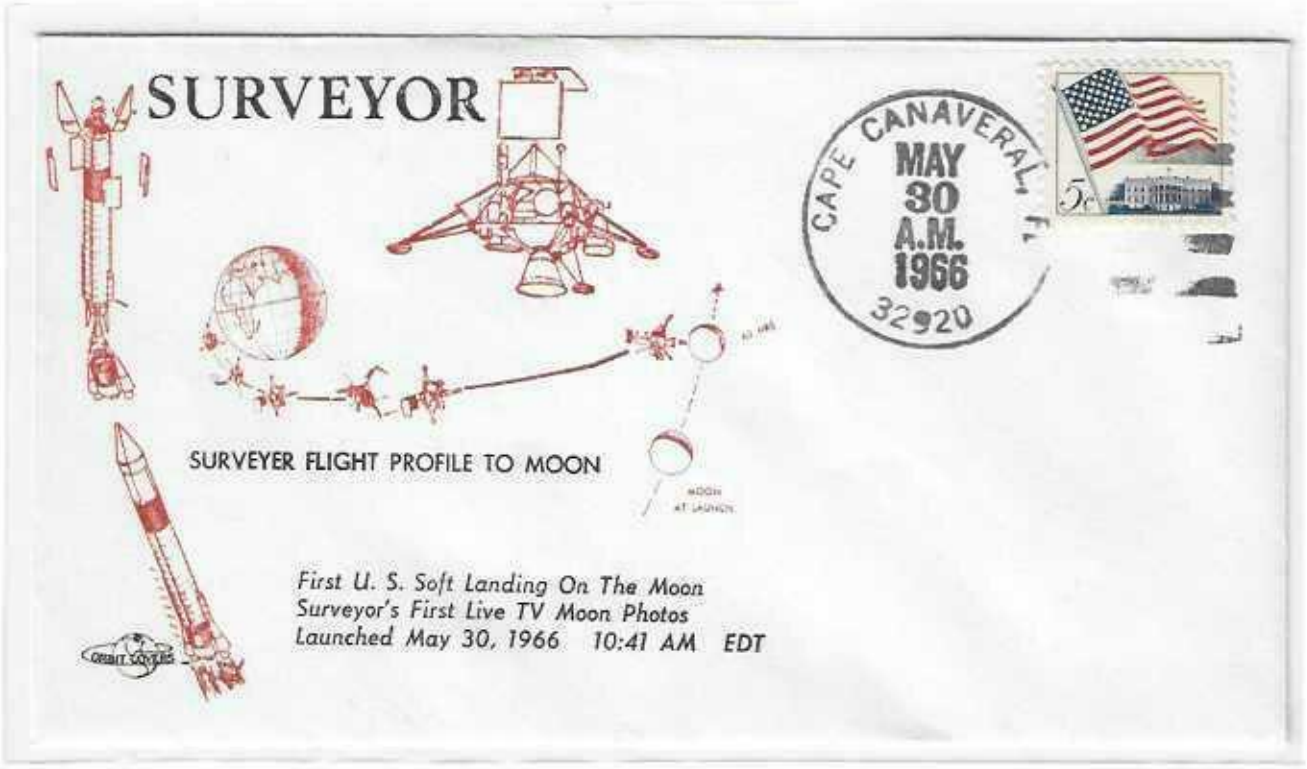
Mariner 4 mission. NOVEMBER 28, 1964. Cape Canaveral manual cancel on the date and time of launch. The mission represented the first successful flyby of Mars, returning the first pictures of the martian surface. The closest approach was 9,846 km from the planet on July 15, 1965. The images returned showed a Moon-like cratered terrain. A surface atmospheric pressure of 4.1 to 7.0 mb and daytime temperatures of -100 deg. C were estimated and no magnetic field was detected. Disciplines: astronomy, planetary science, solar physics, space physics.

Ranger 8 mission. FEBRUARY 17, 1965. Cape Canaveral manual cancel on the date and time of launch. On February 18, at a distance of 160,000 km from the Earth, the planned mid-course maneuver took place. Transmission of 7,137 photographs of good quality occurred over the final 23 min. of flight. The final image taken before impact has a resolution of 1.5 m. Discipline: planetary science.

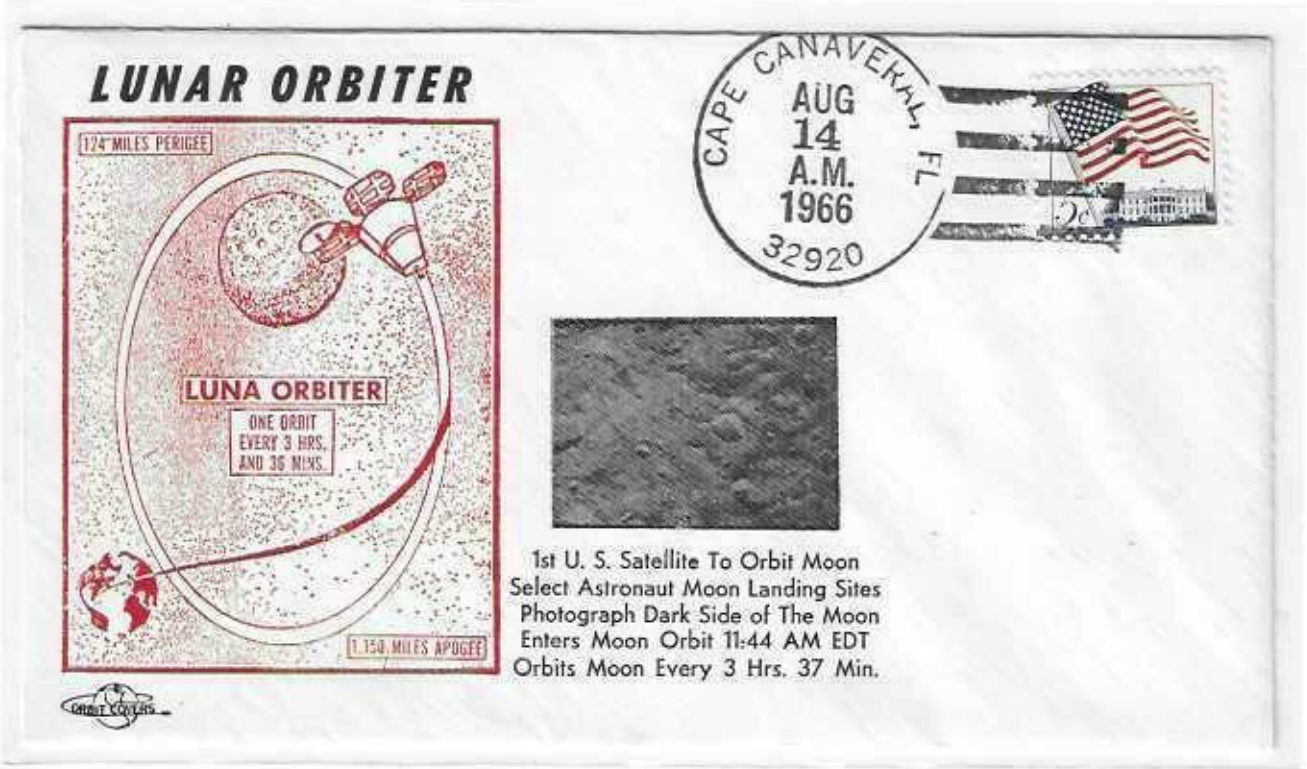
Ranger 9 mission. MARCH 21, 1965. Cape Canaveral manual cancel on the date and time of launch. The spacecraft reached the Moon on March 24. Impact occurred in the crater Alphonsus at a velocity of 2.67 km/sec. Its performance was excellent. Transmission of 5,814 good contrast photographs was made during the final 19 min. of flight. Real time television coverage with live network broadcasts of many of the F-channel images were provided for this flight. Discipline: planetary science.



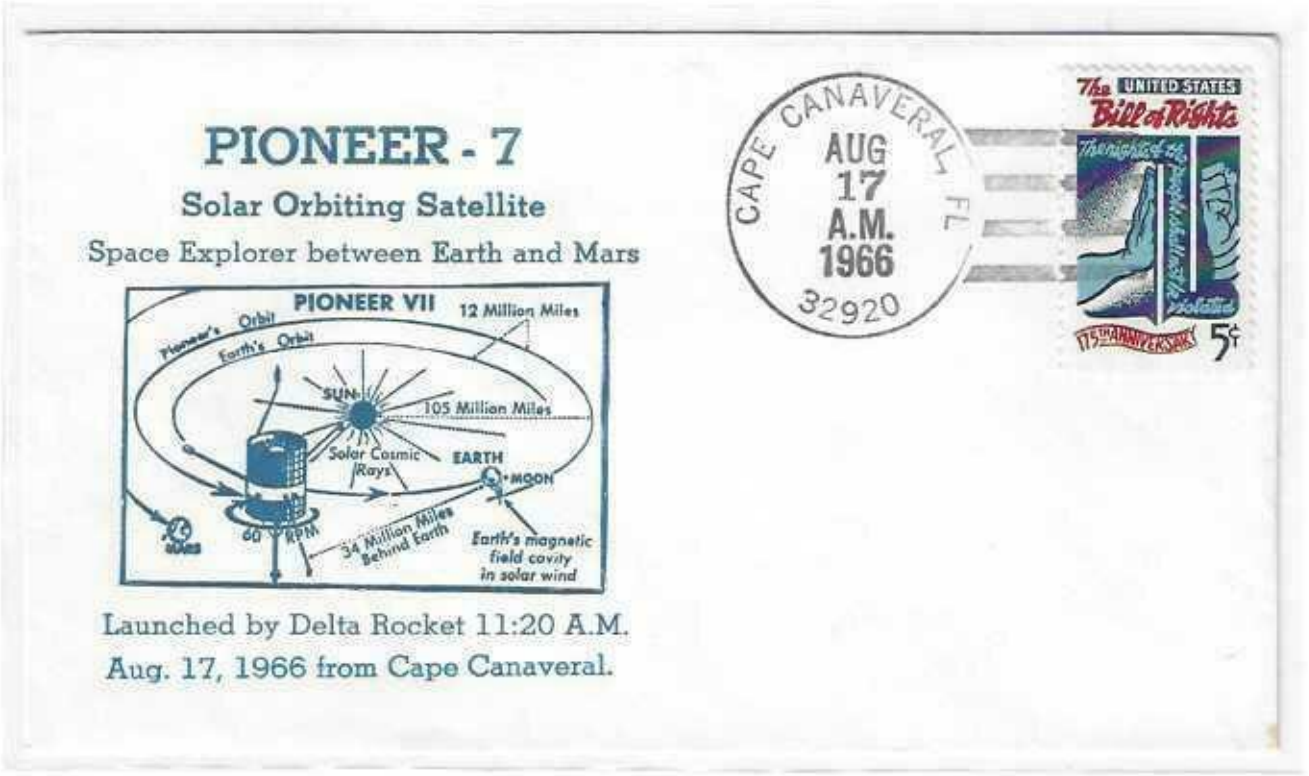
Pioneer 6 mission. DECEMBER 16, 1965. Patrick AFB machine cancel on the date and time of launch. It was the first in a series of solar-orbiting satellites designed to obtain measurements on a continuing basis of interplanetary phenomena from widely separated points in space. Its original design life expentancy was only 6 months. The Pioneer 6-9 program has been touted as one of the least expensive of all NASA spacecraft programs in terms of scientific results per US dollar spent. Disciplines: astronomy, planetary science, solar physics, space physics.



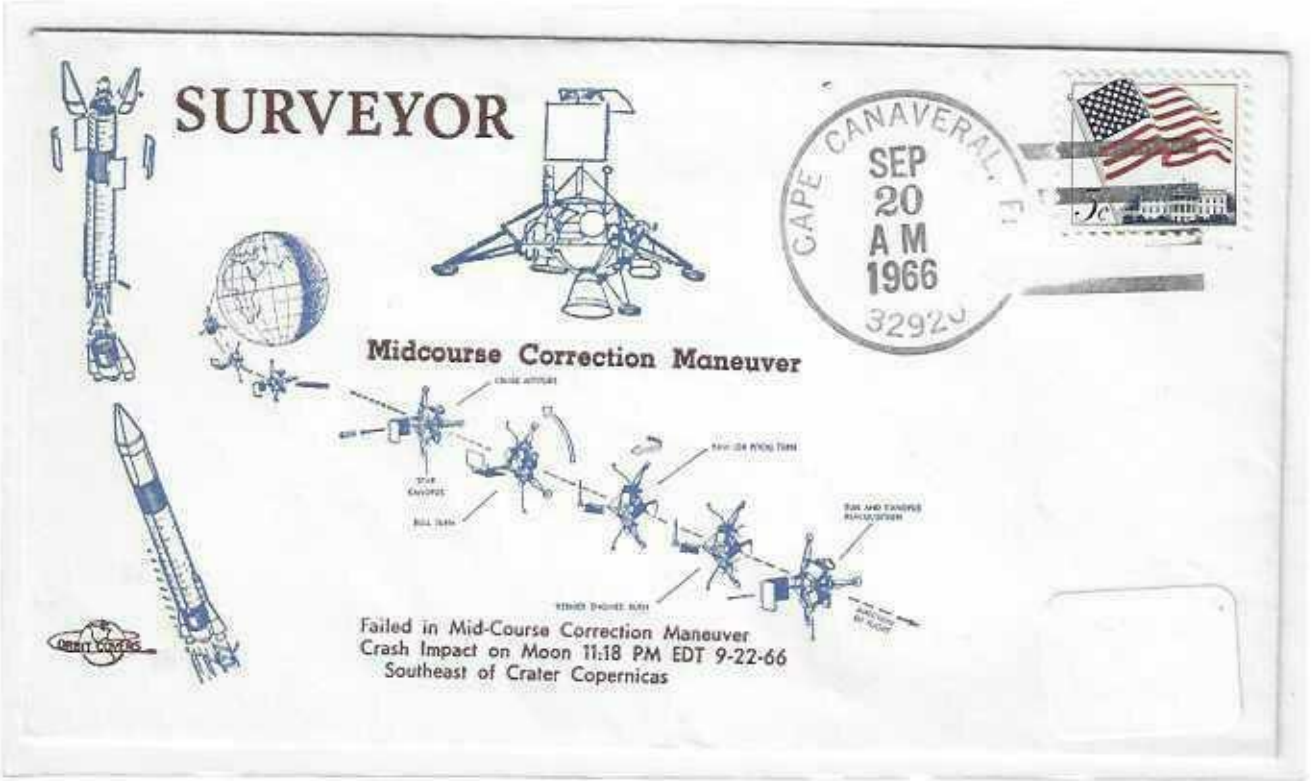
Surveyor 1 mission. MAY 30, 1966. Cape Canaveral manual cancel on the date and time of launch. It was launched on an Atlas Centaur rocket and, about 63 hours after launch, reached the Moon in southwest Oceanus Procellarum. The mission was considered a complete success and demonstrate the technology necessary to achieve landing and operation on the lunar surface. Photography session were performed and the television system transmitted pictures of the spacecraft footpad and surrounding lunar terrain and surface materials. Discipline: planetary science.



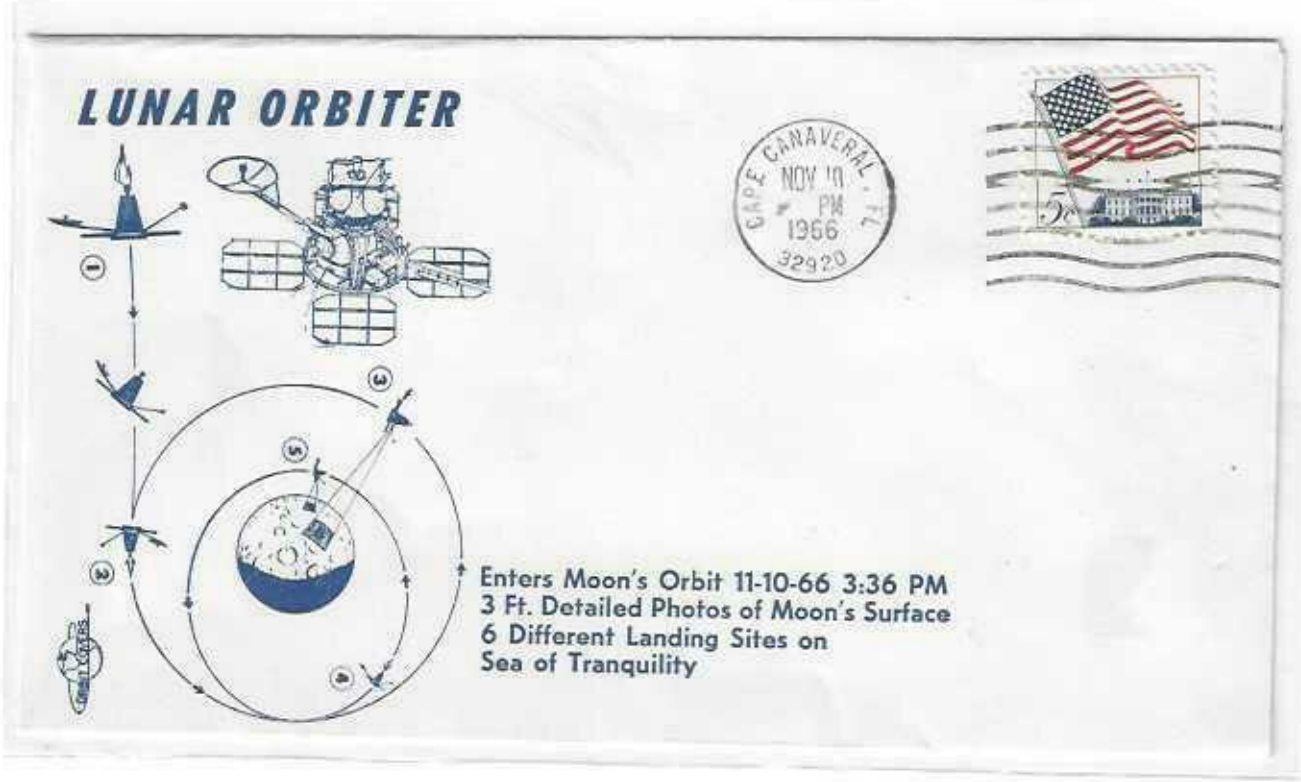
Lunar Orbiter 1 mission. AUGUST 14, 1966. Cape Canaveral manual cancel. Launched on August 10, 1966, it was injected into an elliptical near-equatorial lunar orbit, 92.1 hours after launch. The spacecraft was designed primarily to photograph smooth areas of the lunar surface for selection and verification of safe landing sites for the Surveyor and Apollo missions. During its mission the probe took 207 frames, covering an area of 5.18 million square km. Disciplines: planetary science, space physics.



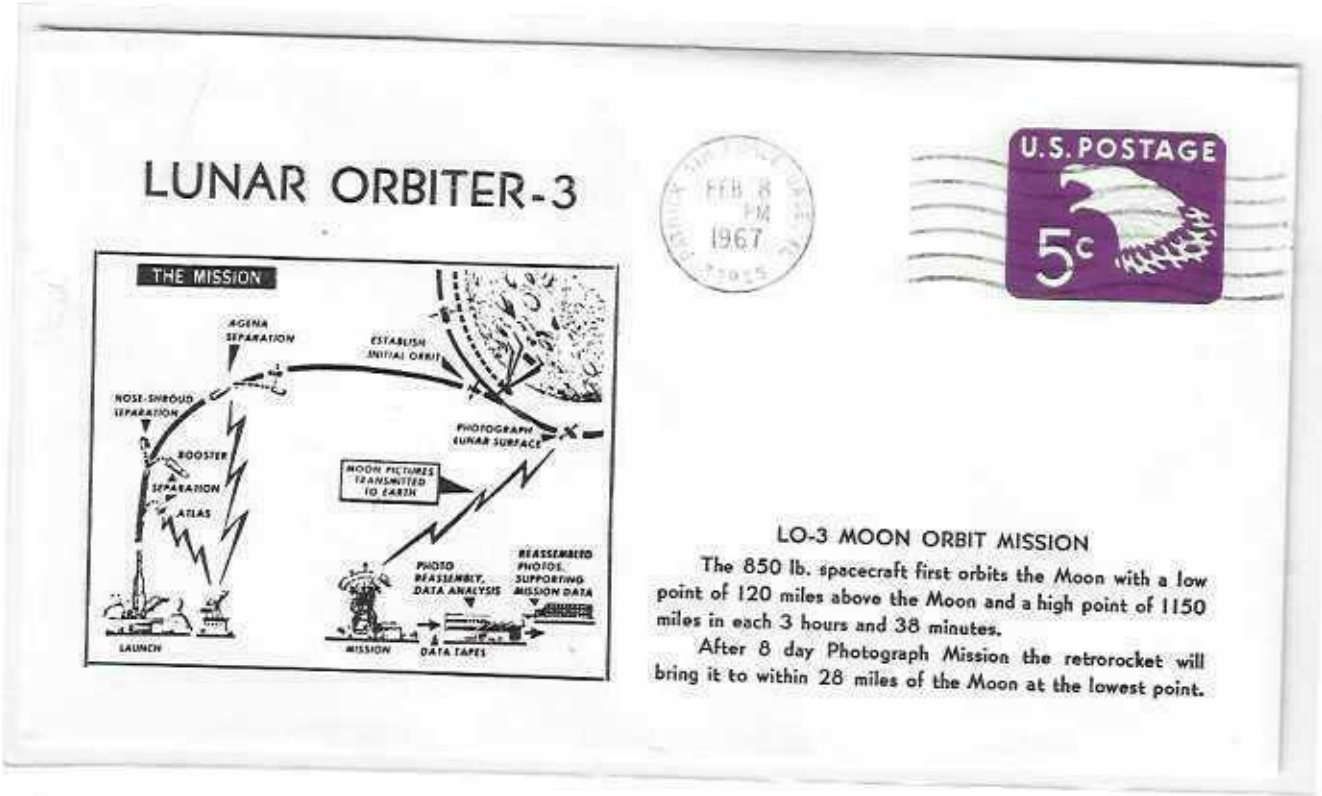
Pioneer 7 mission. AUGUST 17, 1966. Cape Canaveral manual cancel on the date and time of launch. The spacecraft carried experiments to study positive ions and electrons in the solar wind, the interplanetary electron density, solar and galactic cosmic rays and the interplanetary magnetic field. Pioneer 6-7-8 and 9 formed a ring of solar-weather stations. Pioneer 7 recorded Earth's magnetic tail more than 19 million km from planet, three times further than previously recorded. Disciplines: astronomy, planetary science, space physics.



Surveyor 2 mission. SEPTEMBER 20, 1966. Cape Canaveral manual cancel on the date and time of launch. The target area proposed was within Sinus Medii. During the midcourse maneuver one vernier engine failed to ignite causing the spacecraft to tumble. It impacted the Moon on September 23. Surveyor 2 was also equipped to return data on radar reflectivity of the lunar surface, bearing strenght of the lunar surface and spacecraft temperatures for use in the analysis of lunar surface temperatures. Discipline: planetary science.

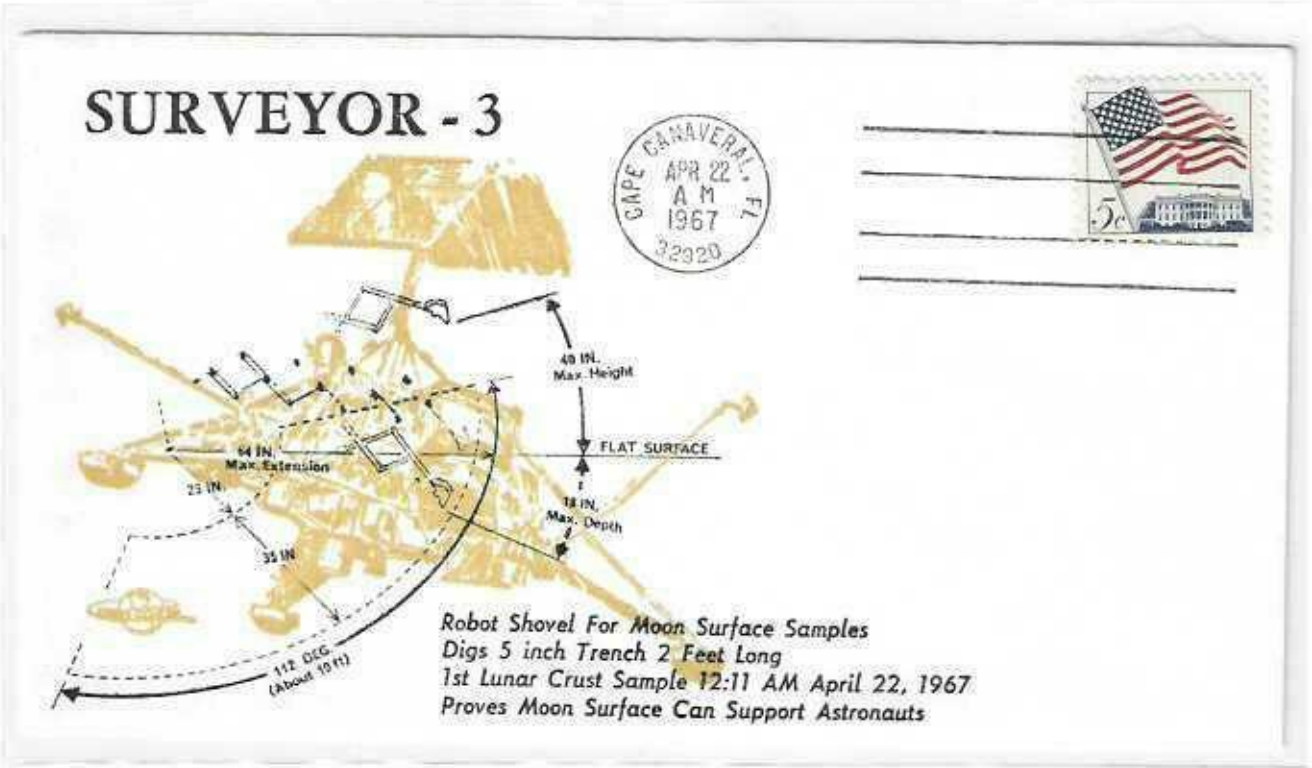


Lunar Orbiter 2 mission. NOVEMBER 10, 1966. Cape Canaveral machine cancel. Launched on November 6, 1966, the spacecraft was placed in a cislunar trajectory and injected into an elliptical near-equatorial lunar orbit for data acquisition after 92.5 hours flight time. The spacecraft was also equipped to collect selenodetic, radiation intensity and micrometeoroid impact data. On December 8, the orbit inclination was altered to provide new data on lunar gravity. The perilune was lowered to 49.7 km five days later, after 33 orbits. Disciplines: planetary science, space physics.

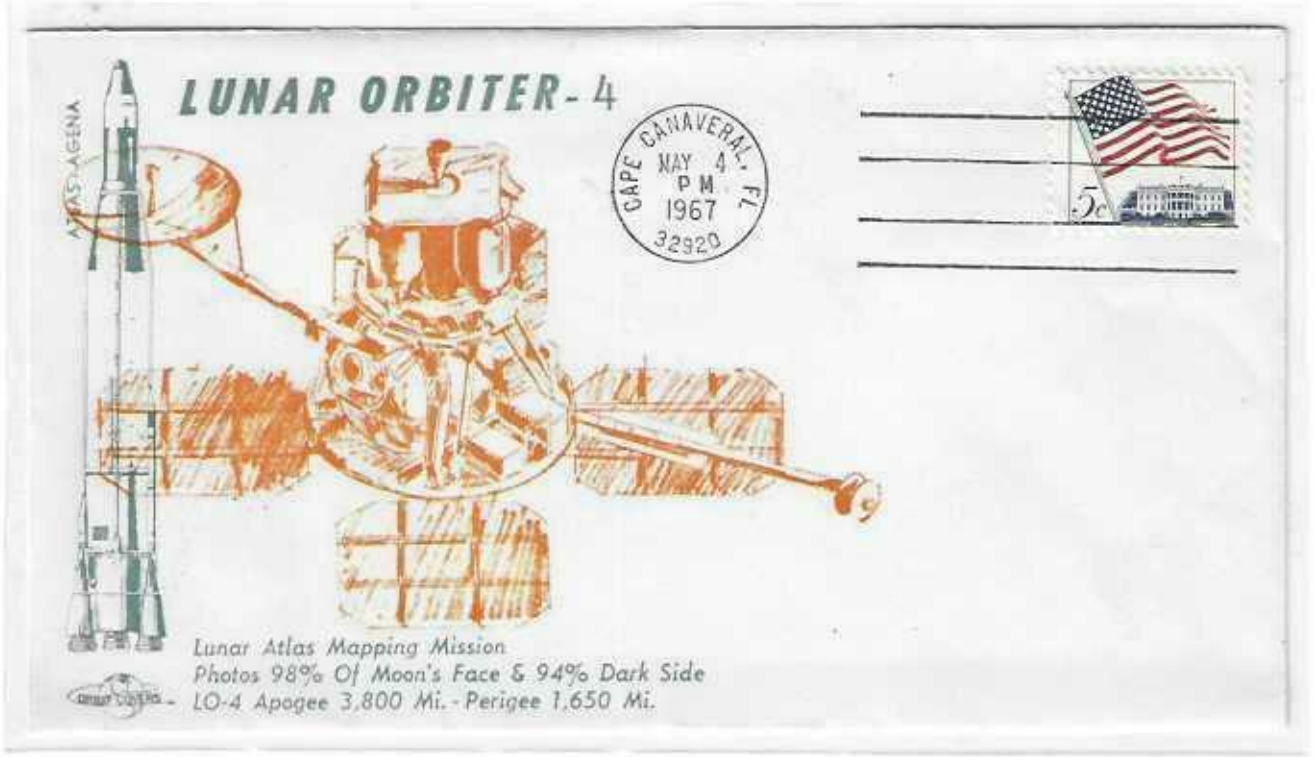


Lunar Orbiter 3 mission. FEBRUARY 8, 1967. Patrick AFB machine cancel. Launched on February 5, 1967 from Cape Canaveral, after 4 days, 25 orbits, of tracking the orbit was changed to 55 x 1,847 km. The spacecraft acquired photographic data from February 15 to 23. A total of 149 medium resolution and 477 high resolution frames were returned. Included was a frame of Surveyor 1 landing site, permetting identification of its location on the surface. The spacecraft was used for tracking purposes until it impacted the Moon on October 9, 1967. Disciplines: planetary science, space physics.

Lunar Orbiter 2 mission. JANUARY 18, 1967. Cape Canaveral machine cancel. The spacecraft acquired photograph data from November 18 to 25, 1967 and readout occurred through December 7. A total of 609 high resolution and 208 medium resolution frames were returned, most of excellent quality, with resolutions down to 1 meter. The spacecraft was used for tracking purpose until it impacted the lunar surface on October 11, 1967. Disciplines: planetary science, space physics.



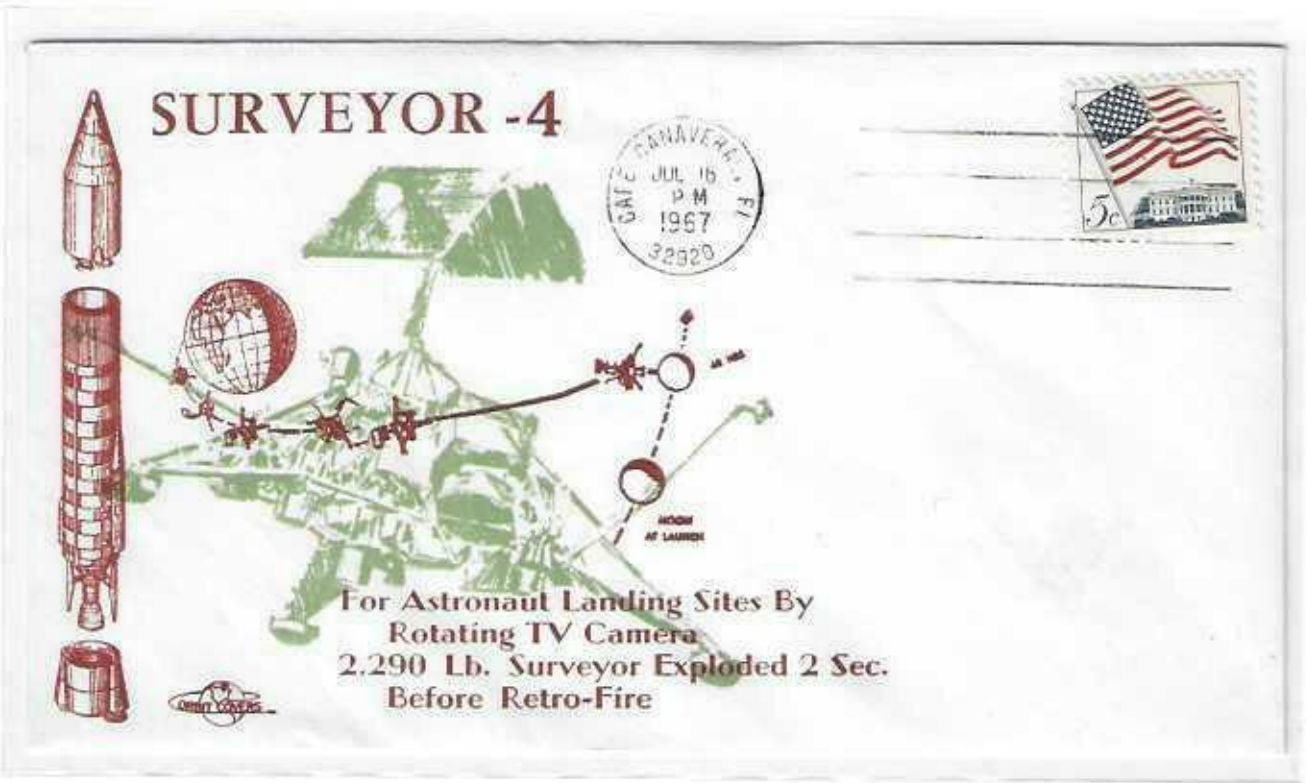
Surveyor 3 mission. APRIL 22, 1967. Cape Canaveral machine cancel. Launched on April 17 by an Atlas Centaur rocket, it most exciting experiment was the deployment of the Remote Scooper Arm which, via commands from Earth, dug four trenches and performed four bearing tests and thirteen impact tests based on these experiments, scientists concluded that lunar soil had consistency similar to wet sand, with a bearing strenght of 0.7 kg per square centimeter-solid enough for an Apollo Lunar Module. Last contact was made on May 4, 1967, two days after the lunar night began. Discipline: planetary science.



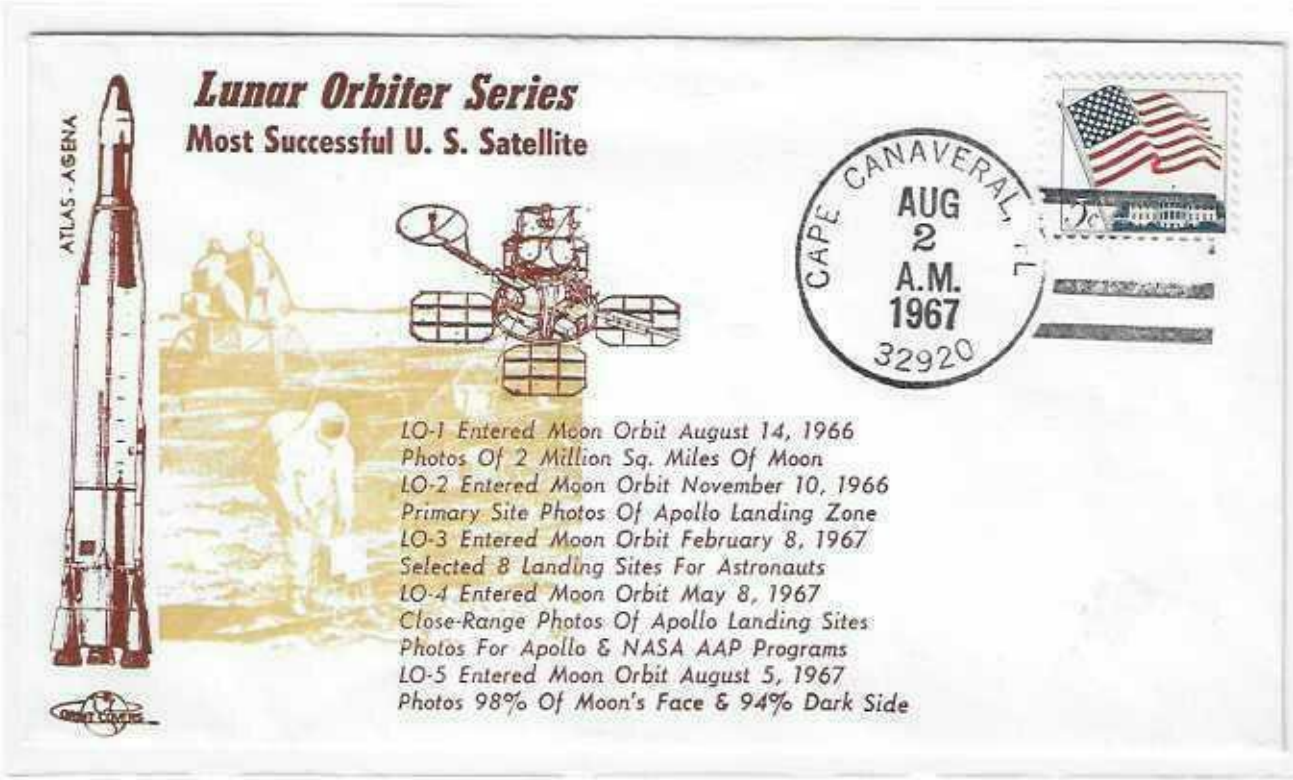
Lunar Orbiter 4 mission. MAY 4, 1967. Cape Canaveral machine cancel on the date and time of launch. The spacecraft was designed to take advantage of the fact that the three previous lunar orbiters had completed the required needs for Apollo mapping and site selection, increasing the scientific knowledge of their nature, origin and processes. Disciplines: planetary science, space physics.

Lunar Orbiter 4 mission. MAY 8, 1967. Cape Canaveral machine cancel. After initial photography, on May 11, problems with camera and readout drive mechanism resulted in a decision to terminate the photographic portion of the mission on May 26. A total of 419 high resolution and 127 medium resolution frames were acquired covering 99% of the Moon's near side at resolution from 58 to 134 meters. It impacted the lunar surface no later than October 31, 1967. Disciplines: planetary science, space physics.

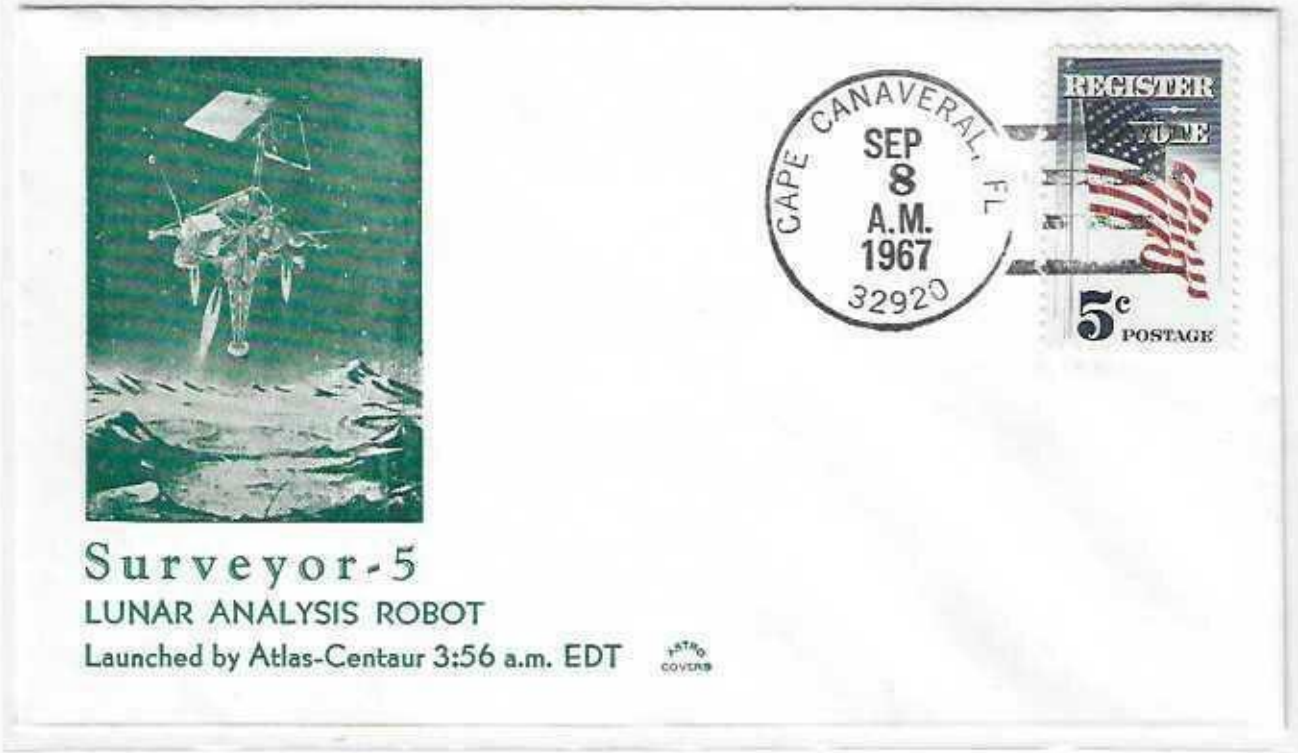
Mariner 5 mission. JUNE 14, 1967. Patrick AFB machine cancel on the date and time of launch. It was a refurbished backup spacecraft for the Mariner 4 mission and was converted from a Mars mission to a Venus mission. The project objectives were to pass within 2,000 km of Venus to provide data on the structure of the planet's atmosphere and its radiation and magnetic field environment. The spacecraft reached Venus on October 19, 1967, closest approach at 4,094 km, approximately 79.5 million km from Earth. Disciplines: astronomy, planetary science, space physics.



Surveyor 4 mission. JULY 16, 1967. Cape Canaveral machine cancel. Launched on July 14, 1967. Equipment onboard included a television camera and auxiliary mirrors, a soil mechanics surface sampler, strain gauges on the spacecraft landing legs and numerous engineering sensors. After a flawless flight to the Moon radio signals from the spacecraft ceased during the terminal descente phase on July 17, approximately 2.5 min. before touchdown. Discipline: planetary science.

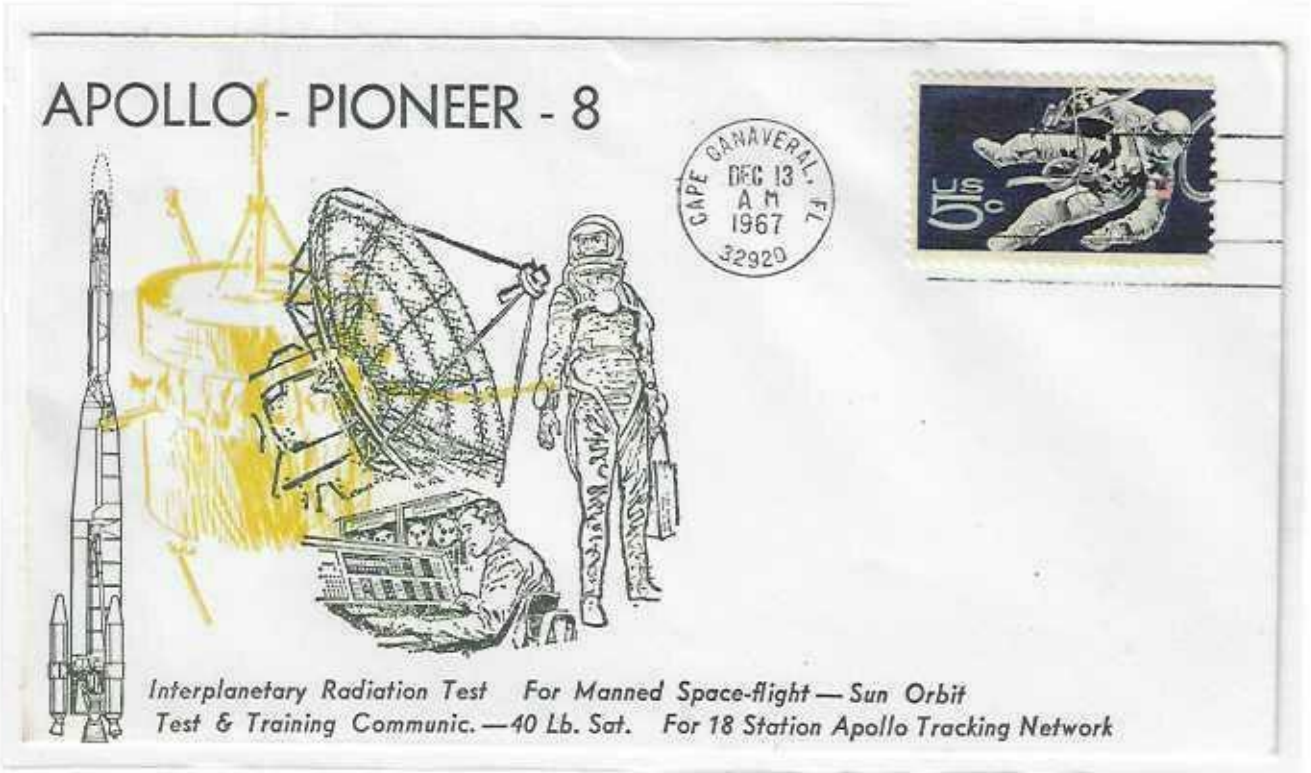


Lunar Orbiter 5 mission. AUGUST 2, 1967. Cape Canaveral manual cancel. Launched on August 1, the spacecraft entered into a terrestrial parking orbit. The last of the Lunar Orbiter series was designed to take additional Apollo and Surveyor landing site photographic and to take broad survey images of unphotographed parts of the Moon's far side. The spacecraft acquired photographic data from August 6 to 18, bringing the cumulative photographic coverage by the Lunar Orbiters to 99% of the lunar surface. Disciplines: planetary science, space physics.



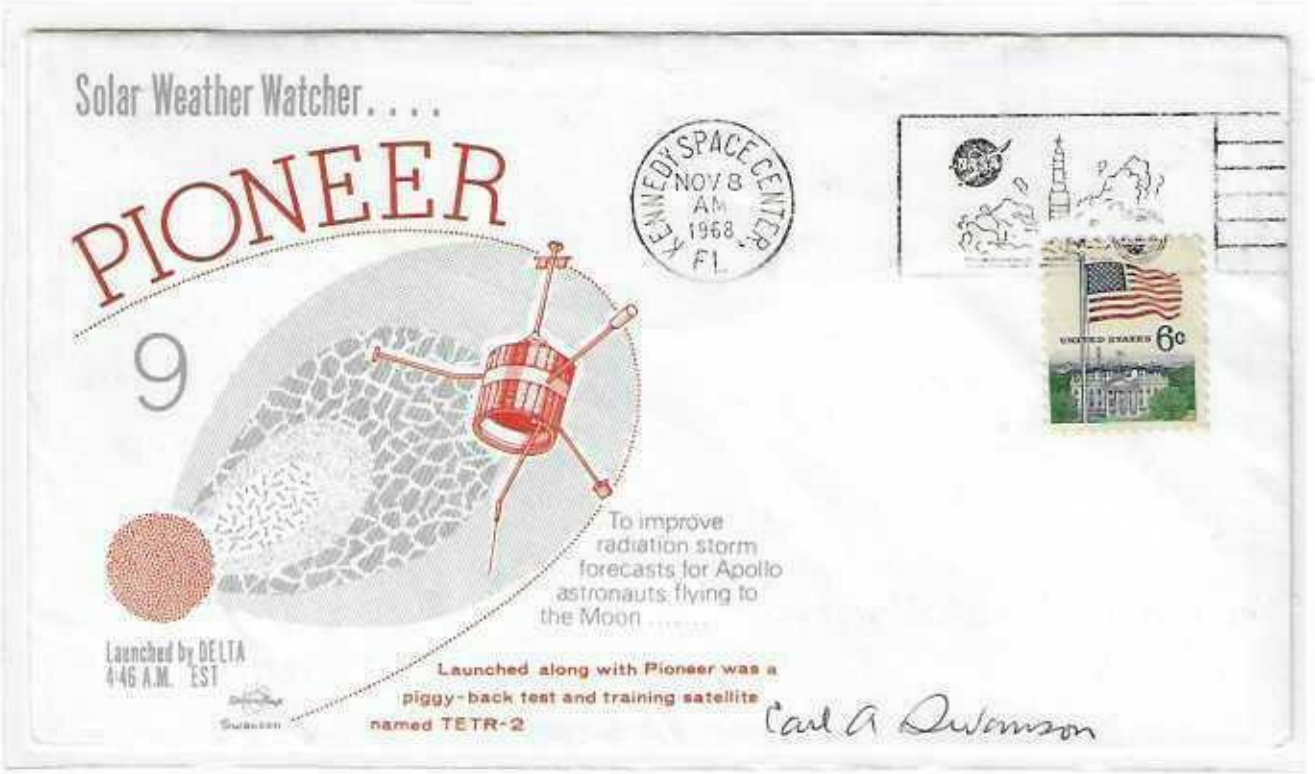
Surveyor 5 mission. SEPTEMBER 8, 1967. Cape Canaveral manual cancel on the date and time of launch. The specific objectives for this mission were to perform a soft landing on the Moon in Mare Tranquillitatis and obtain postlanding television pictures of the lunar surface, to conduct a vernier engine erosion experiment, determine the relative abundance of the chemical elements in the lunar soil by operation of the Alpha-Scattering Instrument, obtain touchdown dynamic data and obtain thermal and radar reflectivity data. Discipline: planetary science.

Surveyor 6 mission. NOVEMBER 7, 1967. Cape Canaveral machine cancel on the date and time of launch. On November 17 the vernier engines were fired for 2.5 sec. causing Surveyor to lift off the lunar surface 3 to 4 meters and land about 2.4 meters west of its original position. This lunar " hop " represented the first powered takeoff from the lunar surface and furnished new informations on the effects of firing rocket engines on the Moon. A total of 30,027 images were transmitted to Earth. Discipline: planetary science.

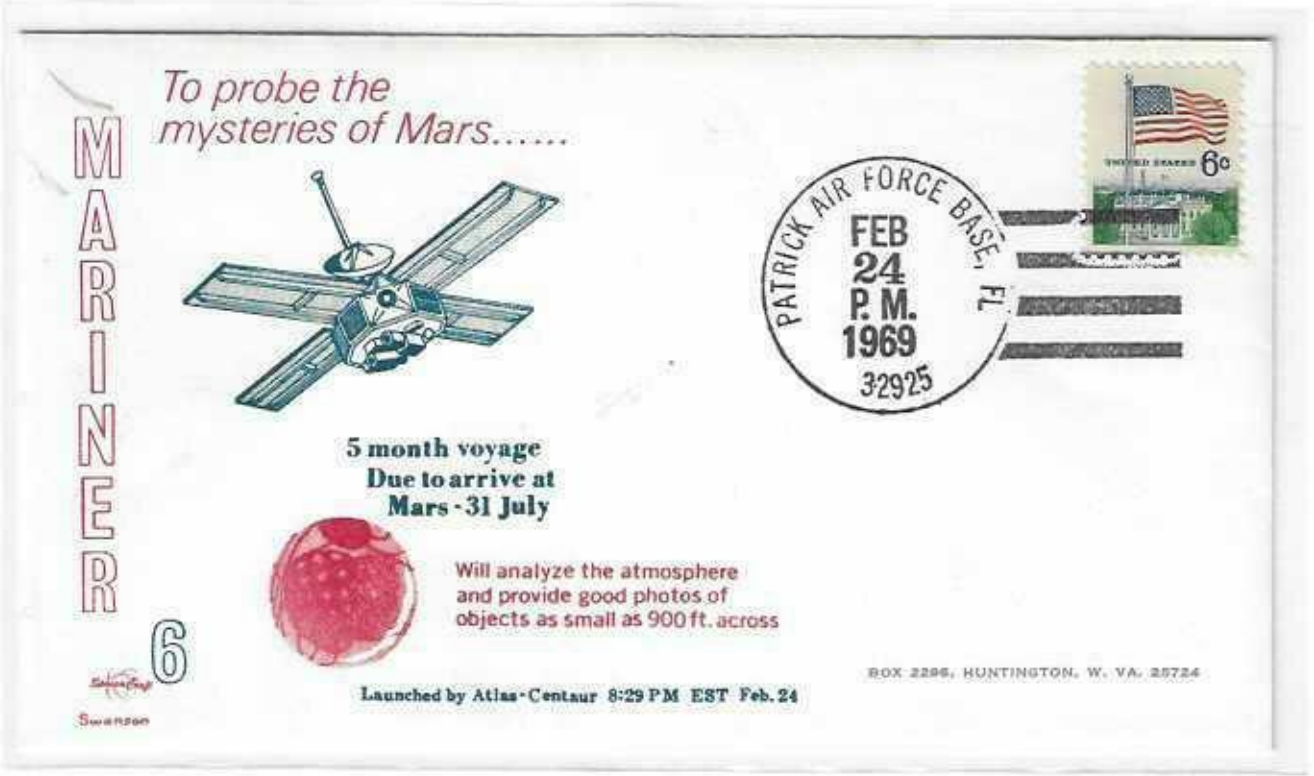


Pioneer 8 mission. DECEMBER 13, 1967. Cape Canaveral machine cancel on the date and time of launch. The spacecraft, launched into a heliocentric orbit, first crossed the geomagnetic tail at a downstream distance of 500-800 R (E) as it left the Earth-Moon system and, during a two-week period, centered on January 23, 1968, the magnetometer, plasma probe and plasma wave instrument all detected specific tail-related phenomena. Disciplines: astronomy, planetary science, space physics.

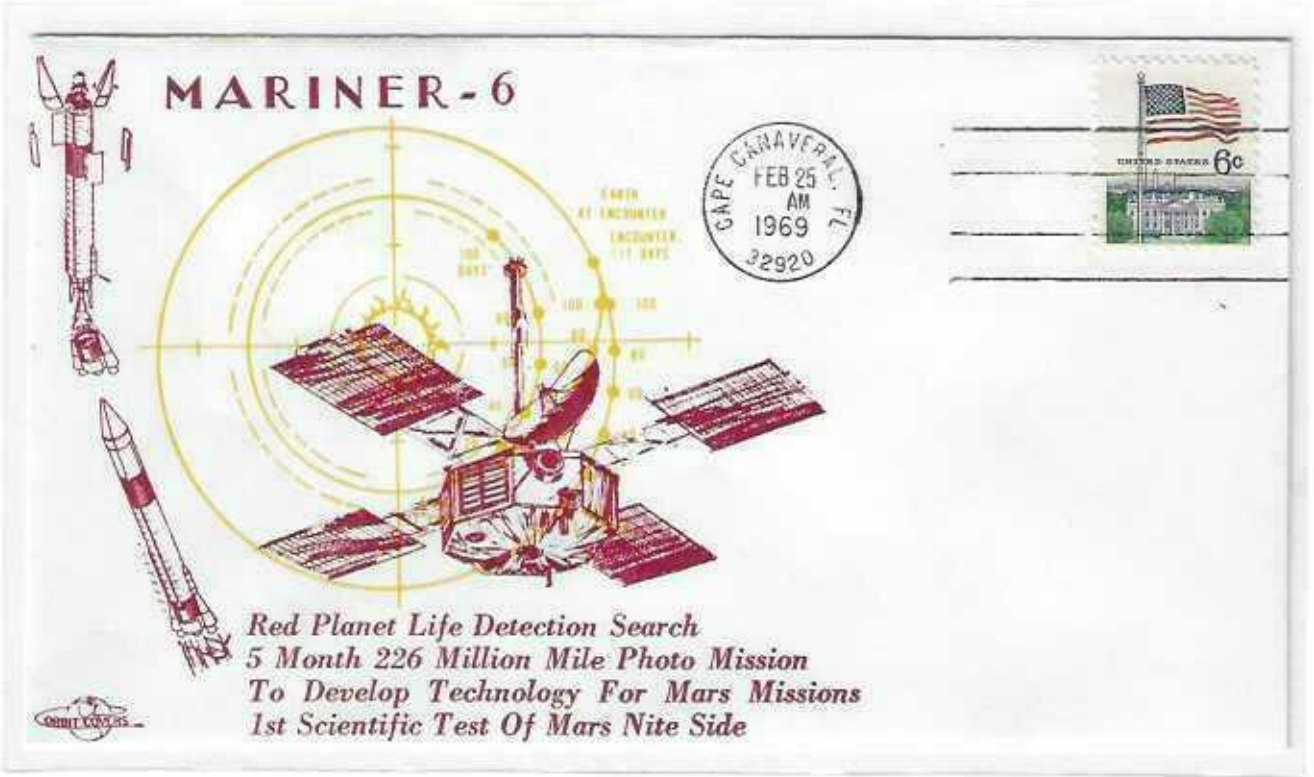
Surveyor 7 mission. JANUARY 7, 1968. Cape Canaveral manual cancel on the date and time of launch. It was the only Surveyor craft to land in the lunar highland region, near Tycho Crater. This spacecraft was similar in design to previous Surveyors, but it carried more scientific equipment, including a television camera. Of the auxiliary mirrors three were used to observe areas below the lander, one to provide stereoscopic views of the surface sampler area and seven to show lunar material deposited on the spacecraft. Discipline: planetary science.



Pioneer 9 mission. NOVEMBER 8, 1968. KSC machine cancel on the date and time of launch. The solar disturbances of August 1972 produced large-scale solar wind perturbations that were detected by Pioneer 9 plasma probe, electric field detector and magnetometer for an extended time period commencing early on August 3. It is demonstrate that no measurable signals were detected in the broad band electric field channel unless the proton density was high enough to yeld a proton plasma frequency with f greather of about 100 Hz. Disciplines: astronomy, planetary science, space physics.

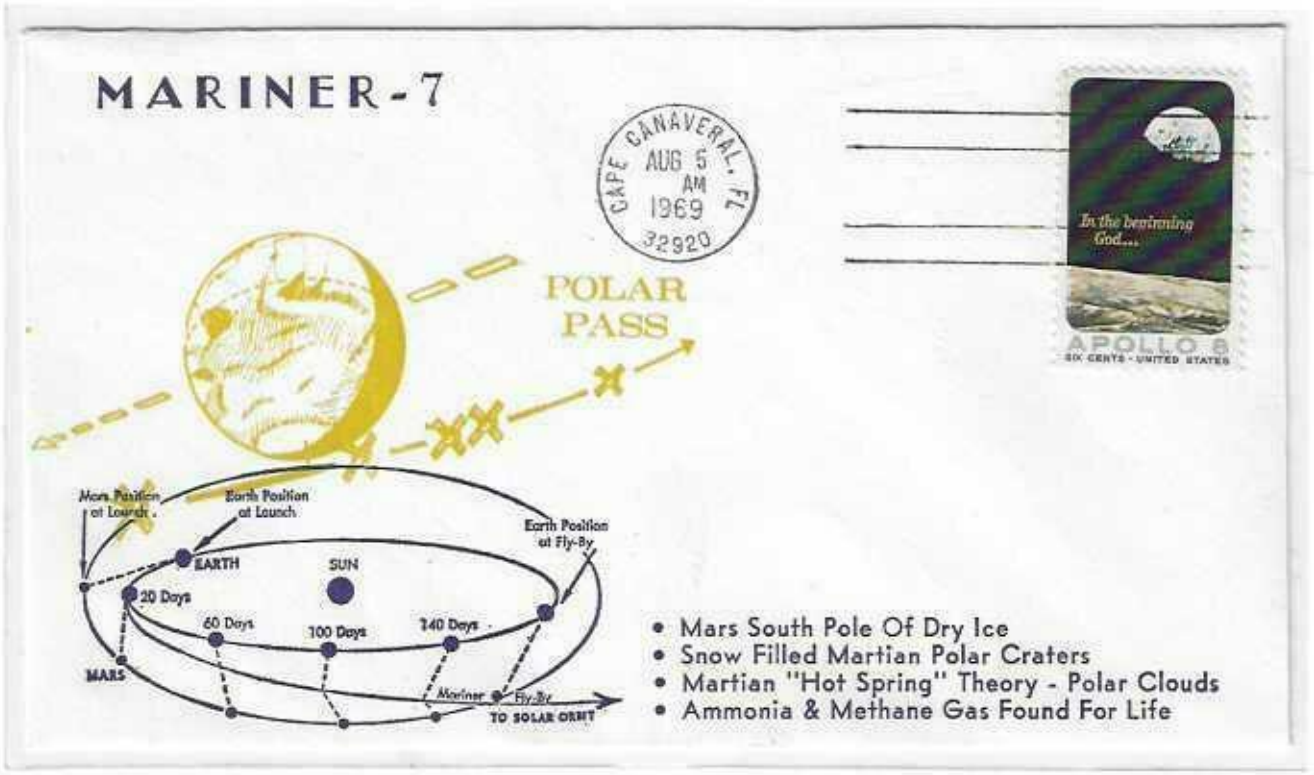


Mariner 6 mission. FEBRUARY 24, 1969. Patrick AFB manual cancel on the date and time of launch. The primary objective of the mission were to study the surface and atmosphere of Mars during close flybys to establish the basis for future investigations, particularly those relevant to the search for extraterrestrial life and to demonstrate and develop technologies required for future Mars missions and other long-duration missions far from the Sun. On July 31 the near-encounter phase began, including collection of 26 close-up images. Disciplines: astronomy, planetary science, solar physics.



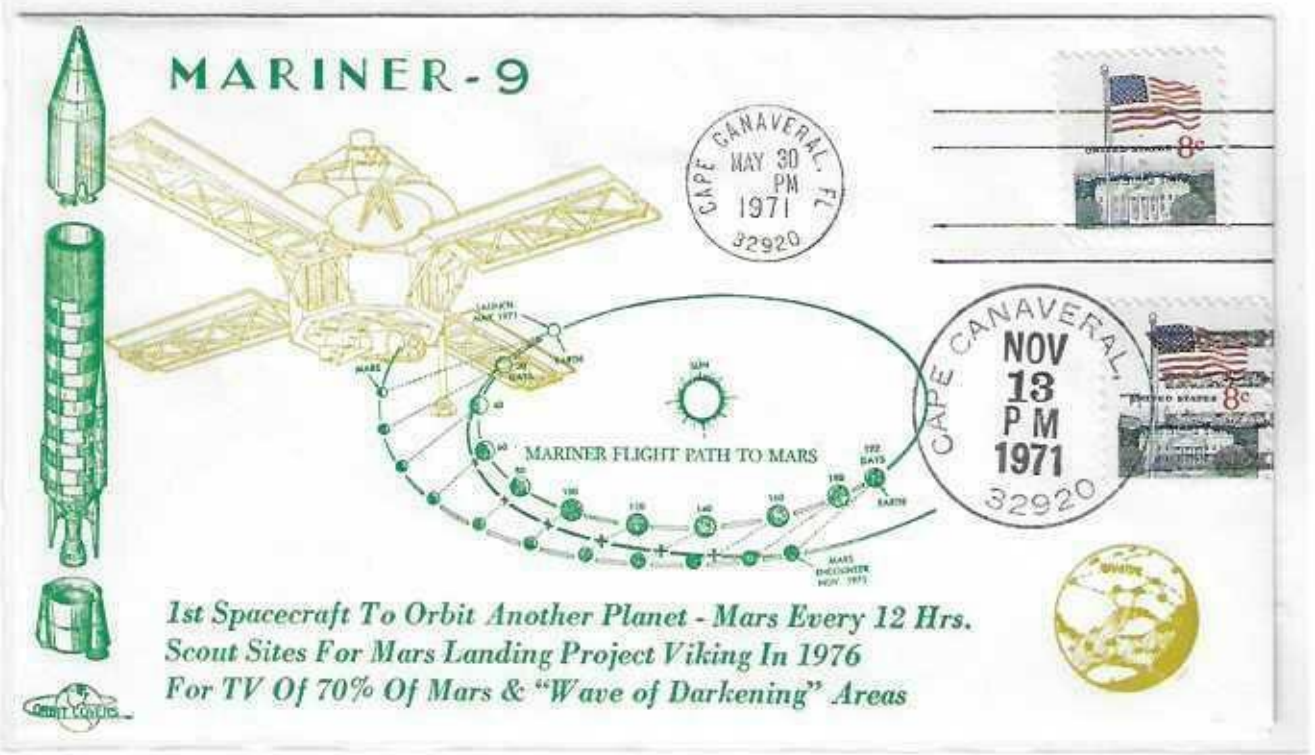
Mariner 6 mission. FEBRUARY 25, 1969. Cape Canaveral machine cancel. Closest approach occurred at a distance of 3,431 km from the martian surface. Science and imaging data were played back and transmitted over the next few days. Mariner 6 returned 49 far encounter and 26 near encounter images which showed the surface of Mars to be very different from that of the Moon. Disciplines: astronomy, planetary science, solar physics.

Mariner 7 mission. MARCH 27, 1969. Cape Canaveral machine cancel on the date and time of launch. Mariner 6 and 7 comprised a dual-spacecraft mission to Mars. On August 2, 1969 Mariner 7 began the far-encounter sequence, involving imaging of Mars with the narrow anglecamera. Over the next 57 hours, ending about 5 hours before closest approach, 93 images of Mars were taken and transmitted. Disciplines: astronomy, planetary science, solar physics.



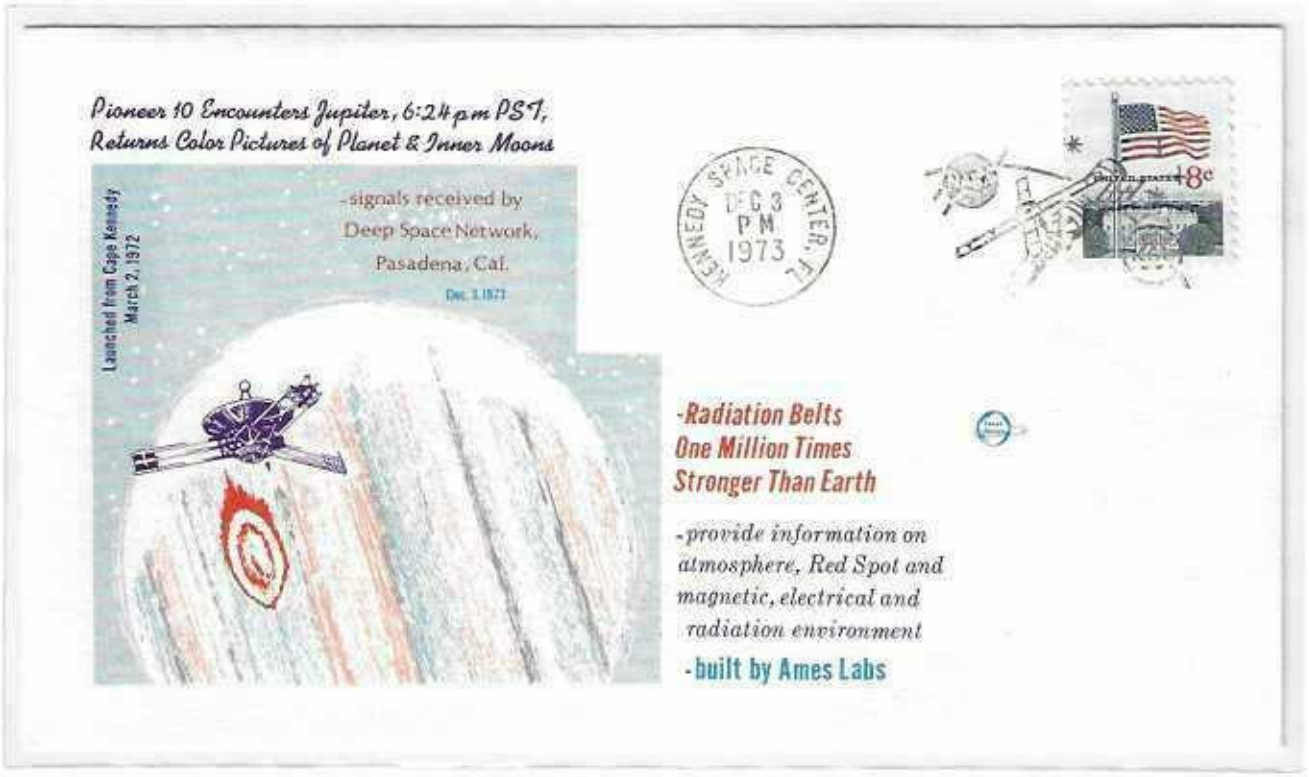
Mariner 7 mission. AUGUST 5, 1969. Cape Canaveral machine cancel. The closest approach occurred 3,430 km above the martian surface. Over this period 33 near-encounter images were taken. Science and images data were played back and transmitted over the next few days. The total data return for Mariner 6 and 7 was 800 millions bits. Mariner 7 returned 93 far and 33 near encounter images. Close-ups from the near encounter phases covered 20% of the surface.

Mariner 8 mission. MAY 10, 1971. KSC machine cancel. Launched on May 9, 1971, The Mariner Mars 71 Project consisted of two spacecraft, Mariner 8 and 9, each of which would be inserted into a martian orbit and each of which would perform a separate but complementary mission. The two spacecraft would have orbited the planet Mars a minimum 90 days during which time data would be gathered on the composition, density, pressure, temperature and topographic of the surface. Disciplines: astronomy, planetary science, space physics.

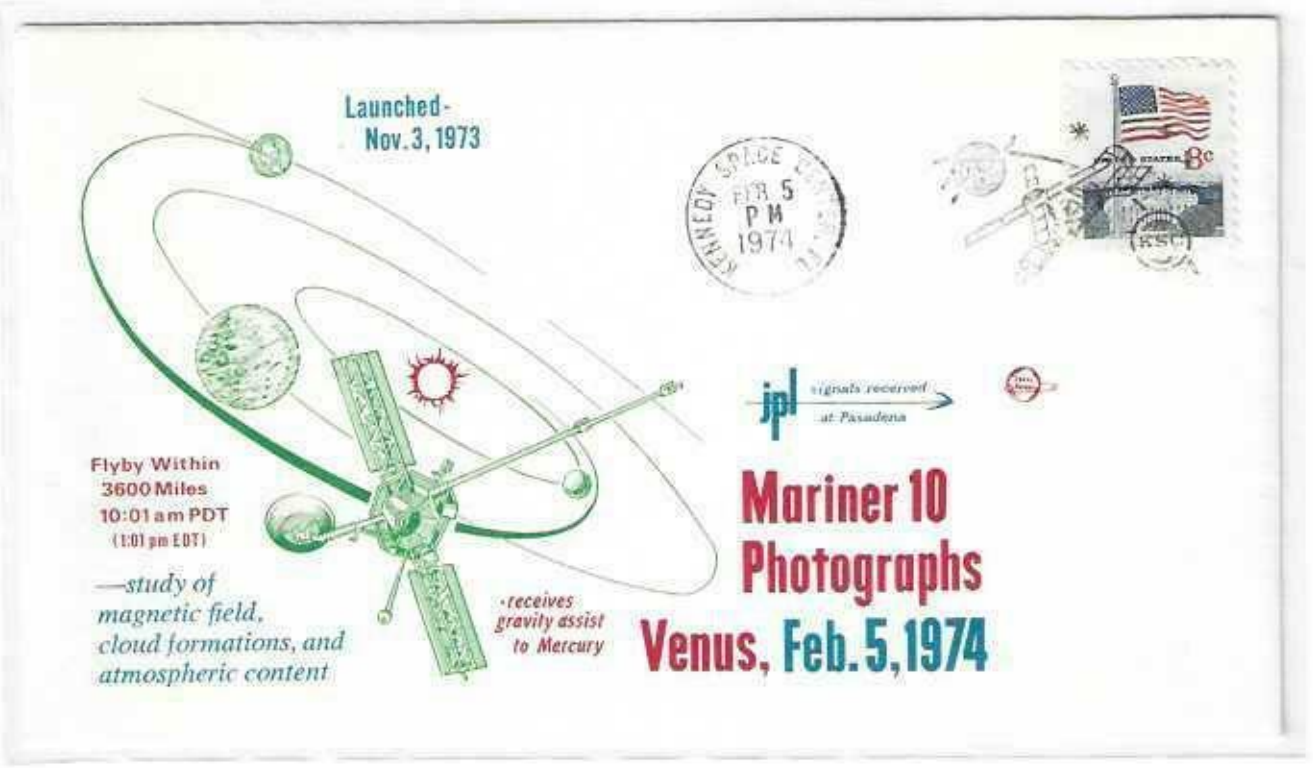


Mariner 9 mission. MAY 30, 1971. Cape Canaveral machine cancel on the date and time of launch. The mission was planned to consist of two spacecraft to orbit Mars on complementary missions, but due to failure of Mariner 8 to launch properly, only one spacecraft was available. Mariner 9 combined mission objectives of both Mariner 8 (mapping 70% of the martian surface) and Mariner 9 (a study of temporal changes in the martian atmosphere and on the martian surface. Disciplines: astronomy, planetary science, space physics.

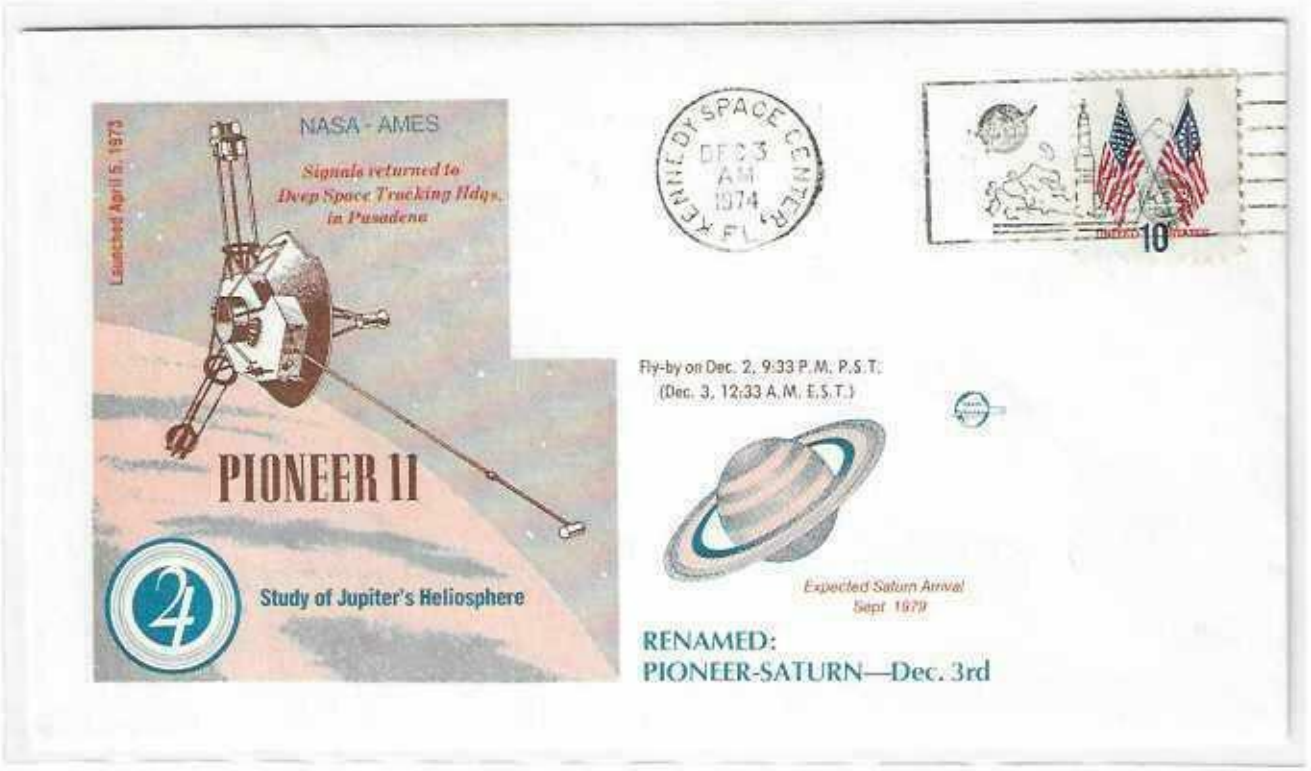
Mariner 9 mission. NOVEMBER 13, 1971. Vandenberg AFB machine cancel. The spacecraft arrived at Mars on November 14, 1971. It is the first spacecraft to orbit another planet. The spacecraft gathered data on atmospheric composition, density, pressure and temperature, and also the surface composition, temperature, gravity and topographic of Mars. A total of 54 billion bits of scientific data were returned, including 7,329 images covering the entire planet.



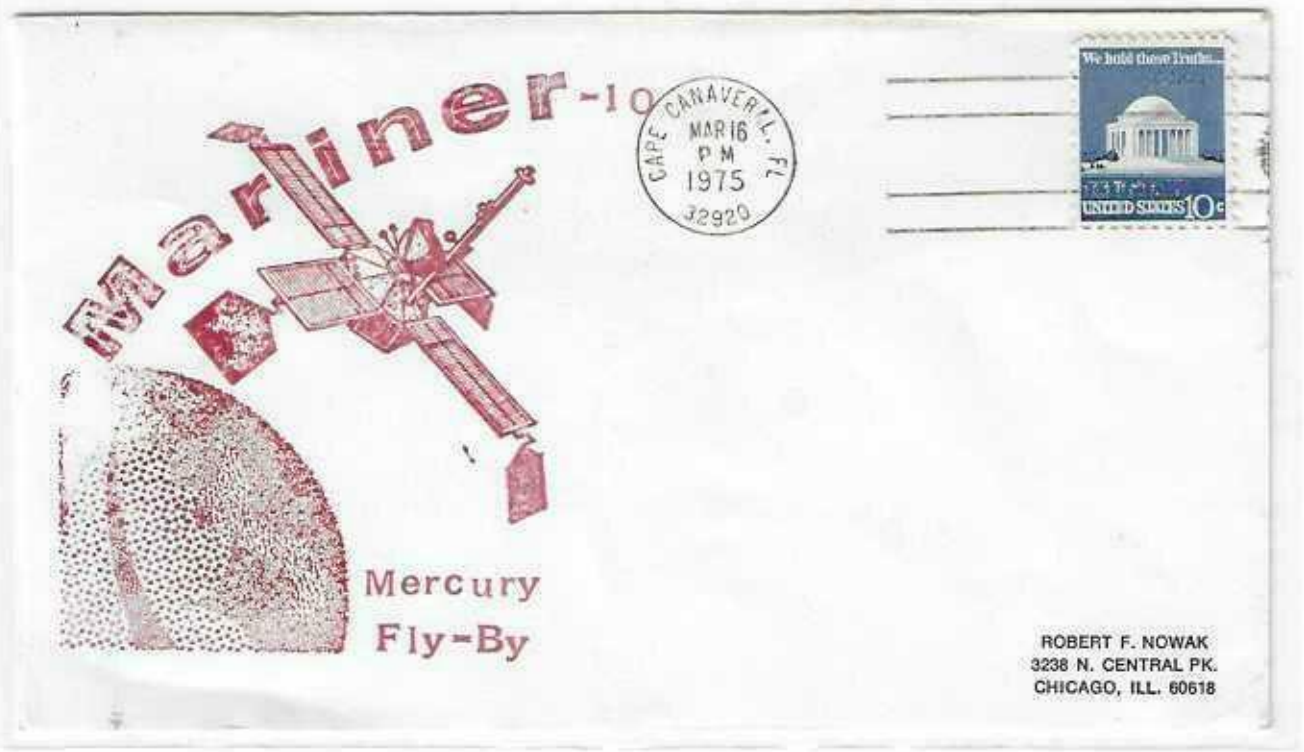
Pioneer 10 mission. DECEMBER 3, 1973. KSC machine cancel. Launched on March 2, 1972, the spacecraft achieved its closest approach to Jupiter on December 4, 1973, when it reached approximately 2.8 Jovian radii, about 200,000 km. The mission was the first to be sent the outer solar system and the first to investigate the planet Jupiter, after which it followed an escape trajectory from the Solar System. Fifteen experiments were carried to investigate and to photograph the planet and its satellites. Disciplines: astronomy, planetary science, space physics.



Mariner 10 mission. FEBRUARY 5, 1974. KSC machine cancel. Launched on November 3, 1973 by an Atlas Centaur rocket, it was the first spacecraft to visit Mercury. It was also the first spacecraft to use the gravitational pull of one planet (Venus) to reach another (Mercury), and the first spacecraft mission to visit two planets. The primary scientific objectives were to measure Mercury's environment, atmosphere, surface and body characteristics and to make similar investigation of Venus. Disciplines: astronomy, planetary science, space physics.



Pioneer 11 mission. DECEMBER 3, 1974. KSC machine cancel. Launched on April 5, 1973, The closest approach to Jupiter occurred within 43,000 km of Jupiter's cloud tops. It was the first spacecraft to explore the planet Saturn and its main rings. Pioneer 11, like Pioneer 10, used Jupiter's gravitational field to alter its trajectory radically. It passed close to Saturn on September 1, 1979 at a distance of 21,000 km from Saturn's cloud tops and then it followed an escape trajectory from the Solar System. Disciplines: astronomy, planetary science, space physics.



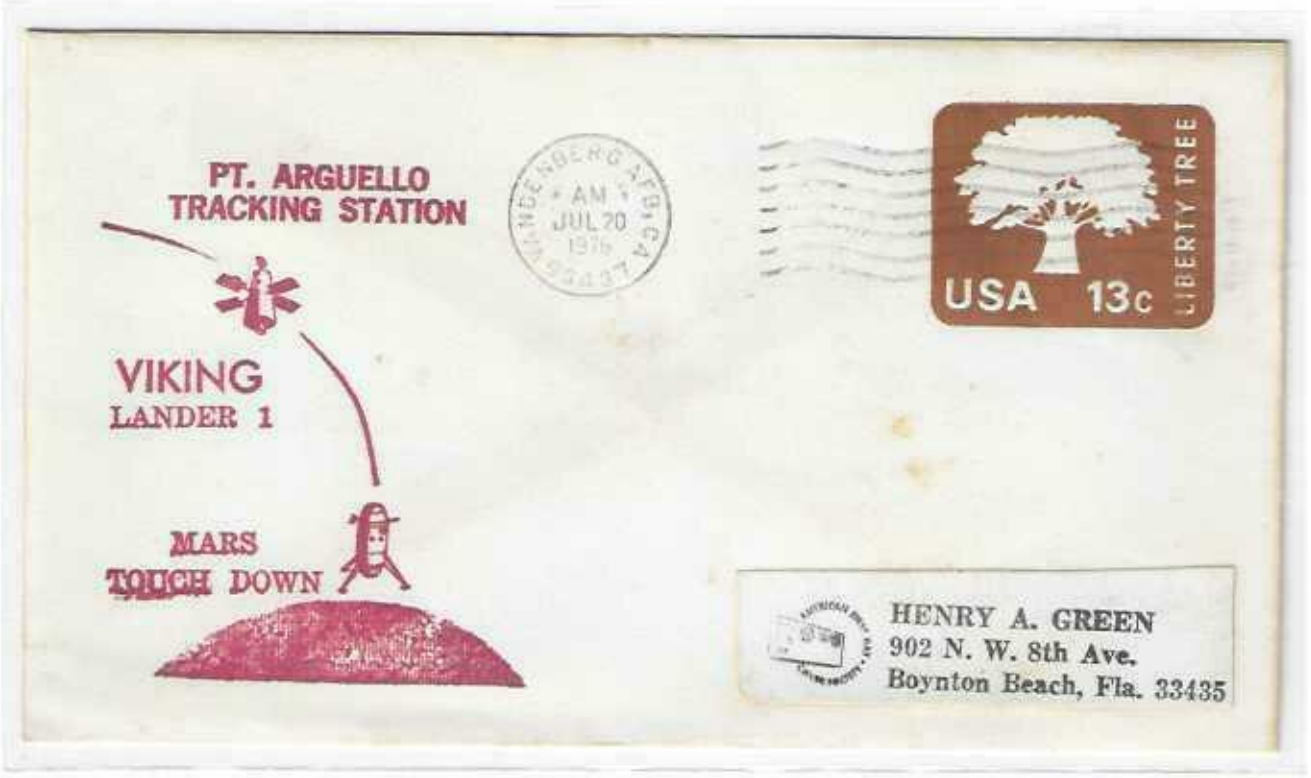
Mariner 10 mission. MARCH 16, 1975. Cape Canaveral machine cancel. The spacecraft crossed the orbit of Mercury on March 29, 1974 at a distance of 704 km. A second encounter with Mercury, when more photographs were taken, occurred on September 21, 1974 at an altitude of 48,069 km. A third and last encounter, at an altitude of 327 km, with additional photography of about 300 frames and magnetic field measurements, occurred on March 16, 1975.

Viking 1 mission. AUGUST 20, 1975. KSC machine cancel on the date and time of launch. The Viking Project consisted of two separate spacecraft to Mars. Each spacecraft consisted of an orbiter and a lander. After orbiting Mars and returning images, used for landing sites selection, the orbiter and lander detached and the lander entered the martian atmosphere and soft-landed at the selected site. Following launch and a 10 month cruise to Mars the orbiter began returning global images of the planet. Discipline: planetary science.

Viking 2 mission. SEPTEMBER 9, 1975. KSC machine pictorial cancel on the date and time of launch. Official cachet. Following launch and a 333 day cruise to Mars, the Viking 2 orbiter began returning global images prior to orbit insertion. Imaging of candidate sites was begun and the landing site was selected based on these pictures and the images returned by Viking 1 orbiter. Discipline: planetary science.

Viking 2 mission. SEPTEMBER 9, 1975. KSC machine cancel on the date and time of launch.

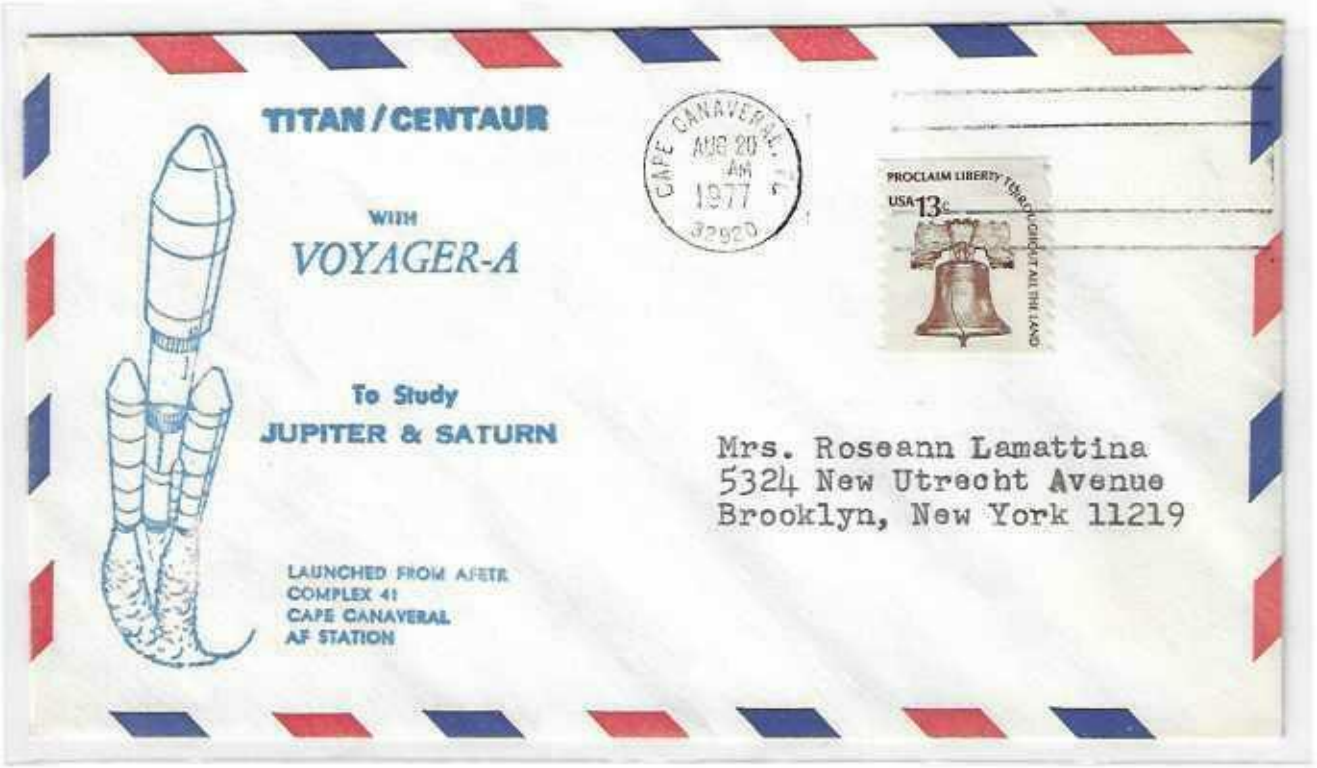
Viking 1 mission. JUNE 19, 1976. Vandenberg AFB machine cancel. Scientific instruments for conducting imaging, atmospheric water vapor and infrared thermal mapping were enclosed in a temperature controlled, pointable scan platform extending from the base of the orbiter. The scientific instrumentation had a total mass of approximately 72 kg. Radio science investigations were also done using the spacecraft transmitter.



Viking 1 mission. JULY 20, 1976. Vandenberg AFB machine cancel. The Mars touch down occurred at Chryse Planitia. Transmission of the first surface image began 25 sec. after landing and took about 4 min. In the next 7 min. the second picture of 300° panoramic scene was taken. On the day after the landing the first color picture of the surface of Mars was taken. The orbiter primary mission ended at the beginning of solar conjunction on November 5, 1976.

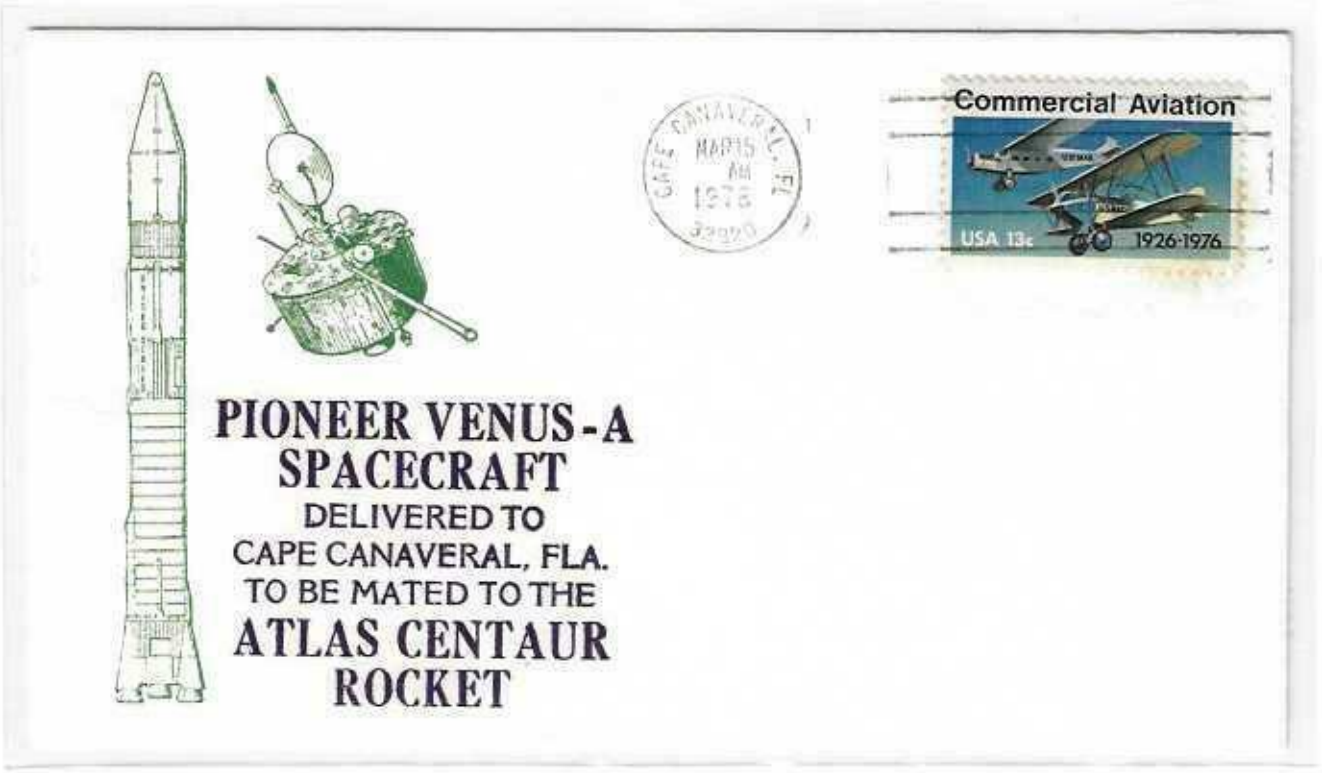
Viking 2 mission. AUGUST 7, 1976. Vandenberg AFB machine cancel. The lander carried instruments to achieve the primary scientific objectives of the lander mission: to study the biology, chemical composition (organic and inorganic), meteorology, seismology, magnetic properties, appearance and physical properties of the martian surface and atmosphere. Two 360-degree cylindrical scan cameras were mounted near one long side of the base.

Viking 2 mission. SEPTEMBER 3, 1976. Vandenberg AFB machine cancel. At the time of separation, on September 3, the lander was orbiting at about 4 km/sec. At 6 km altitude, at about 250 m/s, the 16 m diameter lander parachute were deployed. In 45 sec. the parachute had slowed the lander to 60 m/s. The lander touched down about 200 km west of the crater Mie in Utopia Planitia. It operated for 1,281 Mars days and data was turned off on April 11, 1980 when its batteries failed.



Voyager 2 mission. AUGUST 20, 1977. Cape Canaveral machine cancel on the date and time of launch. Voyager, because of its distance to Earth and the resulting time-lag for commanding, was designed to operate in a highly-autonomous manner. In order to do this and carry out the complex sequences of spacecraft motions and instruments operations, three interconnected on-board computers were utilized. Disciplines: astronomy, planetary science, space physics.

Voyager 1 mission. SEPTEMBER 5, 1977. Cape Canaveral machine cancel on the date and time of launch. Originally planned as a Grand Tour of the outer planets, including dual launches to Jupiter, Saturn and Pluto in 1976-77, and dual launches to Jupiter, Uranus and Neptune in 1979, budgetary constrains caused a dramatic rescoping of the project to two spacecraft, each of which would go to only Jupiter and Saturn. Although launched 16 days after Voyager 2, Voyager 1's trajectory was the quicker one to Jupiter.



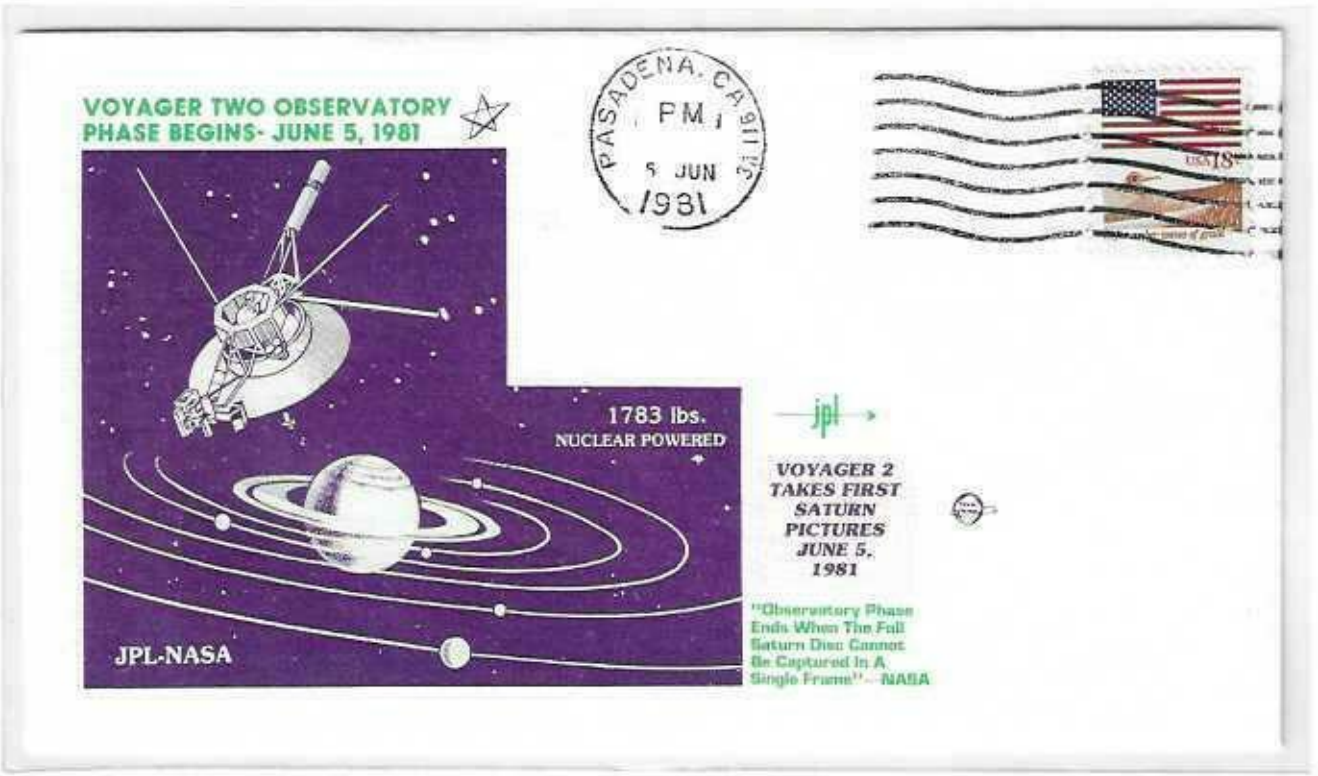
Pioneer Venus-A (Pioneer 12) mission. MARCH 15, 1978. Cape Canaveral machine cancel. Launched on May 20, 1978, it consisted of two spacecraft, the orbiter and the multiprobe. The Pioneer Venus Project's main objective was to investigate the solar wind in the venusian environment, map the planet's surface through a radar imaging system and study the characteristics of the upper atmosphere and ionosphere. It reached orbit around Venus on December 4, 1978. Disciplines: astronomy, planetary science, space physics.

Pioneer Venus 2 (Pioneer 13) mission. AUGUST 8, 1978. KSC machine cancel on the date and time of launch. The spacecraft reached Venus on December 9, 1978. It was made of five separate probes: the probe transporter (referred to as the BUS), a large atmospheric entry probe (called SOUNDER) and three small probes. The Sounder released from the Bus on November 15; the three smaller probes released on November 19. The probes sent data to Earth as they descended toward the surface. Disciplines: astronomy, planetary science, space physics.

Voyager 2 mission. JULY 9, 1979. Cape Canaveral machine cancel. The spacecraft made successful flybys of Uranus (January 24, 1986) and Neptune (August 25, 1989).The space probe was successfully able to obtain about 8,000 images of Uranus and its satellites. Additional improvements in the on-board software and use of image compression techniques allowed about 10,000 images of Neptune and its satellites to be taken.

Voyager 1 mission. NOVEMBER 10, 1980. Pasadena machine cancel. Each Voyager had as its major objectives at each planet to: investigate the circulation, dynamics, structure and composition of the atmosphere, characterize the morphology, geology and physical state of the satellites of the planet, provided improved valves for the mass, size and shape of the planet, satellites and any rings, determine the magnetic field structure and study the energetic trapped particles and plasma therein.

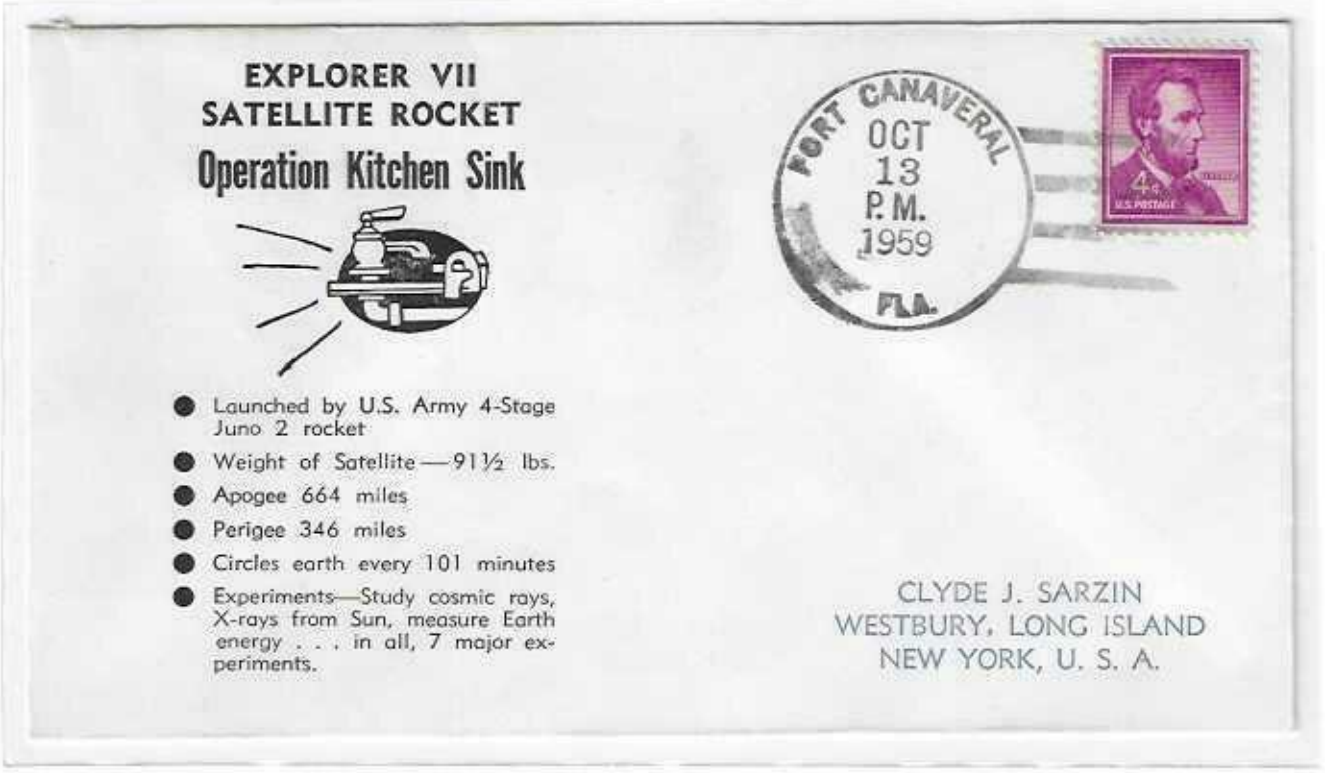
Voyager 1 mission. NOVEMBER 12, 1980. Pasadena machine cancel. Some 18,000 images of Jupiter and its satellites were taken by Voyager 1. In addition roughly 16,000 images of Saturn, its rings and satellites were obtained. After nearly 9 years of dormancy, on February 14, 1990 Voyager 1 loocked back and took the first " family portrait " of the Solar System, a mosaic of 60 frames of the Sun and 6 of the planets (Venus, Earth, Jupiter, Saturn, Uranus and Neptune).



Voyager 2 mission. JUNE 5, 1981. Pasadena machine cancel. Although use of the backup receiver made communications with the spacecraft more difficult, engineers were able to find workarounds. Despite the difficulties encountered scientists and engineers had been able to make Voyager enormously successful. As a result, approval was granted to extend the mission, first to Uranus, then to Neptune, and later to continue observations well past Neptune.

7 SATELLITES

Explorer 4 mission. JULY 26, 1958. Patrick AFB machine cancel on the date and time of launch. It was a cylindrically shaped satellite instrumented to make the first detailed measurements of charged particles (protons and electrons) trapped in the terrestrial radiation belts. An unexpected tumble motion of the satellite made the interpretation of the detector data very difficult. The spacecraft decayed from orbit after 454 days, on October 23, 1959. Discipline: space physics.



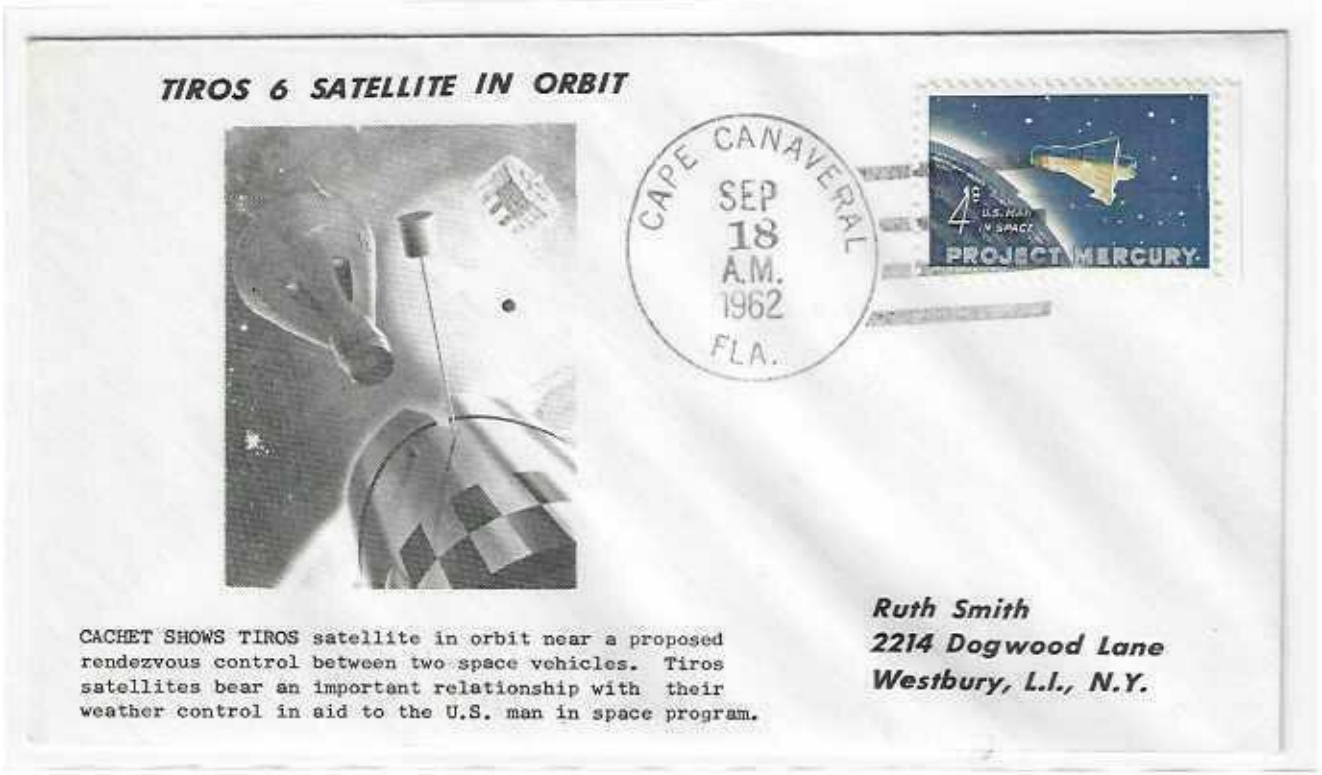
Explorer 7 mission. OCTOBER 13, 1959. Port Canaveral manual cancel on the date and time of launch. The mission was designed to measure solar x-ray and Lyman alpha flux, trapped energetic particles, and heavy primary cosmic rays. The spacecraft was powered by approximately 3,000 solar cells mounted on both the upper and lowers shells. Additional power was provided by 15 nickel-cadmium batteries. Useful real-time data were transmitted from launch through February 1961, and intermittently until August 24, 1961. Disciplines: Earth science, space physics.

Explorer 8 mission. NOVEMBER 3, 1960. Port Canaveral manual cancel on the date and time of launch. It was an Earth-orbiting satellite designed to obtain measurements of the electron density, the electron temperature, the ion concentration, the ion mass, the micrometeorite distribution, and the micrometeorite mass in the ionosphere at altitudes between 400 and 1,600 km. As a result of considerable difficulties, the data were mostly processed by hand. Considerable new knowledge about the ionosphere was gained. Disciplines: Earth and planetary science, space physics.

EPE-A (Explorer 12) mission. AUGUST 15, 1961. Port Canaveral manual cancel on the date and time of launch. Launched by a Thor-Delta rocket, it was a spin-stabilized, solar-cell-powered spacecraft instrumented to measure cosmic ray particles, trapped particles, solar wind protons, and magnetospheric and interplanetary magnetic fields. It was the first of the S3 series of spacecraft, whic also included Explorers 14, 15 and 26. Good data were recorded for approximately 90% of the active lifetime of spacecraft. Discipline: space physics.

S55A (Explorer 13) mission. AUGUST 25, 1961. Wallops Island manual cancel on the date and time of launch. The objectives of the flight were to test vehicle performance and guidance and to investigate the nature and effects of micrometeoroids on the spacecraft systems. The orbit was lower than planned and the spacecraft reentered the atmosphere on August 28, 1961. Discipline: planetary science.

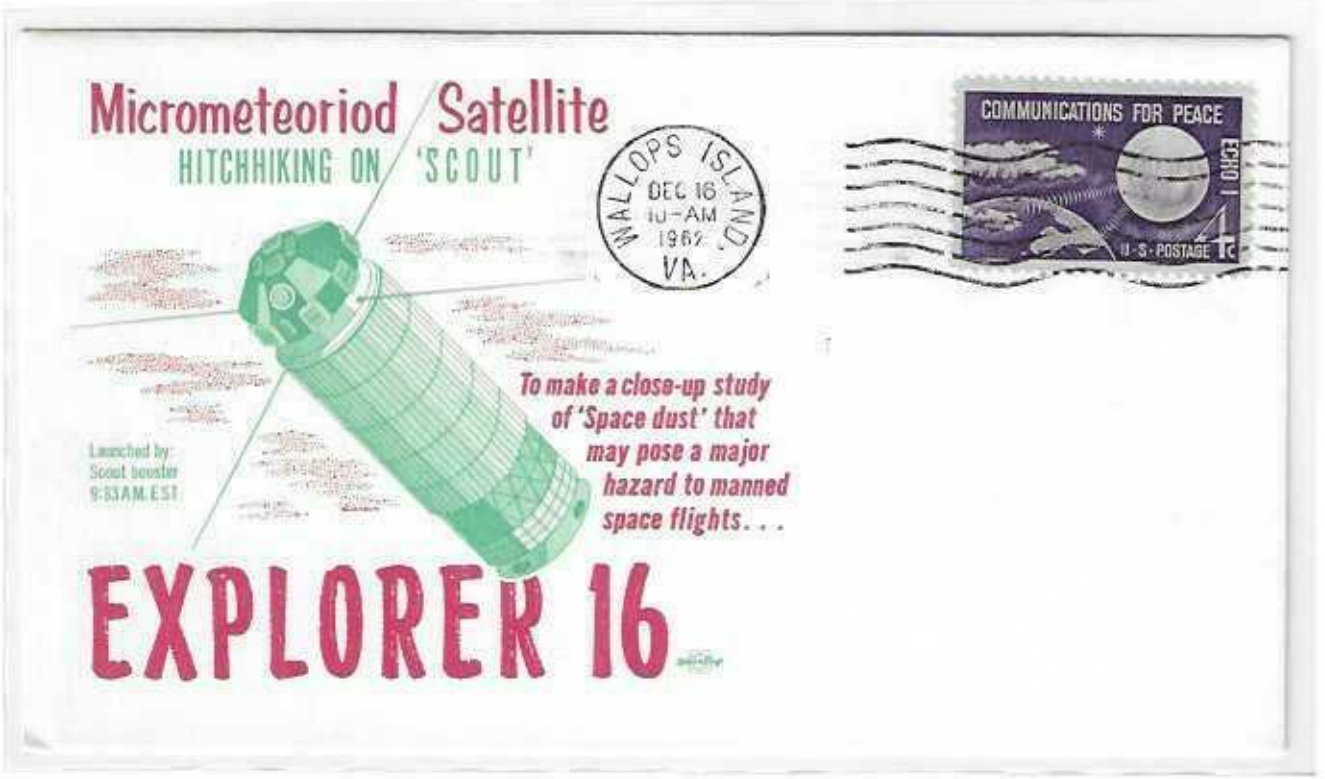
Tiros 4 mission. FEBRUARY 8, 1962. Patrick AFB machine cancel on the date and time of launch. Mission's objectives were to continue research into infra-red television observations and development of the meteorological satellite information system. This mission was designed to maintain an operational Tiros in orbit for an extended period of time and to obtain improved data for operational use in weather forecasting during the northern hemisphere hurricane season. Discipline: Earth science.



Tiros 6 mission. SEPTEMBER 18, 1962. Cape Canaveral manual cancel on the date and time of launch. Mission's objectives were to continue research and development of the meteorological satellite information system, prove Tiros could stay in orbit for an extended period of time, obtain improved data for use in weather forecasting during hurricane season, provide operational support for the Mercury-Atlas 8 launch on October 3, 1962. Discipline: Earth Science

EPE-B (Explorer 14) mission. OCTOBER 3, 1962. Launched on October 2 by a Thor-Delta rocket. The time required to sample the 16 channels (one frame period) was 0.323 s. Half of the channels were used to convey eight-level digital information, and the others were used for analog information. Good data were recorded for approximately 85% of the active lifetime of the spacecraft. On August 11, 1963, the encoder malfunctioned terminating the transmission of usable data. Discipline: space Physics.

EPE-C (Explorer 15) mission. OCTOBER 28, 1962. Cape Canaveral manual cancel. Launched on October 27. The backup payload for Explorer 14 was modified and used for Explorer 15. The instrumentation included three sets of particle detectors to study both electrons and protons, and a two-axis fluxgate magnetometer to determine magnetic aspect. During launch the spacecraft failed to despin. The spin rate ranged from 72.9 to 73.2 rpm during the life of the spacecraft. Discipline: space physics.

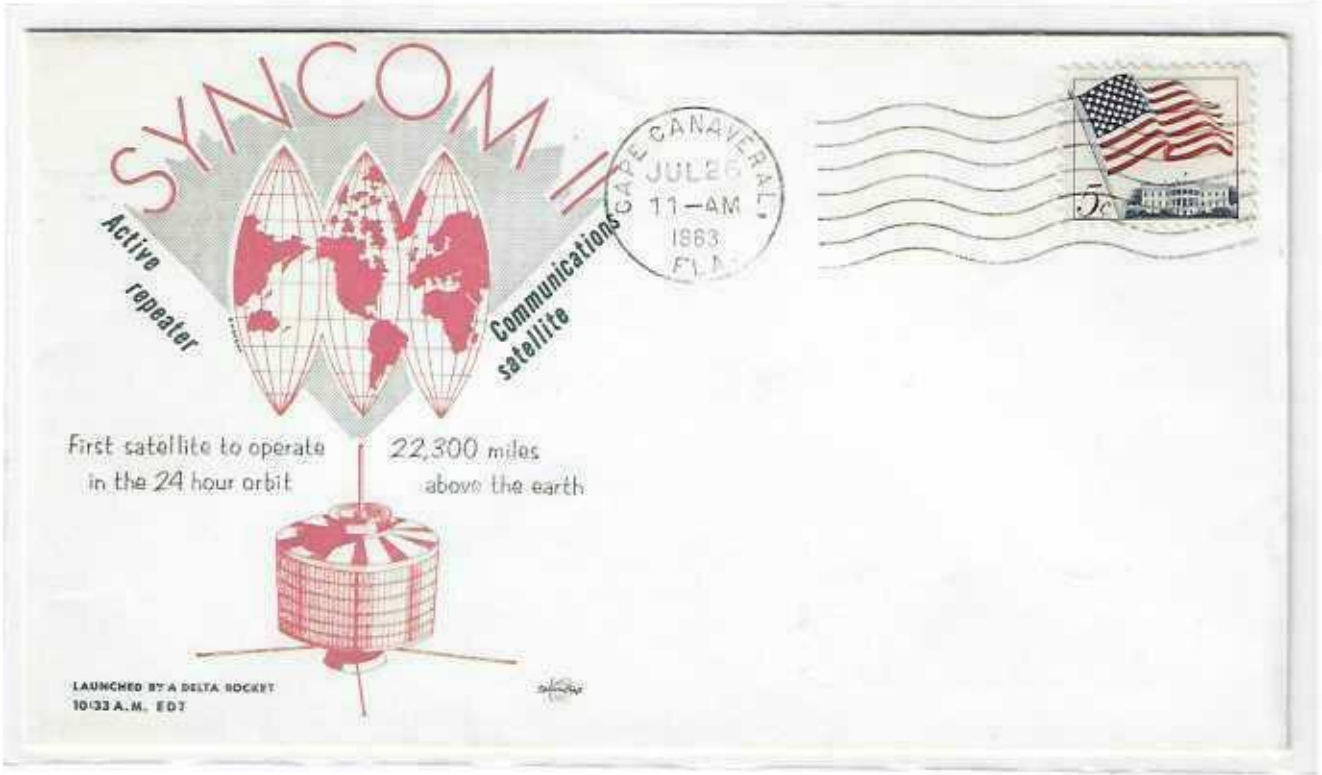


S55B (Explorer 16) mission. DECEMBER 16, 1962. Wallops Island machine cancel on the date and time of launch. The cylindrically shaped spacecraft was built around the burned-out fourth stage of the Scout launch vehicle. Its purpose was to obtain data on the near-Earth meteoroid environment, thus providing an accurate estimate of the probability of penetration in spacecraft structures by meteoroids and allowing a more confident definition of the relationship between penetration flux and material thickness to be derived. Discipline: planetary science.

Syncom 1 mission. FEBRUARY 14, 1963. Cape Canaveral manual cancel on the date and time of launch. Syncom (for " Synchronous Communications Satellite ") started as a NASA Program for active geosynchronous satellite, all of which were developed and manufactured by Hughes Space and Communications. The satellite was lost on the way due to an electronics failure. Discipline: communications.

AE-A (Explorer 17) mission. APRIL 3, 1963. Cape Canaveral machine cancel on the date and time of launch. The satellite carried four pressure gauges for the measurement of total neutral particle density, two mass spectrometers for the measurement of certain neutral particle concentrations, and two electrostatic probes for ion concentration and electron temperature measurements. Battery power failed on July 10, 1963. One spectrometer malfunctioned, and the other operated intermittently. Disciplines: Earth science, space physics.

Tiros 7 mission. JUNE 19, 1963. Cape Canaveral machine cancel on the date and time of launch. Objectives: continue research and development of the meteorological satellite information system; obtain improbe data for use in weather forecasting, especially during hurricane season. The electron density and temperature probes were the same as the ones flown on board Explorer 17. The spacecraft was deactivated after furnishing over 30,000 cloud photographs; it lasted the longest of the Tiros series thus far, 1,809 days. Discipline: Earth science.



Syncom 2 mission. JULY 26, 1963. Cape Canaveral machine cancel on the date and time of launch. During the first year, NASA conducted voice, teletype and facsimile tests, as well as 110 public demonstrations to show the capabilities of this satellite and invite feedback. In August 1963, President J. F. Kennedy in Washington, D.C., telephoned Nigerian Prime Minister Abubakar Tafawa Balewa aboard Template USNS docked in Lagos Harbor, the first live two-way call between heads of government by satellite. Syncom 2 also relayed a number of test low-quality television transmission. Discipline: communications.

IMP-A (Explorer 18) mission. NOVEMBER 27, 1963. Cape Canaveral machine cancel on the date and time of launch. It was a solar-cell and chemical-battery powered spacecraft instrumented for interplanetary and distant magnetospheric studies of energetic particles, cosmic rays, magnetic fields and plasma. After every third normal sequence there was an 81.9 s interval of rubidium vapor magnetometer analog data transmission.

Tiros 8 mission. DECEMBER 21, 1963. Cape Canaveral machine cancel on the date and time of launch. Objectives: continue research and development of the meteorological satellite information system; flight test the Automatic Picture Transmission (APT) camera system and ground stations. The Tiros 8's APT system exceeded its 90-days expected lifetime. True space-based study of the Earth had begun. Forty-seven ground stations around the world were able to ingest satellite images, forming the first body of wide-angle imagery ever assembled. Discipline: Earth science.

Syncom 3 mission. AUGUST 19, 1964. Cape Canaveral machine cancel on the date and time of launch. It was the first geostationary communication satellite. The satellite, in orbit near the International Data Line, had the addition of a wideband channel for television, and was used to telecast the 1964 Summer Olympics in Tokyo to the United States. Although Syncom 3 is sometimes credited with the first television program to cross the Pacific Ocean. Discipline: communications.

IE-A (Explorer 20) mission. AUGUST 25, 1964. Vandenberg AFB machine cancel on the date and time of launch. The satellite was designed to measure electron distribution, ion density and temperature, and to estimate cosmic noise levels between 2 and 7 Mhz. It was a small ionospheric observatory instrumented with a six-frequency ionospheric sounder and ion probe. Telemetry stations were located to provide primary data coverage near 80 deg. W plus areas near Hawaii, Singapore, the UK, Australia and Africa. Disciplines: astronomy, space physics.

IMP - B

United States Interplanetary monotoring platform launched October 4, 1964. Early projects to aid in putting an American on the Moon and Planets.

CLYDE J. SARZIN
FORT WASHINGTON, L. I.
NEW YORK, U.S.A.

IMP-B (Explorer 21) mission. OCTOBER 4, 1964. Patrick AFB machine cancel on the date and time of launch. The significant deviation of the spin rate and direction from the planned values and the achievement of an apogee of less than half the planned value adversely affected data usefulness. Othervise, spacecraft systems performed well, with nearly complete data transmission for the first four months and for the sixth mounth after launch. Discipline: space physics.

EXPLORER 22

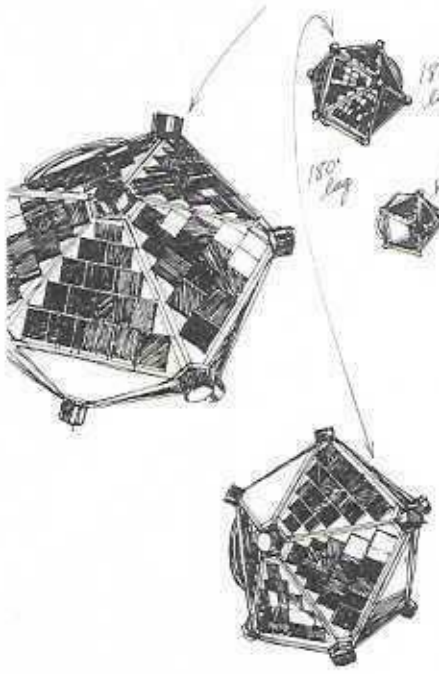
S - 66 Ionosphere Laser Ray Beacon Satellite, Vandenberg Air Force Base, California October 9, 1964

BE-B (Explorer 22) mission. OCTOBER 9, 1964. Vandenberg AFB machine cancel on the date and time of launch. Launched by a Scout rocket, its objective was to obtain worldwide observations of total electron content between the spacecraft and the Earth. There was not tape recorder abord so that satellite. Performance data and electrostatic probe data could be observed only when the satellite was within range of a ground telemetry station. Disciplines: Earth science, space physics.

EXPLORER XXIII

NASA launches meteoroid detection satellite from U.S. rocket launch - ing station at Wallops Island, Virginia. Its primary purpose is to provide future manned space craft with the accurate knowledge of the penetra - tion capabilities of space debris, thereby safeguarding the lives of our spacemen and paving the way for passenger service to the stars.

S55C (Explorer 23) mission. NOVEMBER 6, 1964. Wallops Island machine cancel on the date and time of launch. The satellite was the third in the series of S55 micrometeoroid satellite orbited by NASA. The spacecraft operated satisfactorily during its 1 year life, and all mission objectives were accomplished, except for the cadmium sulfide cell detector experiment, which was damaged on liftoff and provided no data. Discipline: planetary science.



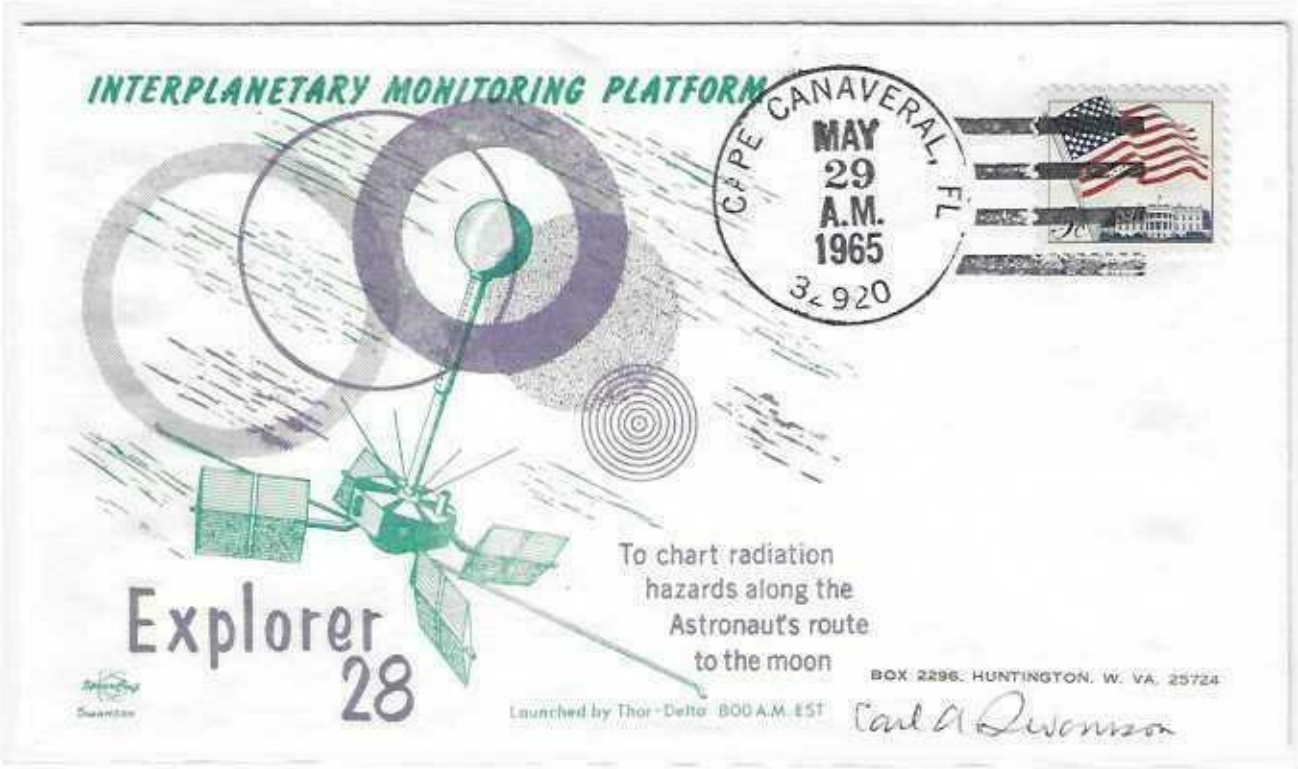
EXPLORER 24 and EXPLORER 25

Launched with single booster.
Vandenberg Air Force Base.
First time two satellites sent
into orbit at the same time.

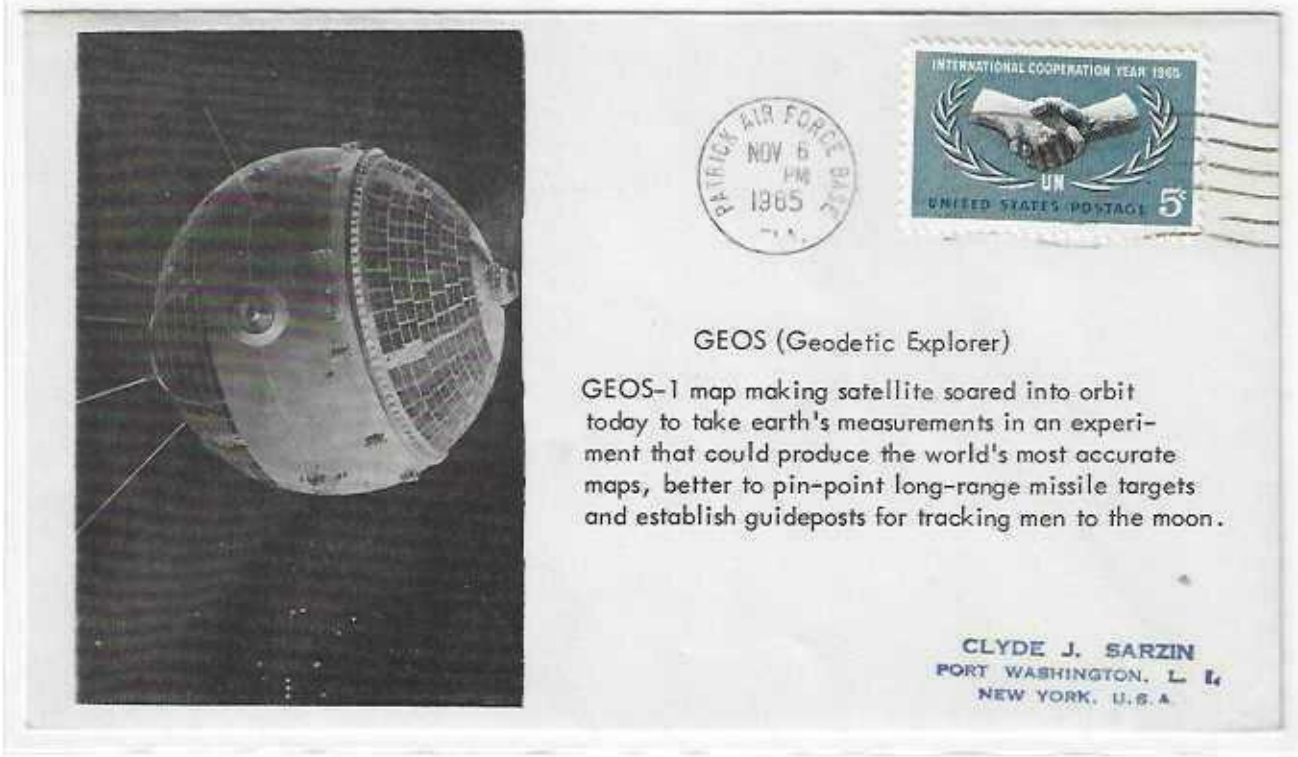
AD-B (Explorer 24), Injum 4 (Explorer 25) missions. Vandenberg AFB machine cancel on the date and time of launch. Explorer 24 was designed to yield atmospheric density. The primary objective of Explorer 25 mission was to make measurements of the influx of energetic particles into the Earth's atmosphere, and to study atmospheric heating and the increase in scale height which have been correlated with geomagnetic activity.

EPE-D (Explorer 26) mission. DECEMBER 21, 1964. Cape Canaveral manual cancel on the date and time of launch. It was a spin-stabilized, solar-cell powered spacecraft instrumented to measure trapped particles and geomagnetic field. The initial spin rate was 33 rpm. The spin rate decreased with time to 2 rpm on September 9, 1965. For the balance of its life, the spacecraft was coning or tumbling at a rate of about 1 rpm. On May 26, 1967, the telemeter failed. Discipline: space physics.

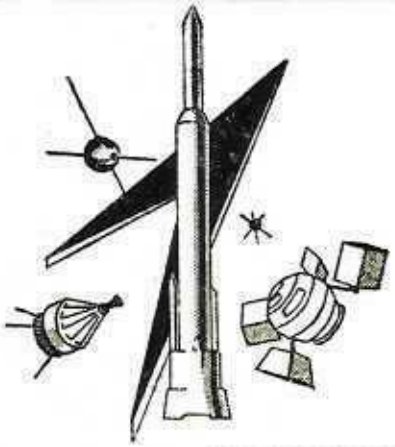
BE-C (Explorer 27) mission. APRIL 29, 1965. Wallops Island machine cancel on the date and time of launch. The satellite was turned on in order to partially replace use made of BE-B beacon experiment. It was a small ionospheric satellite instrumented with an electrostatic probe, radio beacons, a passive laser tracking reflector and a Doppler navigation experiment. Its primary objective was to obtain worldwide observation of total electron content between the spacecraft and the Earth. Disciplines: Earth science, space physics.



IMP-C (Explorer 28) mission. MAY 29, 1965. Cape Canaveral manual cancel on the date and time of launch. It was a solar-cell and chemical-battery powered spacecraft instrumented for interplanetary and distant magnetospheric studies of energetic particles, cosmic rays, magnetic field and plasmas. After every third normal telemetry sequence there was an 81.9 s interval of rubidium vapor magnetometer analog data transmission. Performance was essentially normal until late April 1967. Discipline: space physics.



GEOS 1 (Explorer 29) mission. NOVEMBER 6, 1965. Patrick AFB machine cancel on the date and time of launch. The Geodetic Earth Orbiting Satellite spacecraft was a gravity-gradient-stabilized, solar-cell-powered unit designed exclusively for geodetic studies. It was the first successful active spacecraft of the National Geodetic Satellite Program. Acquisition and recording of data were the responsibility of the GSFC Space Tracking and Data Acquisition Network (STADAN). Discipline: Earth science.



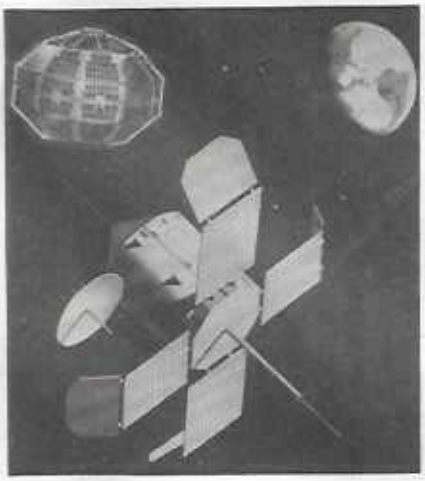
A SOLAR EXPLORER SATELLITE

Launched, November 18, 1965, from WALLOPS ISLAND, VIRGINIA

Cancel delayed.
Launched after Postoffice closed.

WALLOPS ISLAND VA. NOV 19 AM 1965

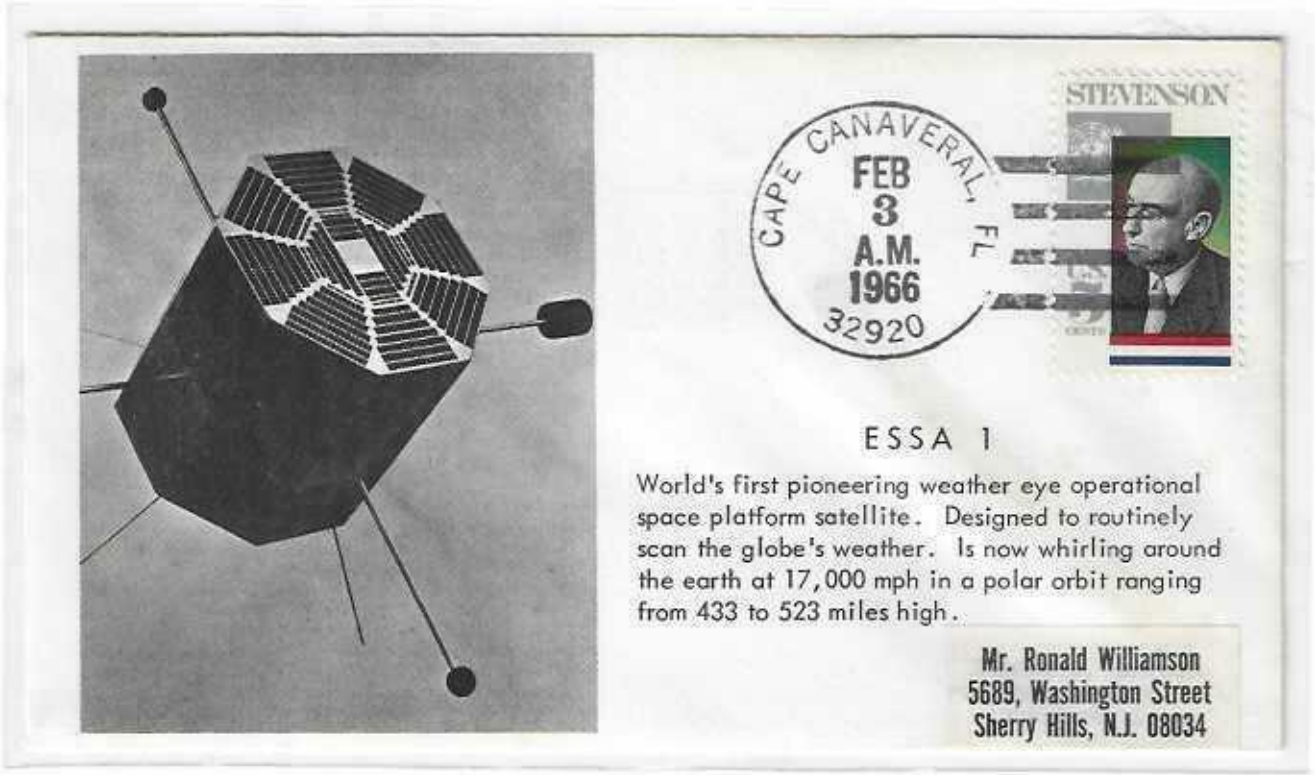
SOLRAD 8 (Explorer 30) mission. NOVEMBER 19, 1965. Wallops Island machine cancel. Launched on November 18, the satellite was one of the SOLRAD series that began in 1960 to provide continuous coverage of solar radiation with a set of standard photometers. Data were transmitted in real time by means of an FM/AM telemetry system and were recorded by the stations on the STADAN tracking network. The satellite performed normally except for the spin system. Discipline: solar physics.



VANDENBERG A.F.B., CALIF. NOV 28 AM 1965

ALOUETTE 2 and EXPLORER 31
LAUNCHED SIMULTANEOUSLY.
Canadian Alouette and U. S.
Explorer today launched at VAFB
placed in orbit by a single booster.
A Thor-Agena B rocket combination.

DME-A (Explorer 31) mission. NOVEMBER 28, 1965. Vandenberg AFB machine cancel. Launched on November 29, it was a small ionospheric observatory instrumented to make direct measurements of selected ionospheric parameters at the spacecraft. It carried 7 experiments. Some difficulties were encountered in obtaining attitude information that was necessary for the reduction of the experiment observations. Discipline: space physics.



Essa 1 mission. FEBRUARY 3, 1966. Cape Canaveral manual cancel on the date and time of launch. It was a spin-stabilized operational meteorological spacecraft designed to take and record daytime cloudcover pictures on a global basis for subsequent playback to a ground acquisition station. The satellite had essentially the same configuration as that of the Tiros series. The satellite was placed in a cartwheel orbital mode, with its spin axis normal to the orbital plane. On October 6, 1966 the camera system failed. Discipline: Earth science.

Essa 2 mission. FEBRUARY 28, 1966. Cape Canaveral manual cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to provide real-time Earth cloudcover TV pictures to properly equipped ground receiving station for use in weather analysis and forecasting. Over 4 yr of useful cloudcover pictures were obtained before the camera systems were placed in a standby mode on March 20, 1970 owing to a telemetry conflict with Itos 1. Essa 2 was deactivated on October 16, 1970. Discipline: Earth science.

NIMBUS - II

NASA

Launched Cape Kennedy 3.56 A.M. The 912-pound is the biggest U. S. Weather Satellite, its 725 miles high orbit is designed to take about 3,000 pictures day and night and send to Transmission Stations in 26 Foreign countries.

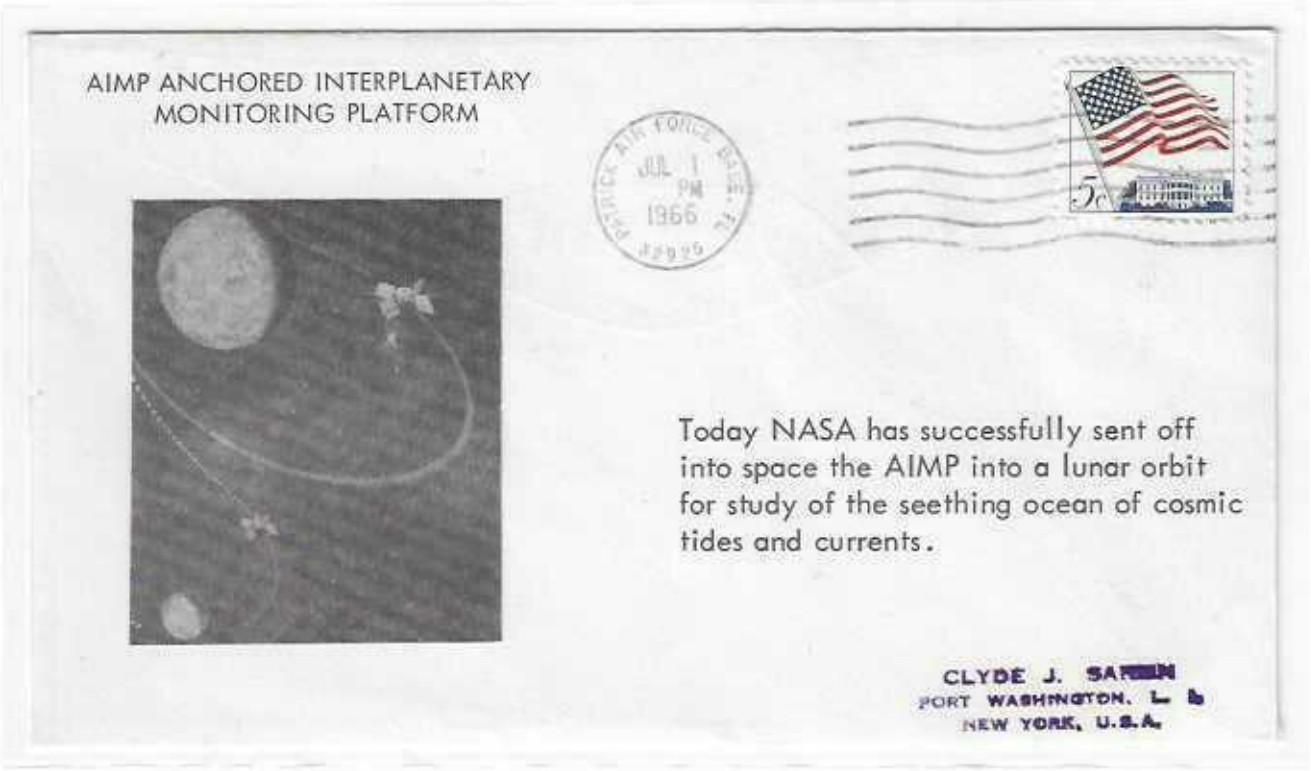
Nimbus 2 mission. MAY 15, 1966. Vandenberg AFB machine cancel on the date and time of launch. The spacecraft carried an Advanced Vidicon Camera System (AVCS), an Automatic Picture Transmission (APT) camera for providing real-time cloudcover pictures, and both High-and-Medium-resolution Infrared Radiometers (HRIR and MRIR) for measuring the intensity and distribution of electromagnetic radiation emitted by and reflected from the Earth and its atmosphere. Discipline: Earth science.

EXPLORER 32

Explorer 32 launched from Florida May 25, 1966 successfully in orbit at 1,688 miles above the earth. The satellite is crammed with 8 atmospheric devices.

CLYDE J. SARZIN
PORT WASHINGTON, L
NEW YORK, U.S.A.

AE-B (Explorer 32) mission. MAY 25, 1966. Cape Canaveral manual cancel on the date and time of launch. It was an aeronomy satellite which was designed to directly measure temperatures, composition, densities and pressures in the upper atmosphere on a global basis. The two neutral particle mass spectrometers failed about 6 days after launch. The remaining experiments operated satisfactorily and provided useful data for most of the 10-month satellite lifetime. Disciplines: Earth science, space physics.



IMP-D (Explorer 33) mission. JULY 1, 1966. Patrick AFB machine cancel on the date and time of launch. It was a spin-stabilized spacecraft instrumented for studies of interplanetary plasma, energetic charged particles (electrons, protons and alphas), magnetic fields and solar x-rays at lunar distances. The spacecraft failed to achieve lunar orbit but did achieve mission objectives. Disciplines: astronomy, planetary science, solar and space physics.

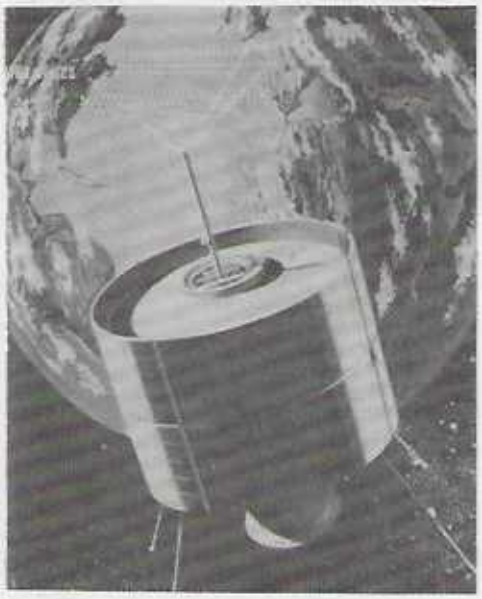
Essa 3 mission. OCTOBER 2, 1966. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to take and record daytime Earth cloudcover pictures on a global basis for subsequent playback to a ground acquisition facility. The spacecraft was also capable of providing worldwide measurements of reflected solar and long-wave radiation leaving the Earth. Essa 3 performed normally until January 20, 1967 when the radiometer experiment failed. Discipline: Earth science.

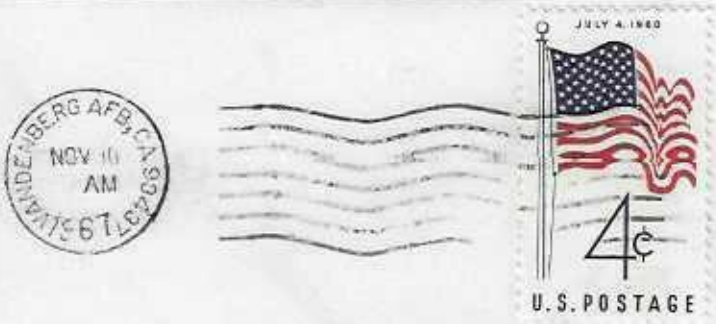
Essa 4 mission. JANUARY 26, 1967. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to provide real-time Earth cloudcover TV pictures to properly equipped ground receiving stations for use in weather analysis and forecasting. The satellite had essentially the same configuration as that of the Tiros spacecraft. It was turned operationally off on December 6, 1967 and was finally deactivated on May 5, 1968. Discipline: Earth science.

Essa 5 mission. APRIL 20, 1967. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to take and record daytime Earth cloudcover pictures on a global basis for subsequent playback to a ground acquisition facility. The spacecraft was also capable of providing worldwide measurements of reflected solar and long-range radiation leaving the Earth. The satellite performed normally until September 22, 1967 when the radiometer experiment failed. Discipline: Earth science.

IMP-F (Explorer 34) mission. MAY 24, 1967. Vandenberg AFB machine cancel on the date and time of launch. The spin-stabilized spacecraft was placed into a high-inclination, highly eccentric Earth orbit. Like the earlier IMPs, this spacecraft was instrumented to study interplanetary magnetic fields, energetic particles and plasma. The satellite optical aspect system failed on March 4, 1969. Otherwise, useful data were acquired until just before spacecraft reentry, which occurred on May 3, 1969. Discipline: space physics.

IMP-E (Explorer 35) mission. JULY 19, 1967. Cape Canaveral machine cancel on the date and time of launch. It was instrumented for interplanetary studies, at lunar distances, of the interplanetary plasma, magnetic field, energetic particles and solar x-rays. It was launched by a Delta rocket into an elliptical lunar orbit. After successful operation for 6 years, the spacecraft was turned off on June 24, 1973. Disciplines: planetary science, solar and space physics.





ESSA 6
Weather Bureau Observation satellite.
Launched into Polar Orbit by Thor Delta
Booster. Tiros Operational Satellite.

Essa 6 mission. NOVEMBER 10, 1967. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to provide real-time Earth cloudcover TV pictures to properly equipped ground receiving stations for use in weather analysis and forecasting. The satellite performed normally after launch. The ATP system was turned operationally off on July 25, 1969 and reactivated on September 11, 1969. The spacecraft was deactivated on November 4, 1969. Discipline: Earth science.

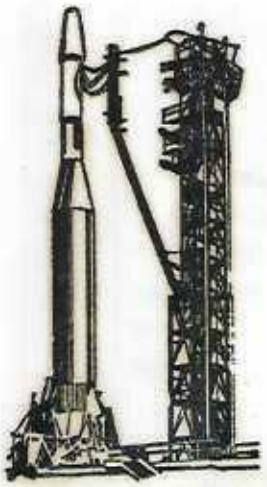
United States' newest attempt at both precision mapping of the earth's gravity field and accurate plotting of selected surface dimensions

Launched by Delta 8:16 A.M. PST

GEOS-2

Carl A Swanson

GEOS 2 (Explorer 36) mission. JANUARY 11, 1968. Vandenberg AFB machine cancel on the date and time of launch. The Geodetic Earth Orbiting Satellite was a gravity-gradient-stabilized, solar-cell- powered spacecraft that carried electronic and geodetic instrumentation. The objectives of the mission were to optimize optical station visibility periods, and to provide complementary data for inclination-dependent terms established by Explorer 29 (GEOS 1) gravimetric studies. Disciplines: Earth science, space physics.



A RADIATION
EXPLORER SATELLITE
PLACED INTO ORBIT FROM
WALLOPS ISLAND, VA., MARCH 5, 1968

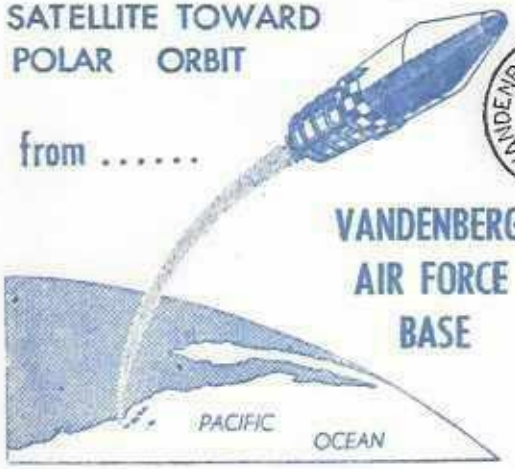
WALLOPS ISLAND VA
MAR 5
1 PM
1968

U. S. POSTAGE
6¢

Solrad 9 (Explorer 37) mission. MARCH 5, 1968. Wallops Island machine cancel on the date and time of launch. This NRL satellite was one of the Solrad series that began in 1960 to provide continuous coverage of solar radiation with a set of standard photometers. Individual scientists and institutions were invited to receive and use the data transmitted on the 136 Mhz telemetry band on the standard IRIG channels 3 trough 8.

SATELLITE TOWARD
POLAR ORBIT

from .....



VANDENBERG
AIR FORCE
BASE

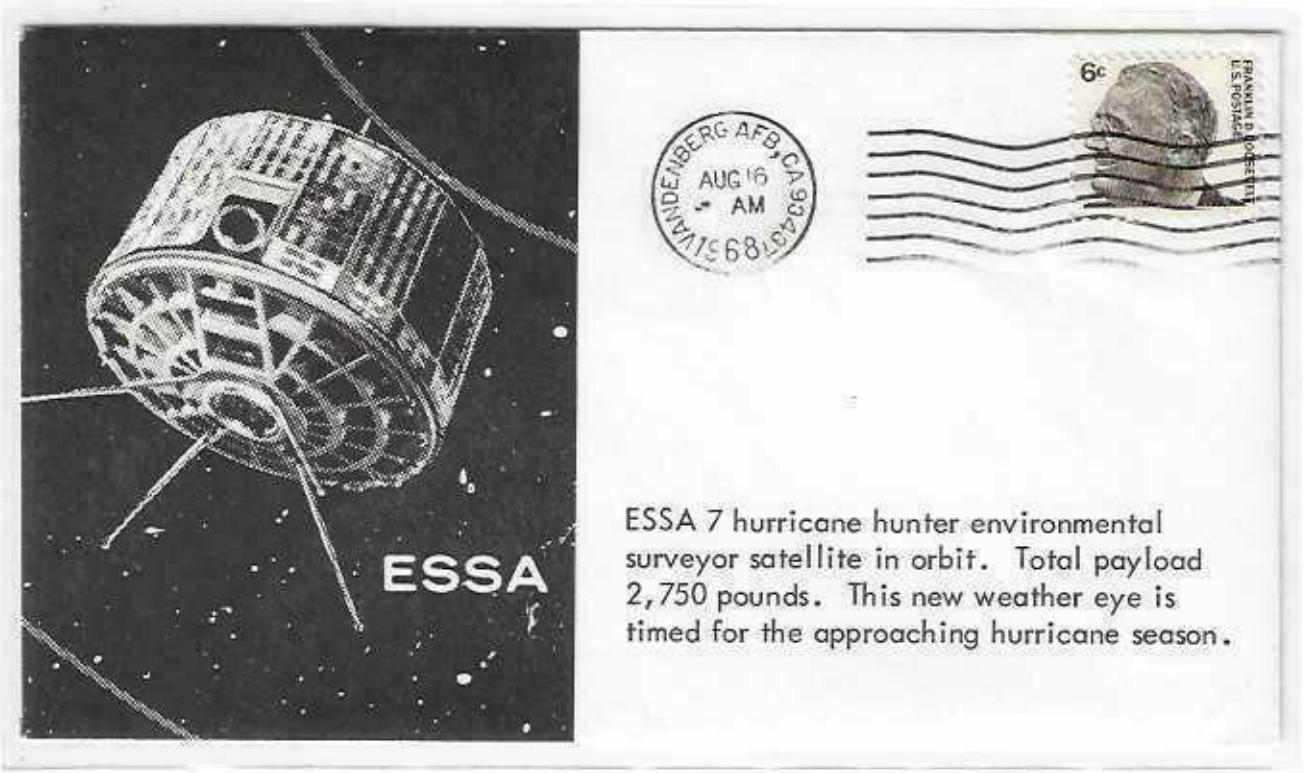
VANDENBERG AFB, CA 93437
JUL 4
AM
1968

RADIO ASTRONOMY EXPLORER
Thor-Delta Booster Rocket

MR. ANGELO J. RECH
125 Ohio Street
Washington, Pa. 15301

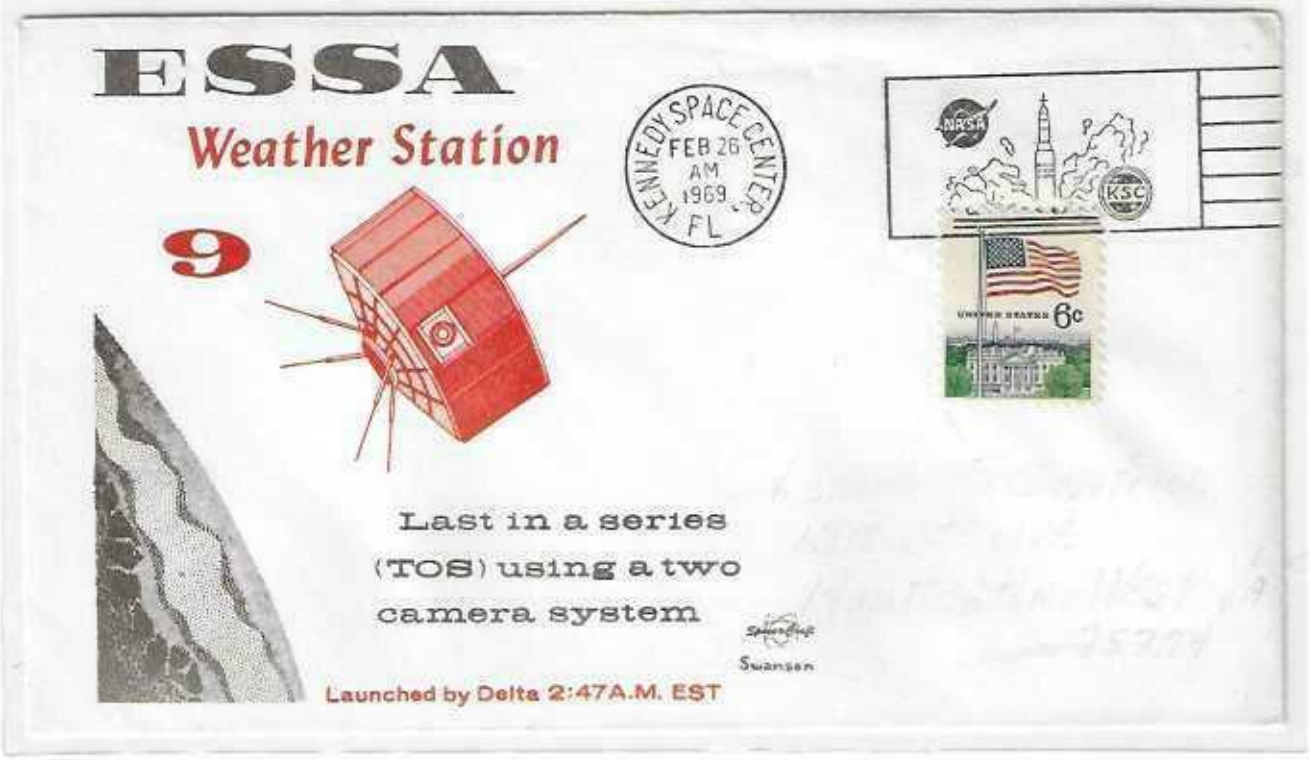
RAE-A (Explorer 38) mission. JULY 4, 1968. Vandenberg AFB machine cancel on the date and time of launch. The Radio Astronomy Explorer-1 spacecraft measured the intensity of celestial radio resources, particularly the Sun, as a function of time, direction and frequency. It was designed for a 1-year minimum operating lifetime. The tape recorder performance began to demonstrate after 2 months in orbit. In spite of several cases of instrument malfunction, good data were obtained on all three antenna systems. Disciplines: astronomy, solar and space physics.

AD-C (Explorer 39), INJUN 5 (Explorer 40) missions. AUGUST 8, 1968. Vandenberg AFB machine cancel on the date and time of launch. Explorer 39 was an inflatable sphere. It was orbited to make atmospheric density determinations. The spacecraft was successfully launched into a nearly polar, highly elliptical orbit. It was folded and carried into orbit together with ejection and inflation equipment as part of the payload of Explorer 40. Discipline: Earth science.

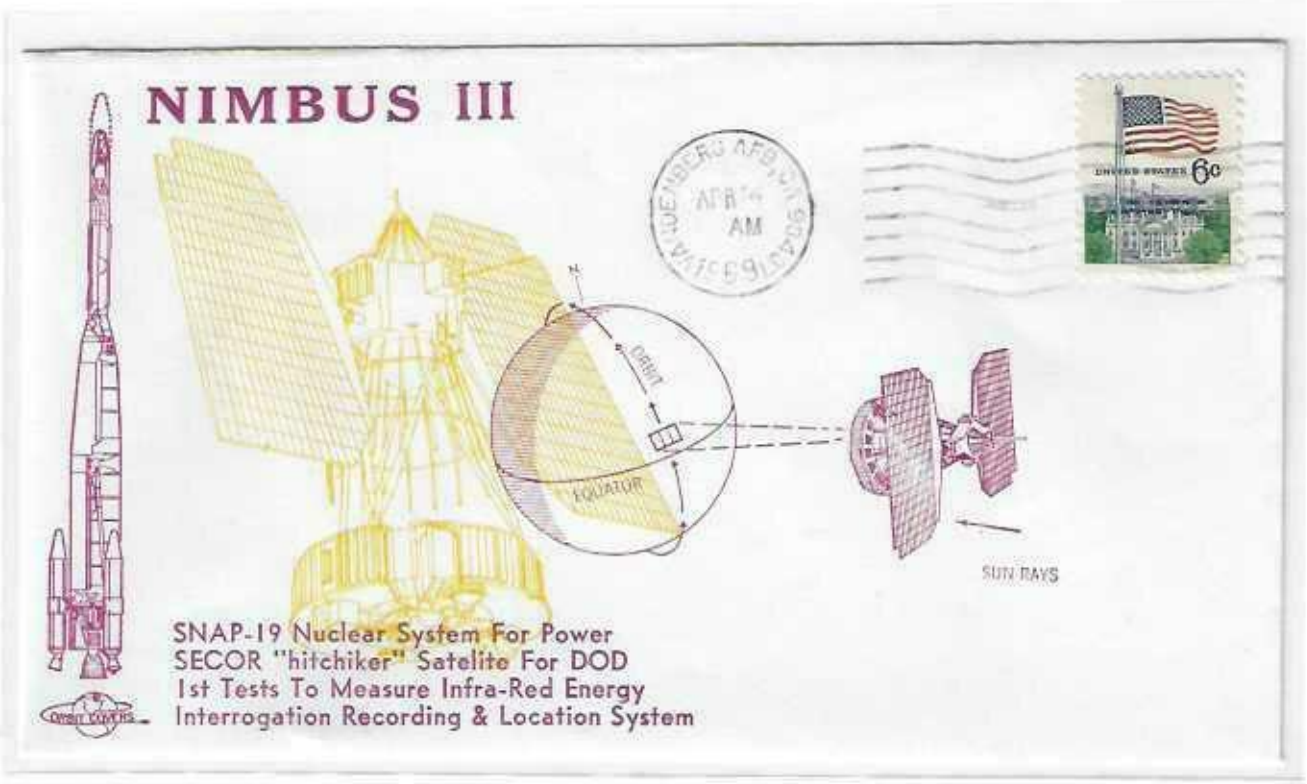


Essa 7 mission. AUGUST 16, 1968. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to take and record daytime Earth-cloud pictures on a global basis for subsequent playback to a ground acquisition facility. The radiometer experiment failed on June 23, 1969. The spacecraft was deactivated on March 10, 1970 after being left on for an additional time period of engineering purposes. Discipline: Earth science.

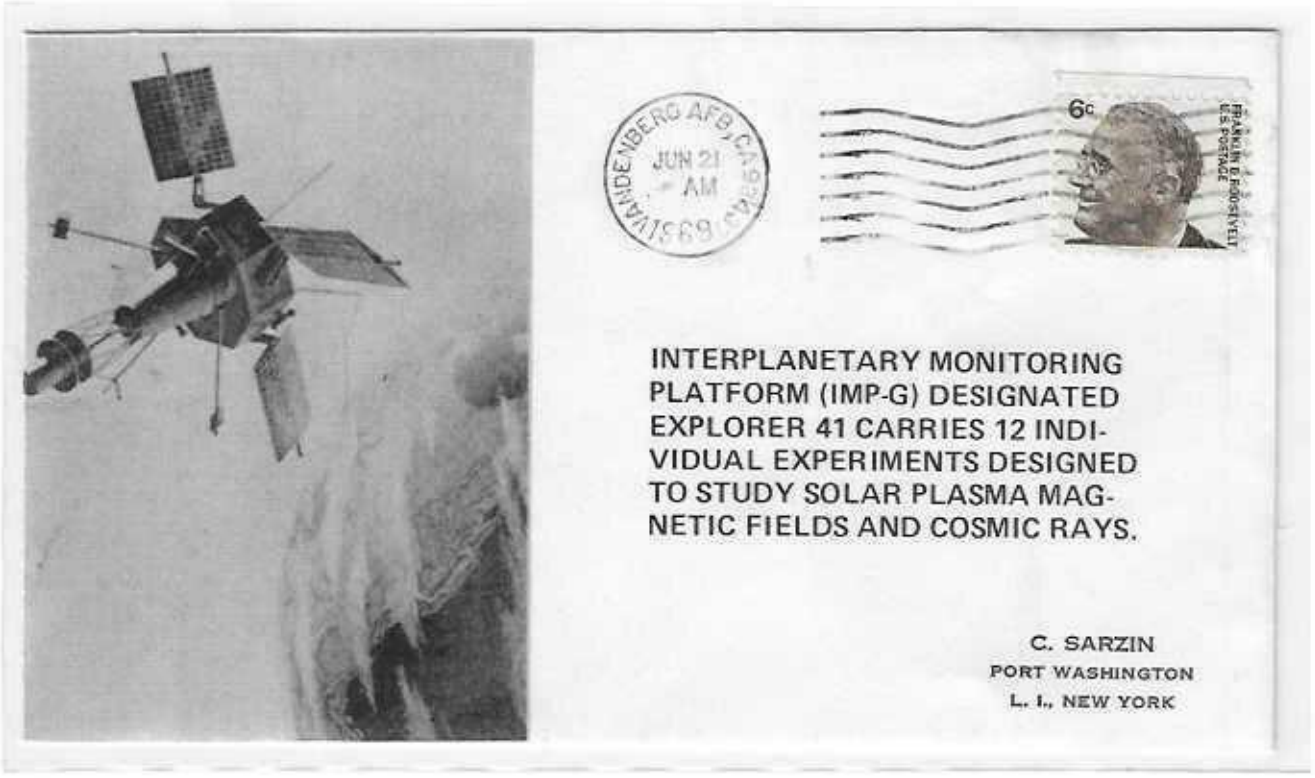
Essa 8 mission. DECEMBER 15, 1968. Vandenberg AFB machine cancel on the date and time of launch. It was a Sun-synchronous operational meteorological satellite designed to provide real-time Earth cloudcover TV pictures to properly equipped ground receiving stations for use in weather analysis and forecasting. Discipline: Earth science.



Essa 9 mission. FEBRUARY 26, 1969. KSC machine cancel on the date and time of launch. It was a Sun-synchronous meteorological satellite designed to take and record daytime Earth cloudcover pictures on a global basis for subsequent playback. The spacecraft was also capable of providing worldwide measurements of reflected solar and long-range radiation leaving the Earth. Following the successful launch of Itos 1, Essa 9 was temporarily deactivated. It was reactivated after Itos 1 ended its operations. The satellite was again turned off in November 1972 with the launching of NOAA 2. Discipline: Earth science.



Nimbus 3 mission. APRIL 14, 1969. Vandenberg AFB machine cancel on the date and time of launch. There are seven experiments onboard including detecting solar UV radiation, providing daytime cloudcover pictures in both real-time mode, assessing the operational capability of radioisotope power for space applications, measuring the emission spectra of the Earth-atmosphere system. On July 22, 1969 IRIS experiment failed. Disciplines: life science, Earth science, solar physics.

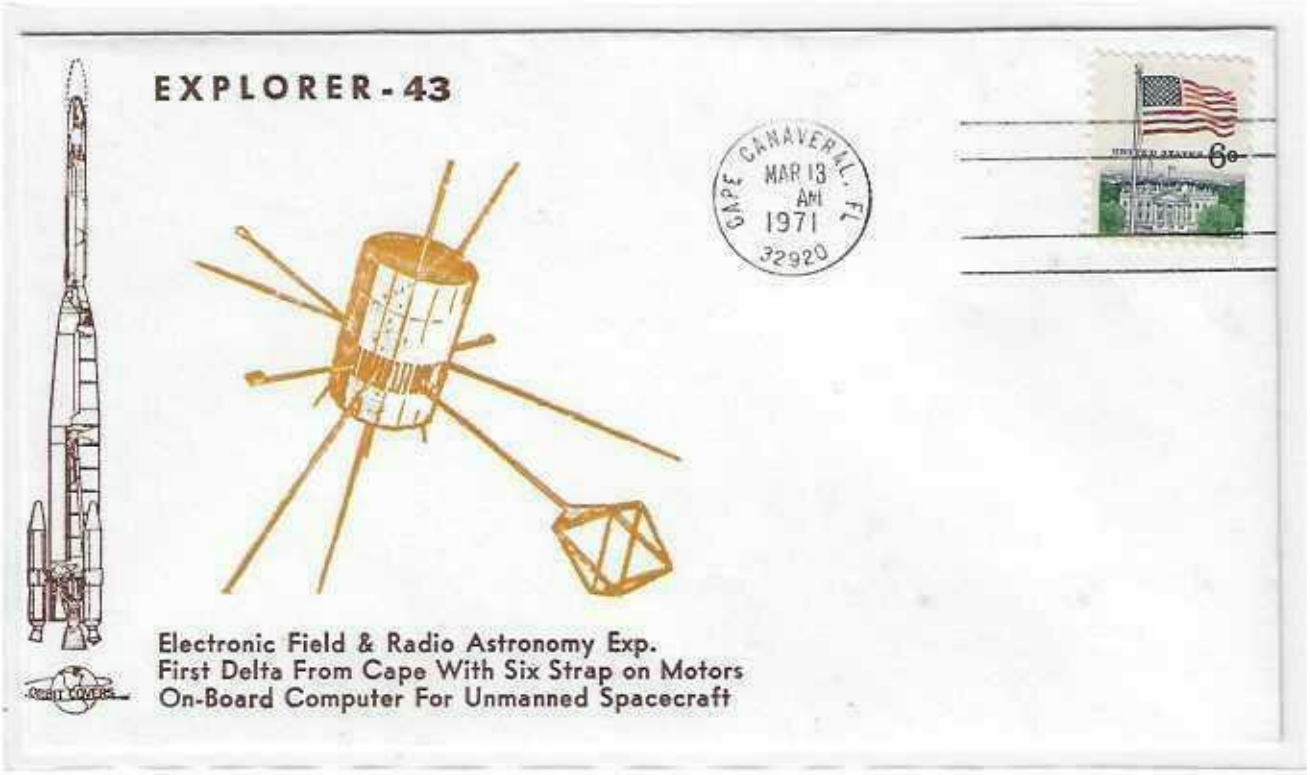


IMP-G (Explorer 41) mission. JUNE 21, 1969. Vandenberg AFB machine cancel on the date and time of launch. It was a spin-stabilized spacecraft placed into a high-inclination, highly elliptic orbit to measure energetic particles, magnetic fields and plasma in cislunar space. The satellite functioned very well from launch until it decayed from orbit on December 23, 1972. Data transmission were nearly 100% for the spacecraft life except for the interval from November 15, 1971 to February 1, 1972.

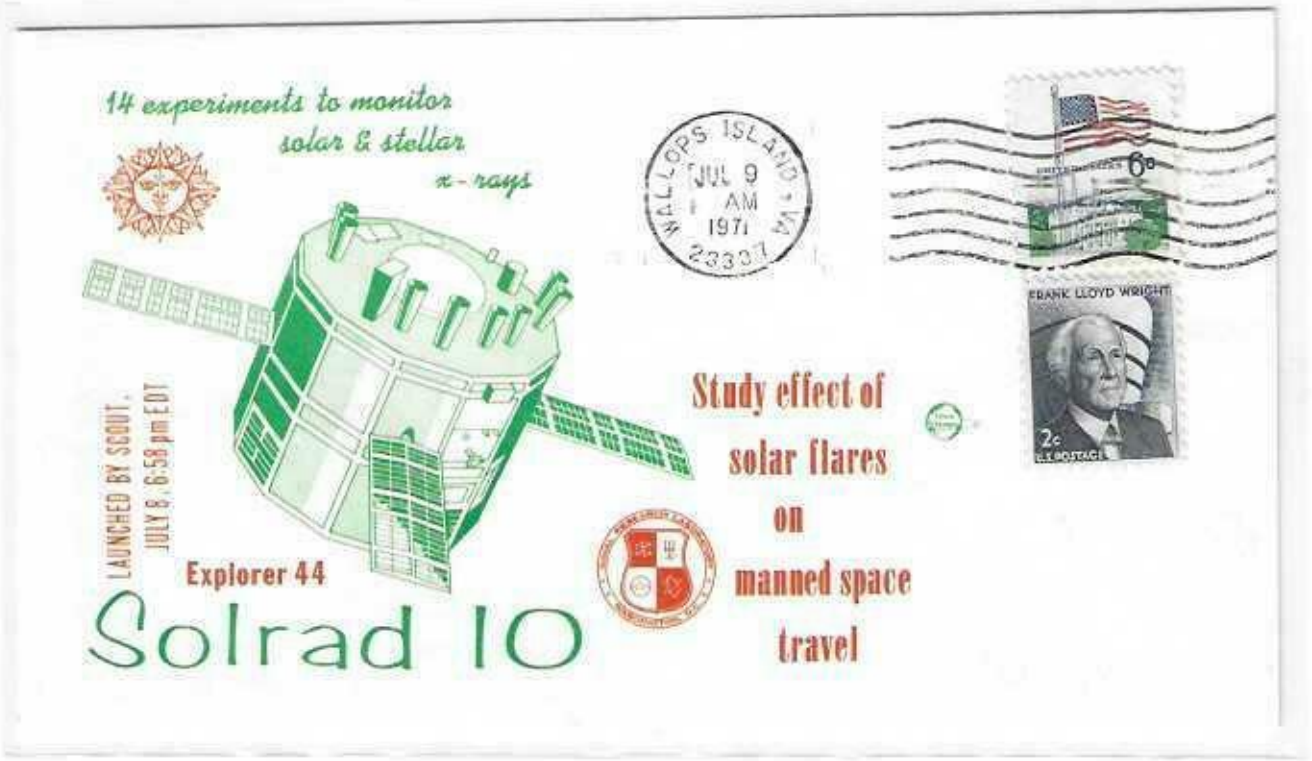
Tiros M (ITOS 1) mission. JANUARY 23, 1970. Lompoc manual cancel on the date and time of launch. The ITOS (Improved Tiros Operational Satellite) series (Tiros M was the prototype spacecraft) were the second generation of operation Sun-synchronous meteorological spacecraft. Operational satellites were renamed NOAA. The primary obiective of ITOS was to provide improved operational infrared and visual observations of Earth cloudcover for use weather analysis and forecasting. Discipline: Earth science.

Nimbus 4 mission. APRIL 8, 1970. Vandenberg AFB machine cancel on the date and time of launch. There are nine experiments onboard including determining the vertical profiles of temperature and water vapor in the atmosphere, monitoring the vertical distribution and total amount of atmospheric ozone on a global scale, locating, interrogating, recording and retrasmitting meteorological and geophysical data from remote collection stations. Disciplines: solar physics, Earth science.

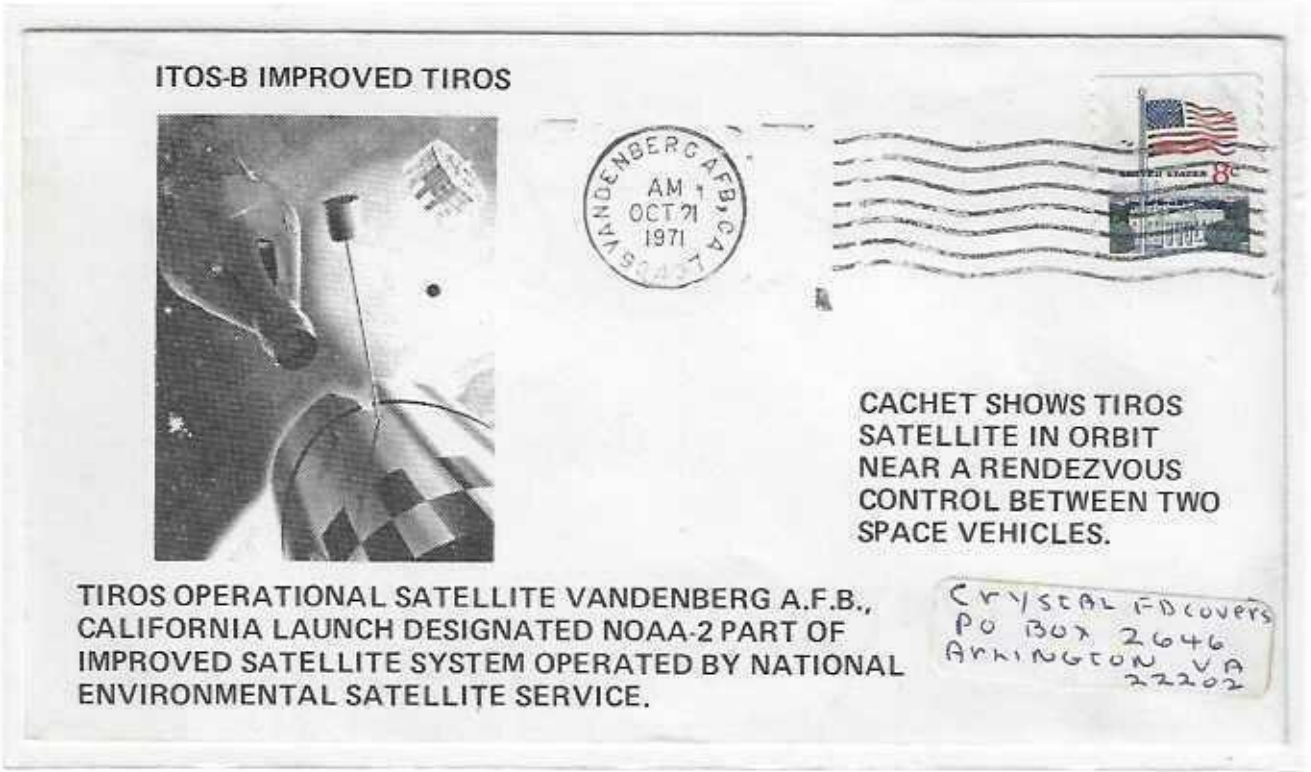
NOAA 1 (Itos A) mission. DECEMBER 11, 1970. Vandenberg AFB machine cancel on the date and time of launch. The nearly cubical spacecraft measured 1 by 1 by 1,2 m. The satellite was equipped with three curved solar panels that were folded during launch and deployed after orbit was achieved. Each panel measured over 4.2 m in lenght when unfolded, and was covered with 3,420 solar cells, each measuring 2 by 2 cm. Discipline: Earth science.



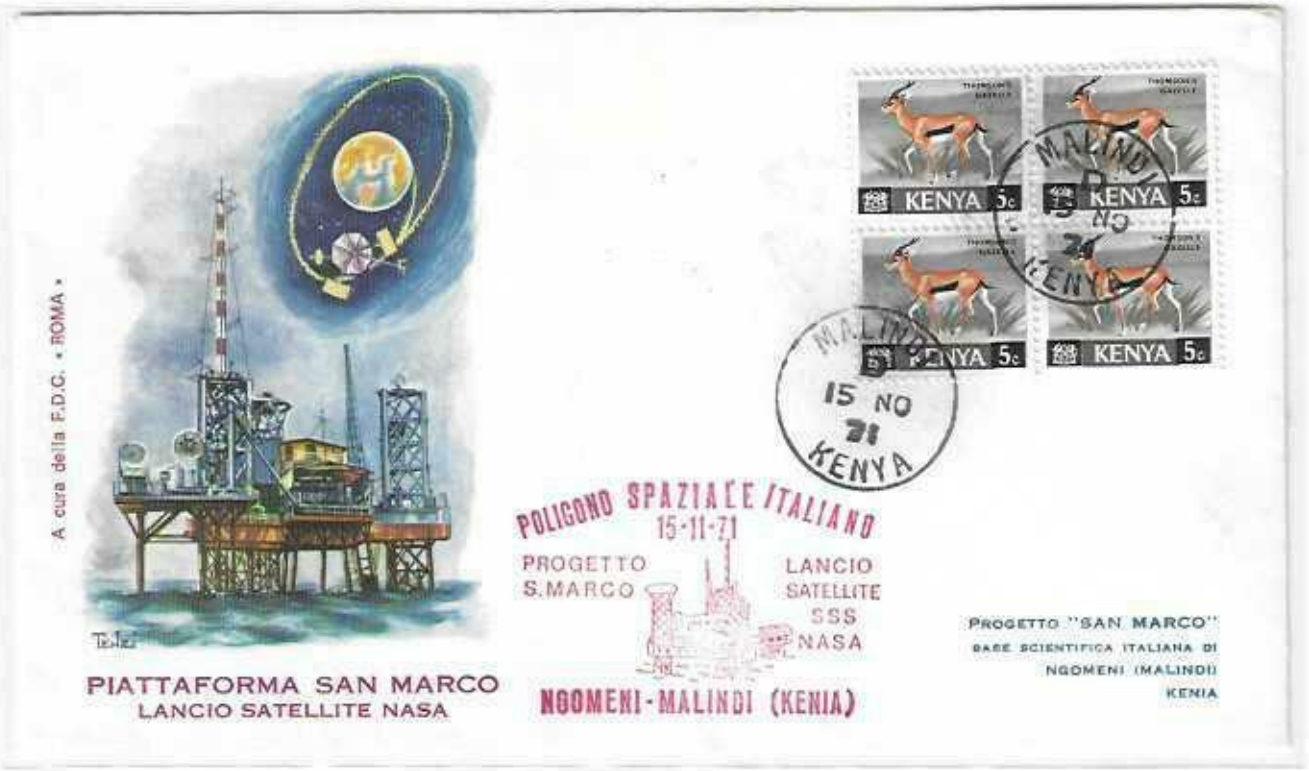
IMP-I (Explorer 43) mission. MARCH 13, 1971. Cape Canaveral machine cancel on the date and time of launch. It continued the study of the interplanetary and outer magnetospheric regions. A radio-astronomy experiment was also included in the payload. Three orthogonal pairs of dipole antennas were used for the electric fields experiments. The members of the pair used in both the electric field and radio-astronomy experiments extended 45.5 m. Disciplines: astronomy, space physics.



Solrad 10 (Explorer 44) mission. JULY 9, 1971. Wallops Island machine cancel. Launched on July 8 by a Scout rocket, it was a spin-stabilized satellite and was one of the SOLRAD series designed to provide continuous coverage of wavelenght and intensity changes in solar radiation in the UV, soft and hard x-ray regions. Eighteen solar sensor were mounted pointing parallel to the spin axis of the satellite, which pointed directly at the solar disc. Discipline: solar physics.

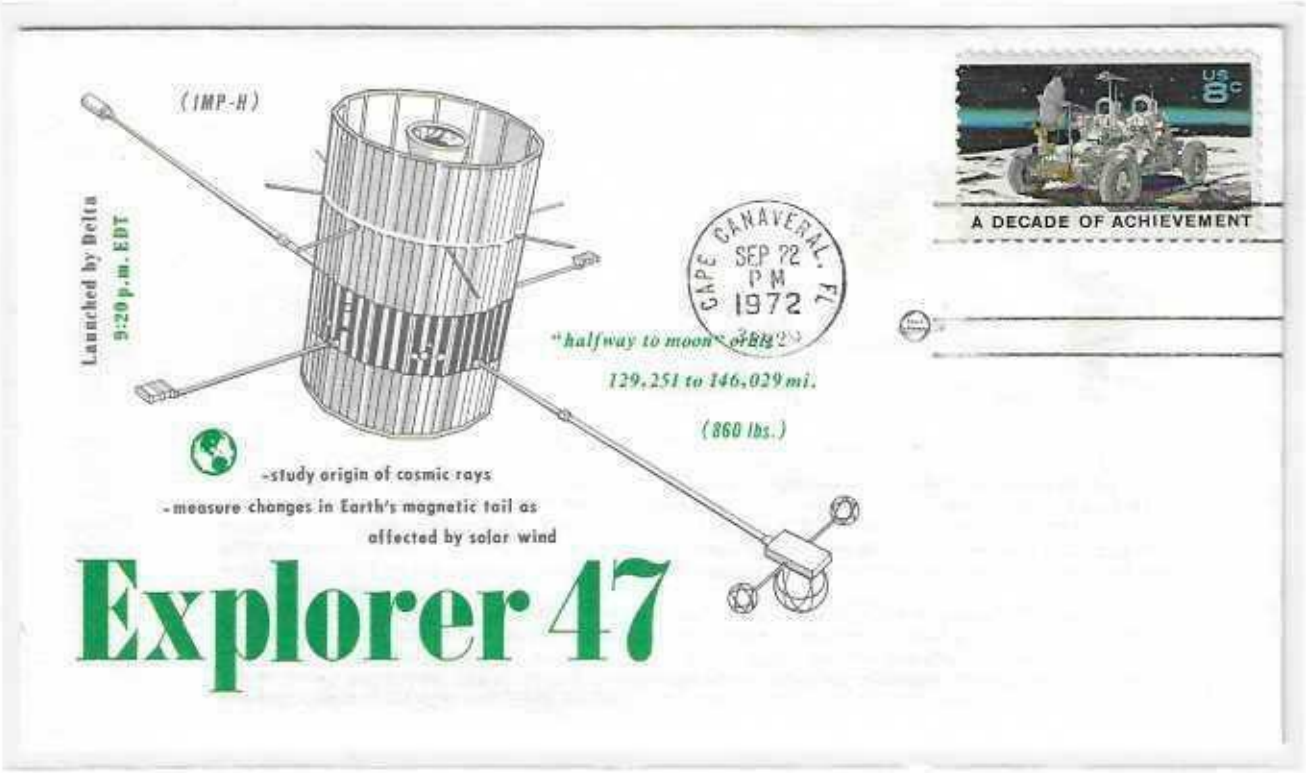


Itos B mission. OCTOBER 21, 1971. Vandenberg AFB machine cancel on the date and time of launch. The TV camera and infrared sensor were mounted on the satellite baseplate with their optical axes directed vertically earthward. The Itos dynamics and attitude control system maintained desidered spacecraft orientation through gyroscopic principles incorporated into the satellite design. Minor adjustments in attitude and orientation were made by means of magnetic coil and by varying the speed of the momentum flywheel. Discipline: Earth science.



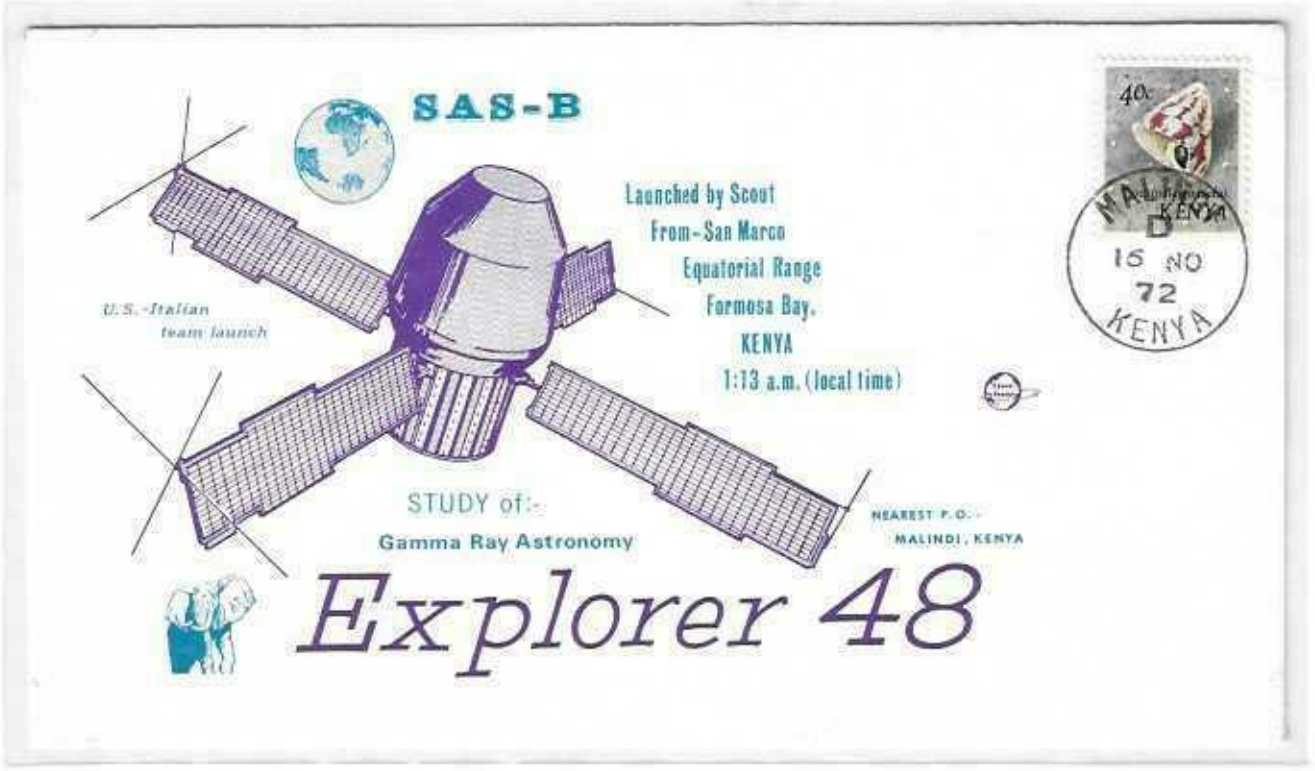
S-Cubed A (Explorer 45) mission. NOVEMBER 15, 1971. Malindi manual cancel on the date and time of launch. Launched by a Scout rocket, it was designed to perform a wide variety of investigations within the magnetosphere with regards to particle fluxes, electric and magnetic fields. It primary scientific objectives were to study the characteristics and origin of the Earth's ring current and development of the main-phase magnetic storms, study the relations between magnetic storms, substorms and the acceleration of charged particles within the inner magnetosphere. Discipline: space physics.

Meteoroid Technology Satellite (Explorer 46) mission. AUGUST 14, 1972. Wallops Island machine cancel. Launched on August 13, its objectives were to measure the meteoroids penetration rates in the bumper-protected target and to obtain data on meteoroid velocity and flux distribution. Bumper targets extended from the satellite giving it an overall widt of 701.5 cm. Discipline: planetary science.

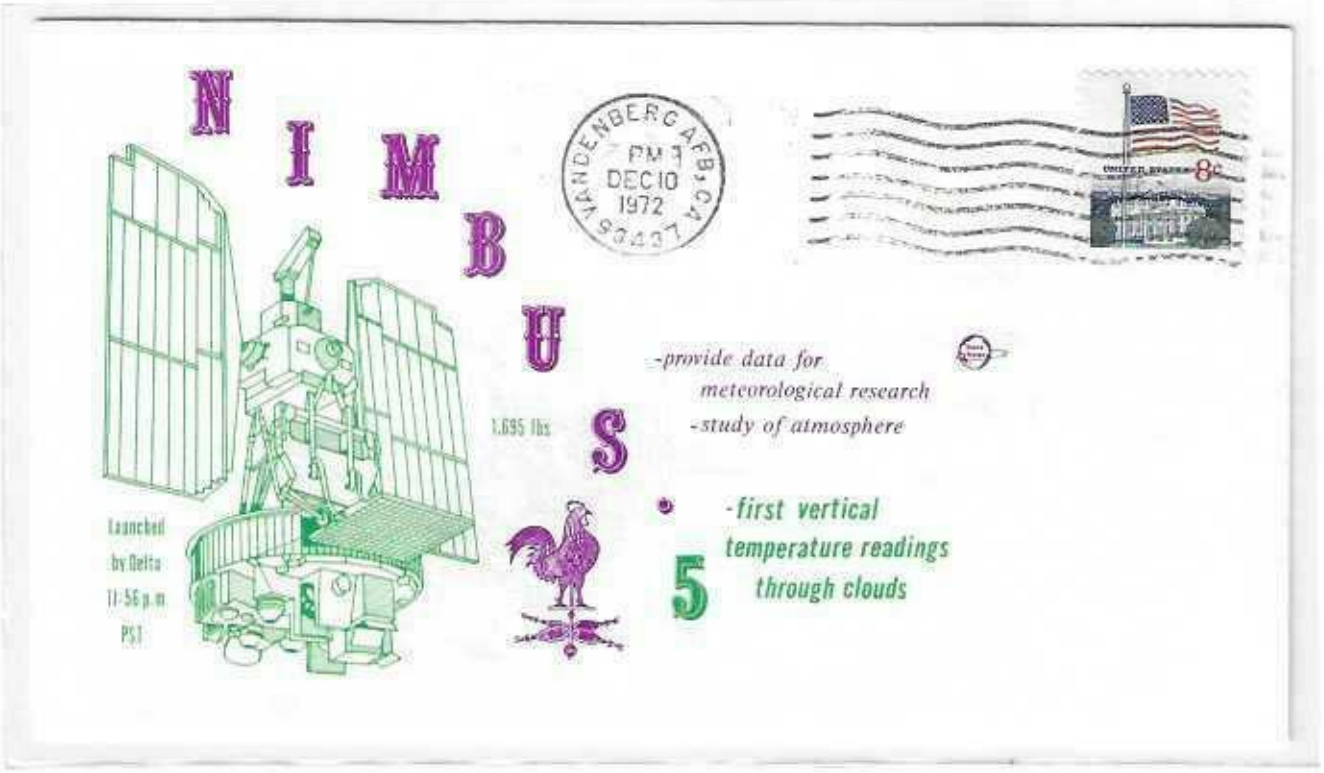


IMP-H (Explorer 47) mission. SEPTEMBER 22, 1972. Cape Canaveral machine cancel. Launched on September 23, the satellite continued the study begun by earlier IMP spacecraft of the interplanetary and magnetotail regions from a nearly circular orbit, near 37 Earth radii. It was designed to measure energetic particles, plasma and electric and magnetic fields. The spacecraft was turned off on October 31, 1978. Disciplines: solar physics, space physics.

NOAA 2 (Itos D) mission. OCTOBER 15, 1972. Vandenberg AFB machine cancel on the date and time of launch. These were a series of reconfigures Itos satellites launched with new meteorological sensors onboard to expand the operational capability of the Itos system. NOAA was not equipped with conventional TV cameras. It was the first operational weather satellite to rely solely upon radiometric imaging to obtain cloudcover data. Discipline: Earth science.

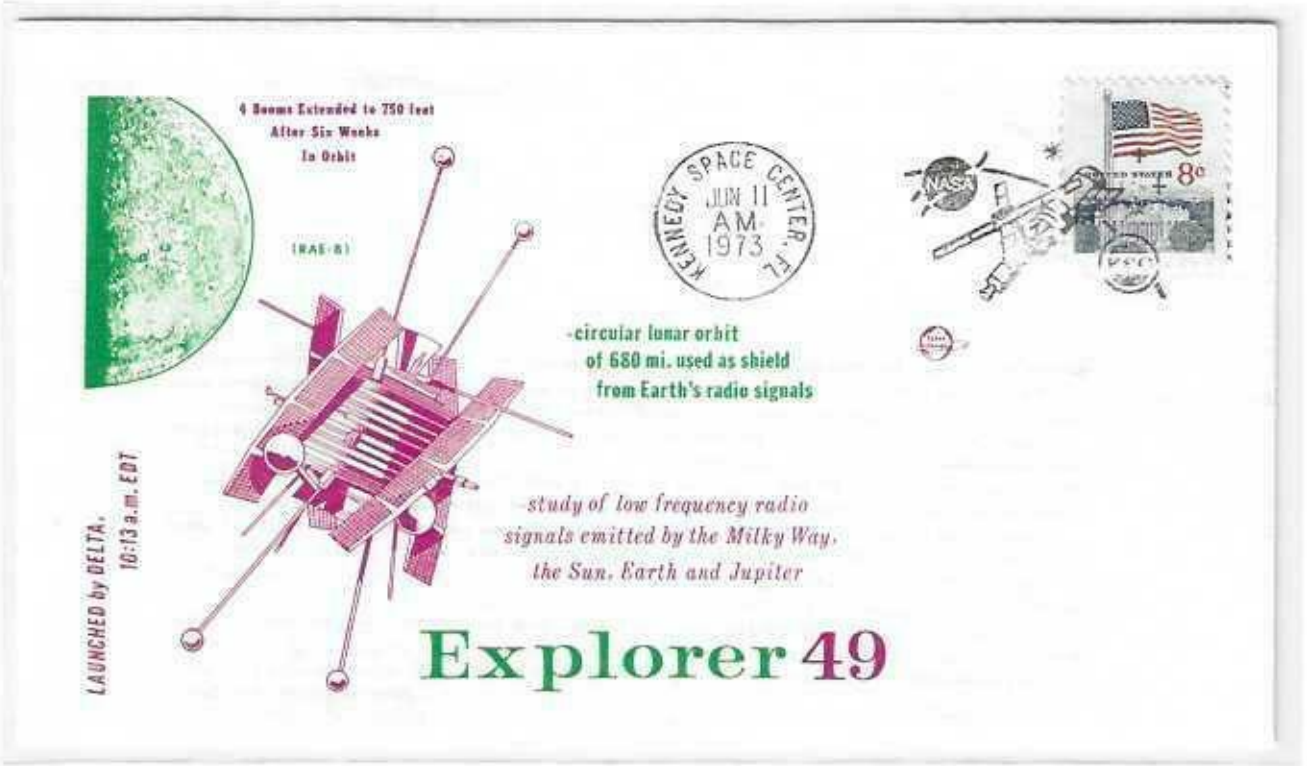


SAS-B (Explorer 48) mission. NOVEMBER 15, 1972. Malindi manual cancel on the date and time of launch. It was the second in the series of small spacecraft designed to extend the astronomical studies in the x-ray, gamma ray, ultraviolet, visible and infrared regions. The primary objective was to measure the spatial and energy distribution of primary galactic and extragalactic gamma radiation with energies between 20 and 300 MeV. Discipline: astronomy.

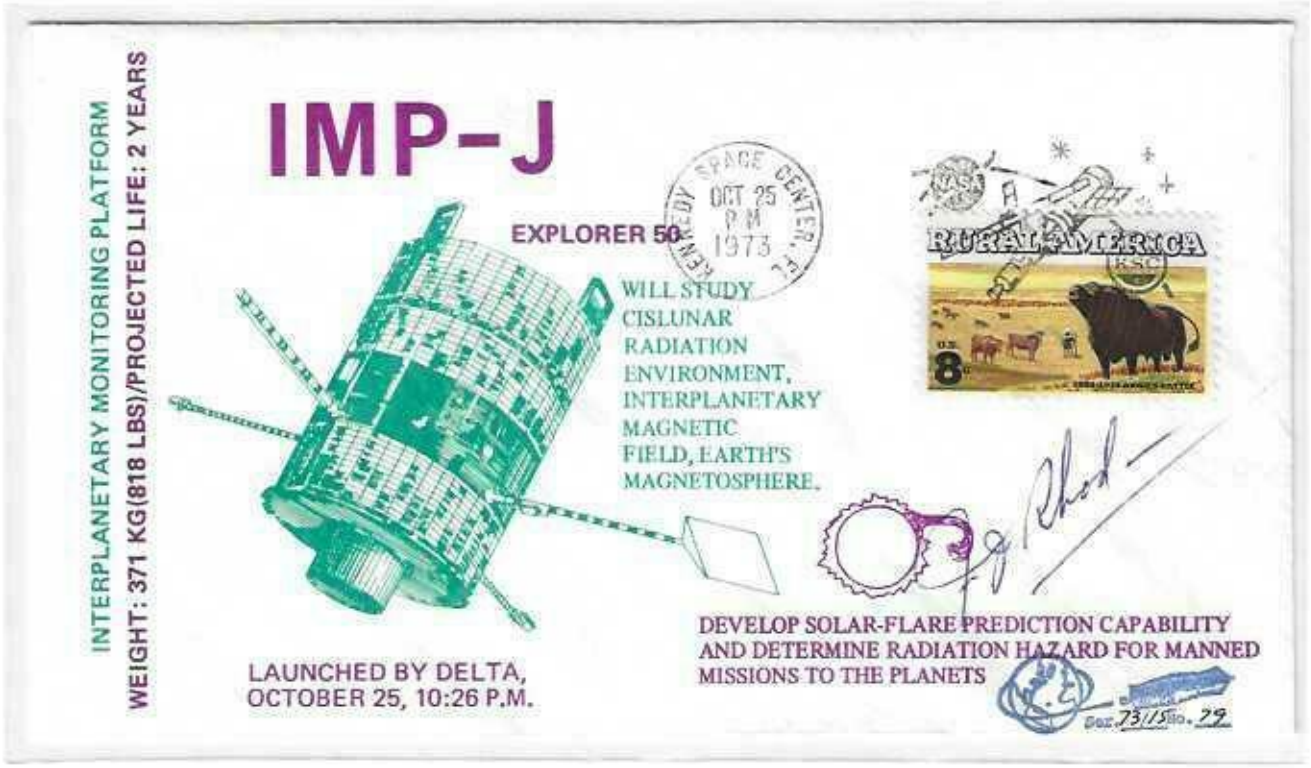


Nimbus 5 mission. DECEMBER 10, 1972. Vandenberg AFB machine cancel on the date and time of launch. There are six experiments onboard including mapping the microwave radiation from the Earth's surface and atmosphere, obtaining vertical profiles of temperature and moisture, determining tropospheric temperature profiles, atmospheric water vapor abundances and cloud liquid water contents, measuring the differences in the thermal emission and characteristics of the Earth's surface. Discipline: Earth science.

Itos E mission. JULY 16, 1973. Greenbelt machine cancel on the date and time of launch. The primary sensors consisted of Very High Resolution Radiometer (VHRR), Vertical Temperature Profile Radiometer (VTPR) and Scanning Radiometer (SR). Discipline: Earth science.

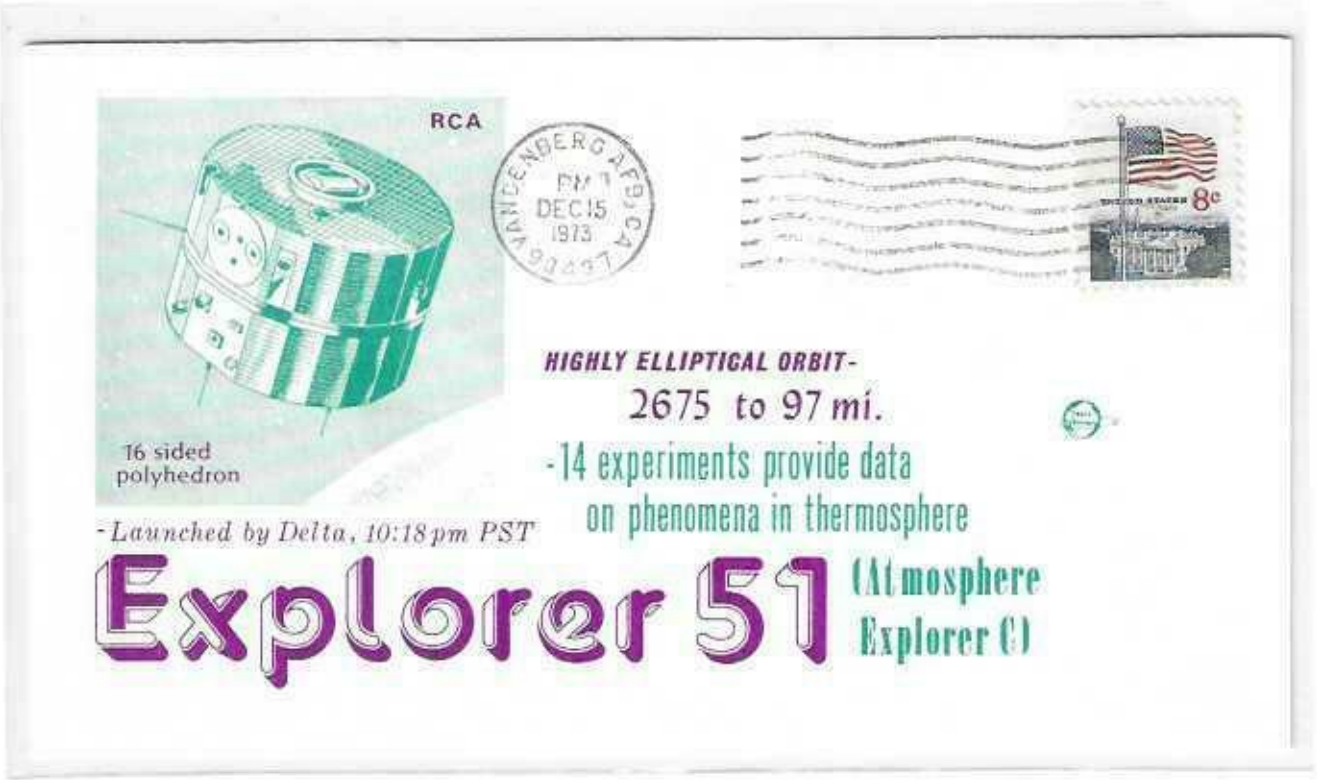


RAE-B (Explorer 49) mission. JUNE 11, 1973. KSC machine cancel. Launched on June 10, the satellite was placed into lunar orbit to provide radio astronomical measurements of the planets, the Sun and the galaxy, over the frequency range of 25 Khz to 13.1 Mhz. The lunar orbit and position of the Earth as a radio source, imposed periodicities on the observations of 29.5 days (the lunar synodic month) and 24.8 hours (the interval between consecutive sweeps of a given Earth geographic position past the Moon. Disciplines: astronomy, planetary science, solar and space physics.



IMP-J (Explorer 50) mission. OCTOBER 25, 1973. KSC machine cancel on the date and time of launch. It was the last satellite of the IMP series, instrumented for interplanetary and magnetotail studies of cosmic rays, energetic solar particles, plasma and electric and magnetic fields. Telemetry acquisition resumed after about three months at Canberra only (30-50% coverage), as an adjunct to the Voyager and Ulysses missions. The last useful science data from IMP-J was acquired on October 7, 2006. Discipline: space physics.

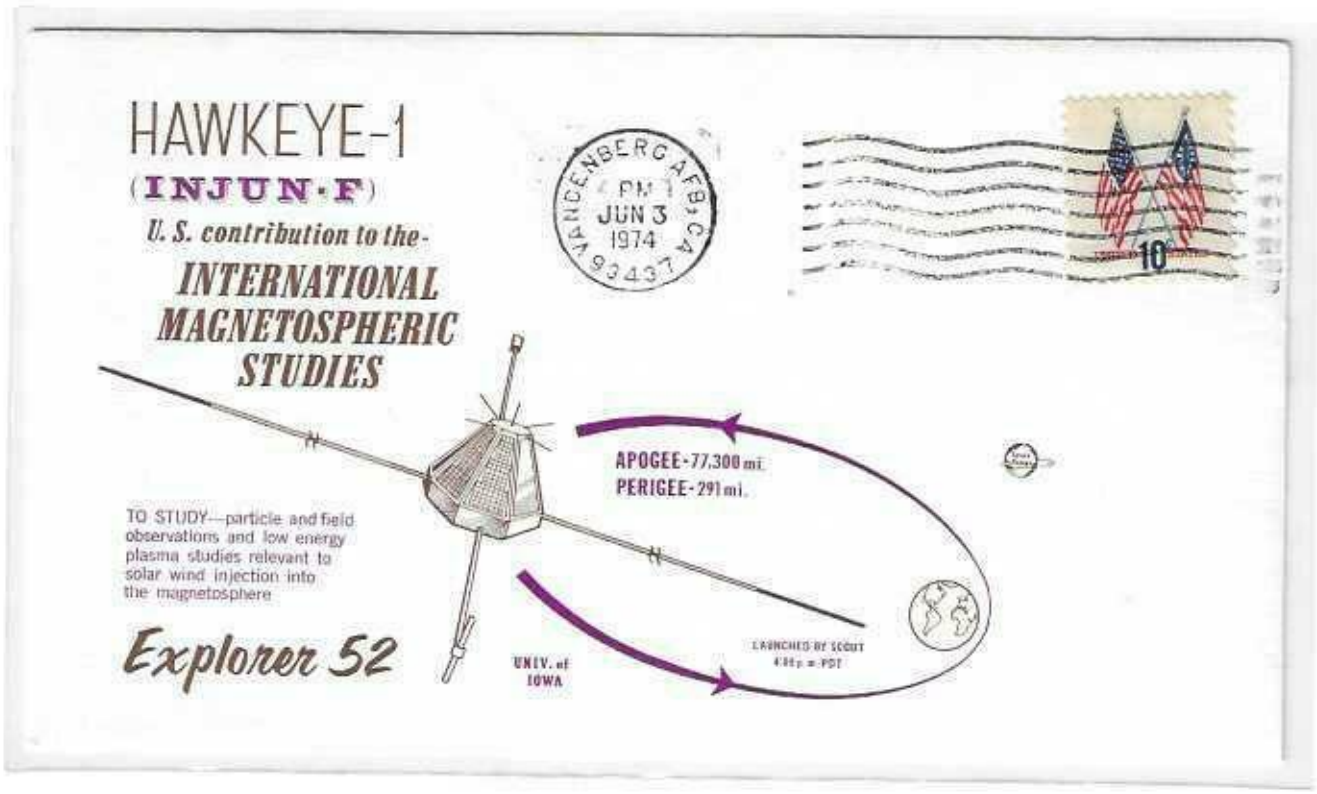
NOAA 3 (Itos F) mission. NOVEMBER 6, 1973. Vandenberg AFB machine cancel on the date and time of launch. The primary objective of NOAA was to provide global daytime and night-time direct readout real-time cloudcover data on a daily basis. The Sun-synchronous spacecraft was also capable of supplying global atmospheric temperature soundings and very high resolution infrared cloudcover data for selected areas in either a direct readout or a tape-recorder mode. Discipline: Earth science.



AE-C (Explorer 51) mission. DECEMBER 15, 1973. Vandenberg AFB machine cancel. Launched on December 16 from Cape Canaveral, the payload included instrumentation for the measurement of solar UV, composition of positive ions and neutral particles, density and temperature of neutral particles, positive ions and electrons, airglow emissions, photoelectron energy spectra and proton and electron fluxes. Disciplines: Earth science, solar physics, space physics.

AD-A (Explorer 19) mission. DECEMBER 19, 1963. Vandenberg AFB machine cancel on the date and time of launch. It was the second in a series of 3.66 m inflatable spheres placed into orbit to determine atmospheric densities. The satellite was launched while Explorer 9, the first satellite in the series, was still active, so that densities in two different portions of the atmosphere were sampled simultaneously. The spacecraft was successfully orbited, but its apogee was lower than planned. Discipline: Earth science.

Westar 1 mission. APRIL 13, 1974. Cape Canaveral manual cancel on the date and time of launch. Launch vehicle for Westar was the three-stage Delta, with nine strap-on motors. The launchings were conducted by the NASA under a contract from Western Union. Three Westar satellites were purchased by Western Union, one of the first applicants in the U.S. to win approval from the Federal Communications Commission to operate a domestic satellite. Discipline: communications.



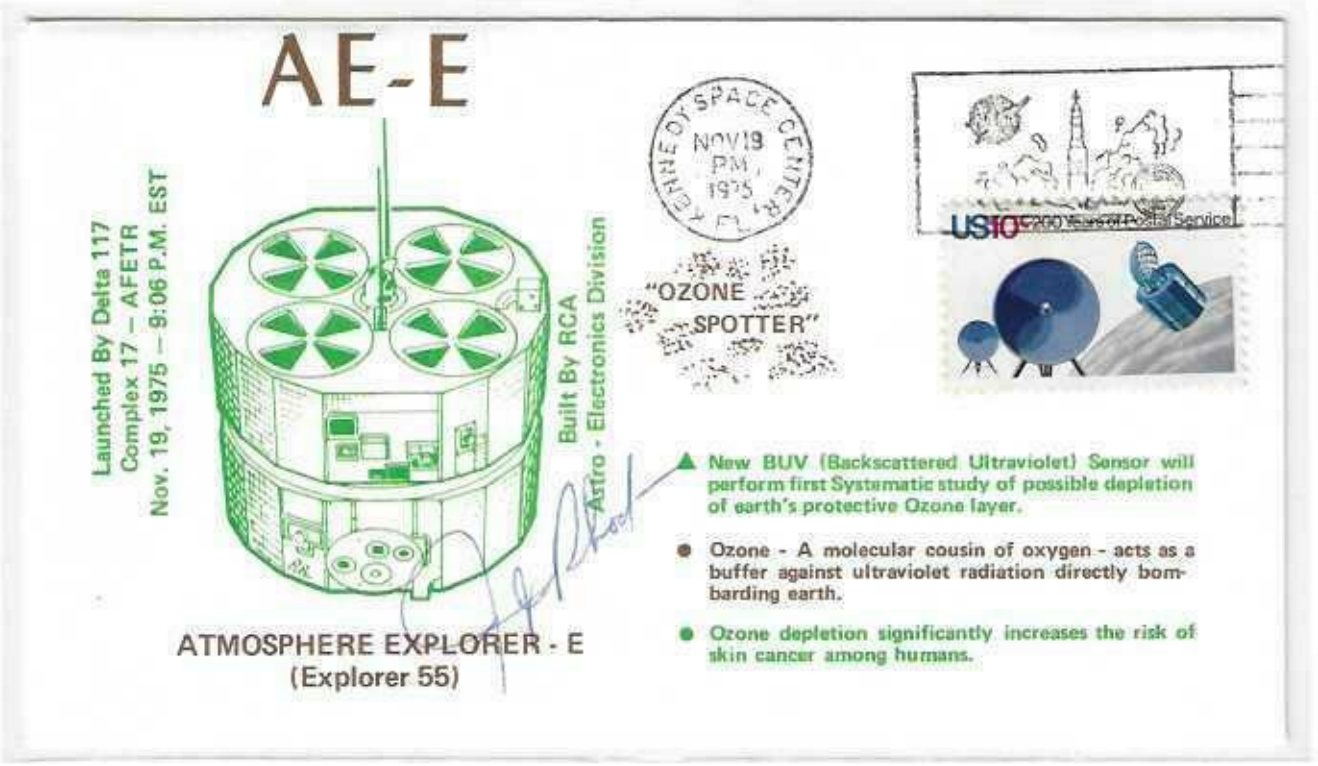
Hawkeye (Explorer 52) mission. JUNE 3, 1974. Vandenberg AFB machine cancel on the date and time of launch. The primary mission objective was to conduct particles and fields investigations of the polar magnetosphere of the Earth out to 21 Earth radii. The mission participated in the International Magnetospheric Study (IMS), and during the first half of 1977 data acquisition was confined to IMS. Discipline: space physics.

Westar 2 mission. OCTOBER 10, 1974. KSC machine cancel on the date and time of launch. The successful launch of Westar 1, America's first domestic communications satellite, signaled the start of a new era of communications in the USA. Westar, built by Hughes Aircraft Company, today know as Boeing Satellite Development Center, is similar to the Anik satellites Hughes designed and build for Canada's domestic system, and the Palapa satellites built for Indonesia. Discipline: communications.

SAS-C (Explorer 53) mission. MAY 7, 1975. Greenbelt machine cancel on the date and time of launch. The spacecraft was launched from San Marco platform into a near-circular, equatorial orbit. SAS-C was the third in the series of small spacecraft whose objectives were to survey the celestial sphere for sources radiating in the x-ray, gamma ray and other spectrals regions. Discipline: astronomy.

Nimbus 6 mission. JUNE 12, 1975. Vandenberg AFB machine cancel on the date and time of launch. There are nine experiments onboard. The complement of advanced sensors was capable of mapping tropospheric temperature, water vapor abundances and cloud water content, providing vertical profiles of temperature, ozone and water vapor, transmitting real-time data to a geostationary spacecraft (ATS 6) and yielding data on the Earth's radiation budget. Discipline: Earth science.

AE-D (Explorer 54) mission. OCTOBER 6, 1975. Vandenberg AFB machine cancel on the date and time of launch. The purpose of the mission was to continue the investigations begun by AE-C (Explorer 51) mission of the chemical processes and energy transfer machanisms that control the structure and behavior of the Earth's atmosphere and ionosphere in the region of high absorption of solar energy. This mission was planned to sample the high latitude regions at the same time that AE-E (Explorer 55) mission was sampling the equatorial and low latitude regions. Disciplines: engineering, Earth science, solar and space physics.

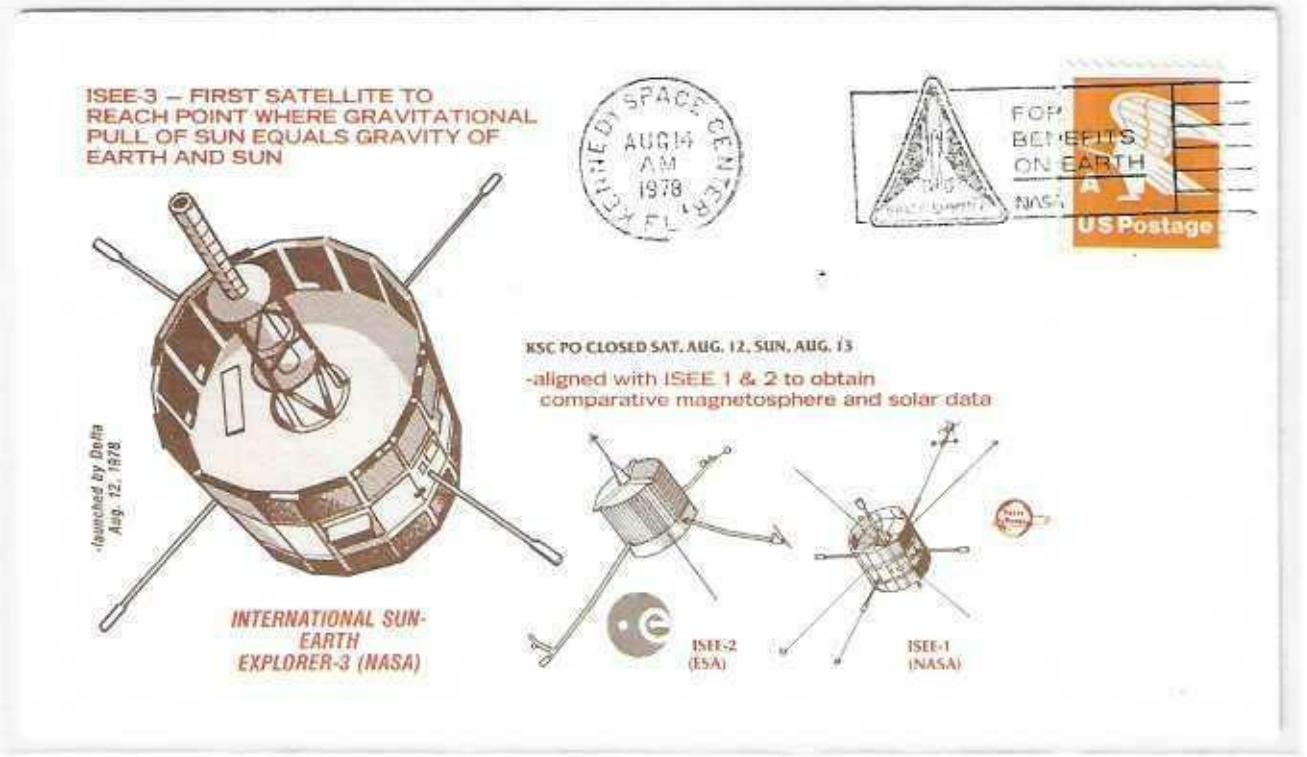


AE-E (Explorer 55) mission. NOVEMBER 19, 1975. KSC machine cancel on the date and time of launch. The purpose of the mission was similar to AE-D (Explorer 54) mission. The simultaneous sampling at higher latitudes was carried out by the AE-D spacecraft until its failure, and then by AE-C until it reentered on December 12, 1978. Disciplines: Earth science, solar physics, space physics.

ISEE 1 (Explorer 56) mission. OCTOBER 22, 1977. Cape Canaveral machine cancel on the date and time of launch. The Explorer-class mother spacecraft, International Sun-Earth Explorer 1, was part of the mother/daughter/Heliocentric mission. The mother/daughter portion of the mission consisted of two spacecraft (ISEE 1 and 2) with stationkeeping capability in the same highly eccentric geocentric orbit with an apogee of 23 Earth radii. Both ISEE 1 and ISEE 2 reentered the Earth's atmosphere during orbit 1,518 on September 26, 1987. Disciplines: astronomy, space physics.

IUE (Explorer 57) mission. JANUARY 26, 1978. KSC machine cancel on the date and time of launch. The International Ultraviolet Explorer satellite was a spaceborne ultraviolet astronomical observatory for use as an international facility. The satellite and optical instrumentation were provided by the Goddard Space Flight Center. The ESA supplied solar paddles for the satellite and a European Control Center. Disciplines: astronomy, planetary science, space physics.

HCMM (Explorer 58) mission. APRIL 26, 1978. Vandenberg AFB machine cancel on the date and time of launch. The Heat Capacity Mapping Mission spacecraft was the first of a series of Application Explorer Mission (AEM). The objective of HCMM was to provide comprehensive, accurate, high-spatial-resolution thermal surveys of the surface of the Earth. Only real-time data were transmitted when the satellite came within reception range of seven ground stations. Discipline: Earth science.



ISEE 3 (Explorer 59) mission. AUGUST 14, 1978. KSC machine cancel. Launched on August 12, it was the first spacecraft to use halo orbit. The Explorer-class heliocentric spacecraft, International Sun-Earth Explorer 3, was part of the mother/ daughter/heliocentric mission (ISEE 1, 2 and 3). In conjunction with the mother and daughter spacecraft, which had eccentric geocentric orbit, this mission explored the coupling and energy transfer processes between the incident solar wind and the Earth's magnetosphere. Disciplines: astronomy, planetary science, solar and space physics.

Westar 3 mission. AUGUST 9, 1979. Greenbelt manual cancel. Launched on August 10, operating in synchronous orbit 22,300 miles above the Equator, the satellite relay voice, video and data communications to the continental U.S. as well Alaska, Hawaii and Puerto Rico. Western Union's primary Earth station is in Glenwood, New Jersey, near New York city. Additional Earth station in the Westar system are located near Atlanta, Chicago, Dallas and Los Angeles. Designed lifetime in orbit for each satellite is 7 years. Discipline: communications.