

Historian Corner

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Program Profile

This issue's profile is of the first lunar landing, the Apollo 11 mission. The 50th anniversary of this phenomenal mission occurred in July of 2019. Heritage company contributions to the Apollo program are also listed. To save space in the MARS STAR, future Historian Corners will feature either a program profile or a History on the Road article. Historical information and program updates are always available on the MARS Associates Facebook page. No History on the Road or quiz question is included in this edition, due to the length of the program profile.

Apollo 11 Mission



Apollo 11 Crew -- Commander: Neil A. Armstrong (left), Lunar Module Pilot: Buzz Aldrin (right), Command Module Pilot: Michael Collins (center) (Photo Credits: NASA)

Launched: 07/16/1969 09:32:00 AM EDT LC-39A

Splashdown: 07/24/1969 12:50:00 PM EST, Pacific near Wake Island, USS Hornet recovery ship

Saturn V AS-506 Launch Vehicle

Translunar Trajectory

30 lunar orbits

Landing site: Sea of Tranquility, located at lunar coordinates 0.71 degrees north, 23.63 degrees east

CSM Call Sign: Columbia (CSM-107)

LM Call Sign: Eagle (LM-5)

On June 26, 1969, George E. Mueller, Associate Administrator for NASA (Office of Manned Space Flight) and USAF Lt. General Sam C. Phillips signed and released the primary Apollo Program mission objective in

document M-932-69-11, which stated succinctly: "Perform a manned lunar landing and return". A month later, the millions of derived requirements and specifications, test and mission protocols, design solutions, contractor deliveries, and crew resources that came from this simple primary objective were met in the successful launch, lunar orbit/landing, and return of the Apollo 11 mission.

A personal note: I was 13 years old that summer and this event occupied my time above and beyond anything else that our family had planned. I saw the launch at a motel in Yuma, Arizona while on a family vacation (yes, it was hot there!). We got home to Colorado before the landing in the early afternoon on July 20 and I paced the living room waiting for confirmation of success and, to this day, still get tears in my eyes remembering the speechless reaction of Walter Cronkite and the cheers in Mission Control when the Eagle landed. That evening, we all gathered in front of the TV (along with 650 million people worldwide) and watched in awe the first walk on the moon by Armstrong and Aldrin. I knew at the moment, that I wanted to be an engineer or scientist and work in the space program. Girls didn't become engineers or scientists in those days, but I was not going to let that stop me! I will have more of this personal story when I profile the Apollo 15 mission in a future historian corner.



Apollo 11 Saturn V Launch, July 16, 1969

Back to the Apollo 11 story: Two hours and 44 minutes after a picture-perfect launch on July 16, the Saturn IVB engine re-ignited for a second burn to place Apollo 11

Apollo 11 Lunar EVA: July 20, 1969

into a translunar trajectory. The CSM Columbia rotated, the crew retracted the LM Eagle, the IVB stage was jettisoned, and the crew was on their way to the moon. Only one of the four planned midcourse corrections was required during the translunar coast. The LM was accessed by Aldrin and Armstrong on July 18 for checkout and the Service Propulsion System (SPS) orbital insertion burn on July 19 placed the two spacecraft into lunar orbit (the finalized elliptical orbit was 62 by 70.5 nm).

Armstrong and Aldrin climbed into the LM for the second time on July 20 and separated from Columbia. Mike Collins was on his own now, for the duration of the descent, landing and return of Eagle. The LM entered a highly elliptical orbit first (almost identical to Apollo 10), then the descent engine was fired for 756 seconds to start the final descent to the orbital location known as "high gate" (26,000 feet in altitude and five miles from the landing site).

The hair-raising descent of Eagle is recalled by those who watched the events or were directly involved, or if you read the superbly detailed Apollo Flight Journals. There were several flight computer memory "overflow" errors that were quickly assessed as non-critical (the now-famous 1201 and 1202 alarms, due in part to spurious data from rendezvous radar) and Mission Commander Armstrong had to take manual control of the LM during the final minutes of the landing to avoid a large crater. At this point, the mission was less than 30 seconds away from the critical Bingo call, which would have required a hard landing and quick ignition of the ascent stage due to fuel depletion in the descent stage. At 102 hours, 45 minutes into the flight, Armstrong spoke the historic words "Houston, Tranquility Base Here – The Eagle has Landed"; future Apollo 16 astronaut Charlie Duke (CAPCOM) responded, in his laconic southern accent: "Roger, Tranquility, we copy you down on the ground. You got a bunch of guys about to turn blue. We're breathing again. Thanks a lot!"



After landing, the decision was made to accelerate the egress and surface activities and postpone a planned rest period. The post-landing and EVA preparations still took several hours. Finally, Armstrong emerged from the LM, carefully descended the ladder, and at 109 hours, 23 minutes elapsed time into the mission, he spoke those amazing words that we all remember: "That's one small step for [a] man, one giant leap for mankind". Twenty minutes later, he was joined by Buzz Aldrin ("Magnificent desolation"). The EVA, which was more than 2.5 hours long, consisted of sample gathering, deployment of the flag, deployment of the EASEP (Early Apollo Scientific Experiments Package), ceremonial activities, including a live call to the astronauts on the surface from President Nixon, and the taking of many photographs by Commander Armstrong (a second Hasselblad camera was left in the LM). Two of the CAPCOMs during the lunar surface activities included Bruce McCandless, who would later fly the MMU built by Martin Marietta and work for Lockheed Martin, and Ron Evans (CSM pilot on Apollo 17).

After the crew returned to the LM, they had a seven-hour sleep period, then prepared for the ascent from the lunar surface. At 124 hours and 22 minutes into the mission, the ascent engine on Eagle fired and the complex rendezvous process with the CSM and Mike Collins began. Four hours after this process began, Collins took control for the final few seconds of rendezvous and docking and the two spacecraft were together again. The two moonwalkers returned to the CSM and Eagle was jettisoned four hours after docking.

Trans-Earth injection began on July 21, with a CSM SPS engine burn for 2.5 minutes on the far side of the moon, on the 59th orbit by Columbia. All three astronauts, after this crucial event, slept for 10 hours. Only one course correction burn was required during the return flight and the astronauts had two television broadcasts, thanking the many people who worked on this program for its success.

Re-entry procedures were initiated on July 24. The SM separated from the CM, oriented for proper entry with heatshield down, and 195 hours, 18 minutes, and 35 seconds after liftoff, Apollo 11 splashed down 13 miles from the recovery ship USS Hornet. The splashdown zone was changed late in the re-entry process due to weather in the primary zone.



Mission Control after splashdown, 7/24/1969

The astronauts donned contamination suits and were quickly brought on board USS Hornet. President Nixon and some of his key advisors were present on the ship. The crew was escorted into the Mobile Quarantine Facility, a converted Airstream trailer and their home for almost three weeks to ensure no contagions were brought back from the moon. The Mobile Quarantine Facility was flown to Houston; after the crew was released, they went on a massive publicity tour in many states and to 22 other countries and addressed joint Congressional sessions. The Apollo 11 Mission collected 22 pounds of samples from the lunar surface, including 50 rocks of various sizes. More than 100 scientific papers were released in the next six months documenting the first results of lunar material analysis.

Crew biographies

Neil A. Armstrong was born near Wapakoneta, Ohio, on August 5, 1930. He was educated at Purdue University and was a naval aviator, seeing action in the Korean War. He became a civilian test pilot, flying many experimental aircraft, including the X-15 (seven flights). He was selected as an astronaut by NASA in September, 1962. He commanded the Gemini 8 mission with pilot Dave Scott, who later commanded Apollo 15; they were put to the test when the Gemini spacecraft began rotating wildly after docking with the Agena upper stage, requiring the mission to be aborted. He was offered the Commander role on Apollo 11 when Apollo 8 was in orbit around the moon. After the Apollo mission, Armstrong went into teaching at the University of Cincinnati, supported the failure investigation teams for Apollo 13

and STS Challenger, traveled to the North Pole, and did advertisements for a few companies including Chrysler. He also served on the boards for several corporations. He was married twice and had three children (daughter Karen died at the age of 2 from cancer). Armstrong passed away on August 25, 2012 from complications following coronary bypass surgery. He received numerous awards and citations and authorized a biography "First Man: The Life of Neil Armstrong", published in 2005 (and the basis for the 2018 movie).

Buzz Aldrin (born Edwin Eugene Aldrin, Jr. on January 20, 1930) is from Glen Ridge, New Jersey. He graduated from the West Point Military Academy in 1951 and chose a career as a fighter pilot in the newly formed Air Force and flew 66 combat missions in the Korean War. Aldrin enrolled as a graduate student at MIT and earned his doctorate in astronautics in 1963. His thesis was entitled: "Line of Sight Guidance Techniques for Manned Orbital Rendezvous". Aldrin was selected as one of 14 astronauts in the third astronaut class in 1963. His first mission was on the final Gemini flight with Jim Lovell (Gemini 12), where he performed three EVAs outside the spacecraft. Aldrin was assigned the LM Pilot role on Apollo 11. In 1971, he left NASA and returned to the Air Force, becoming Commandant of the USAF Aerospace Research Pilot School. He retired from the Air Force in 1972 and suffered for years from alcoholism and depression (his mother and grandfather had both committed suicide). He wrote two books about his astronaut experiences and mental health struggles ("Return to Earth" and "Magnificent Desolation"). He has been married three times and had three children with his first wife Joan; in 2018, he was involved in a legal dispute with his children over his mental state and financial status but the legal dispute was dropped by his family early in 2019. He currently spends time traveling and advocating missions to Mars. My husband and I met Buzz on an eclipse cruise in the southern Caribbean in February 1998. We spent quite a bit of time talking to him after dinner one evening after I asked him what it was like to ride on a Titan II (he liked the uniqueness of that question). We also attended some of his lectures on the Mars cyclor concept that he created due to his expertise in orbital mechanics.

Michael Collins was born in Rome, Italy on October 30, 1930. His father was a career Army officer. He graduated from the West Point Military Academy in 1952 and decided to join the Air Force, as many family members were in positions of significant influence in the Army. He trained in F-86 Sabre aircraft and was assigned to flying duties in Europe. In 1960, Collins applied for the Experimental Test Pilot School at Edwards Air Force Base and was accepted, flying a

number of different air craft and later being accepted into a postgraduate program studying spaceflight. He was selected as an astronaut with the third group (14 total) in 1963. His first space mission was on Gemini 10 with Commander John Young and they conducted many successful experiments including rendezvous and docking maneuvers, as well as limited EVAs for Collins. He moved on to the Apollo program and was a CAPCOM on the Apollo 8 mission, then was assigned to the primary crew for Apollo 11, as the Commander Module Pilot. After Apollo 11, Collins left NASA and worked as the Assistant Secretary of State for Public Affairs; he left this role and became the director of the new Smithsonian Air and Space Museum and did other functions for the Smithsonian. Collins also worked as a Vice-President of LTV Aerospace. His autobiography "Carrying the Fire: An Astronaut's Journeys" was critically acclaimed. His wife Pat (they married in 1957) passed away in 2014; they had three children.

References for Apollo 11 article and program profile bonus.

Apollo Flight Journal: <https://history.nasa.gov/afj/>

Apollo Program: <https://go.nasa.gov/2bfU3qu>

Apollo 11 Pages: <https://go.nasa.gov/1K3YjY0>

Apollo Press Kits:

<https://www.apollopresskits.com>

Saturn V Subcontractors:

<https://go.nasa.gov/2Yf6yIb>

Major Spacecraft Component Manufacturers:

<https://go.nasa.gov/33460xl>

Wikipedia (source of biographies):

<https://www.wikipedia.org>

General Dynamics Press Release:

<https://qdmissionsystems.com/space/apollo11>

PROGRAM PROFILE BONUS

Listed below are the system and component contributions to the Apollo program from LM Heritage companies (Martin Marietta, General Dynamics, Lockheed Space, General Electric, and RCA). NOTE: This list is based on exhaustive research and omissions may have occurred due to inadequate available on-line information. Corrections and additions are welcome!

Martin Marietta:

Apollo Lunar Surface Drill (ALSD) – used on missions 15-17

Helium Bottles (subcontract to Boeing for Saturn V First Stage)

General Dynamics (legacy company Motorola Government Electronics Division):

S-Band Transponder (Unified system/LM communication systems)

Flight Data/Command Receivers

C-Band Transponder

Lockheed Space (Propulsion, Electronics Divisions):

Pitch Motor

Launch Escape Motor (major subsystem)

Cold Cathode Gage Instrument (lunar surface experiment package)

Real-Time Analysis System

General Electric Apollo Systems Division:

Spacecraft Acceptance Checkout Equipment (ACE)

Launch Vehicle Electrical Support Equipment (ESE)

Launch Control and Checkout Equipment (LCCE)

Electronics components (subcontract to Boeing for Saturn V First Stage)

RCA:

Ground-commanded Color Television Assembly

Lunar Communications Relay Unit

Laser Altimeter

Lunar Sounder Radar

LM-S-Band Communications (with GD)

LM Guidance (with Honeywell)

VHF Communications, LM-CSM

EVA Communications System (Backpack Radios)

Erectable Antenna

Rendezvous Radar/Transponder

LM Landing Radar

LM Descent Engine Control Assembly

LM Attitude Translation Control Assembly

Saturn Countdown Computers

Tracking Radar Support for Apollo

Black & White Television Cameras

LM Guidance (subcontract to Grumman)

On This Date in History

This section has milestones retrieved from publicly available information for LM, ULA and heritage programs from 10 to 60 years ago (2009, 1999, 1989, 1979, 1969, 1959). Delta launches prior to the formation of ULA, unless it included an LM or heritage company payload or upper stage, are not listed. No classified programs are identified, even if the program is now considered unclassified. The events reflect milestone activity in the quarter previous to the release of the MARS STAR -- where appropriate, key press releases are also included; significant milestones are in bold. The order has been changed since the last MARS STAR to show decadal events under each month heading. There will be gaps if no events occurred in that decadal year for that month (for example, no relevant milestones were found for

July, 1989 and July, 1979). The list is not intended to be all-inclusive due to historical record inaccuracies.

NOTE: The very bad year of 1999 continued for LM with the loss of Mars Climate Orbiter (MCO) at Mars orbit insertion on September 23, 1999. MCO was built in Denver and launched in December, 1998. The spacecraft disappeared from communications and its ultimate fate is unknown; the cause was attributed to a navigation error due to thrusters on the spacecraft measuring their output in English versus Metric (SI) units. The accumulating navigation error was seen but discounted during the coast phase of the mission.

Events in July (10 to 60 years ago)

- 07/15/2009: STS-127 (Endeavour) launched, LC-39A, KSC to ISS; small satellites included
- 07/30/2009: LM Press Release: Lockheed Martin-build Trident II D5 Missile Achieves 127 successful flights [noting the May 26, 2009 launch]
- **07/23/1999: STS-93 (Columbia) launched, LC-39B, KSC; Chandra X-ray Observatory. Control and fuel leak anomalies during ascent.**
- **07/20/1969: Apollo 11 mission launched, LC-39A, KSC. First lunar landing (see program profile this edition).**
- 07/24/1969: Classified launch by Thorad-SLV2H-Lockheed Agena-D, SLC-3W, VAFB
- 07/31/1969: Classified launch by Thorad-SLV2H-Lockheed Agena-D, SLC-1W, VAFB
- 07/15/1959: Lockheed UGM-27 Polaris AX launched, LC-25A, CCAFS (launch failure)
- 07/21/1959: GD Atlas SM-65C launched, LC-12, CCAFS
- 07/29/1959: GD Atlas SM-65D launched, LC-11, CCAFS

Events in August (10 to 60 years ago)

- **08/18/2009: LM GPS IIR-21/M8 launched by ULA Delta II 7925-9.5 from SLC-17A, CCAFS; final GPS IIR launch, final launch from SLC-17A**
- 08/29/2009: STS-128 (Discovery) launched, LC-39A, KSC; ISS mission
- 08/02/1999: LM THAAD interceptor launched, White Sands, New Mexico
- 08/08/1999: STS-28 (Columbia) launched, LC-39B, KSC (classified satellites)
- **08/25/1989: Voyager I flyby of Neptune (Voyager I launched by MM Titan IIIIE/GD Centaur in August, 1977)**
- 08/12/1969: ATS-5 launched by GD Atlas SLV-3C Centaur-D, LC-36A, CCAFS
- 08/23/1969: Classified launch by MM Titan IIIIB, SLC-4W, VAFB

- 08/06/1959: Lockheed UGM-27 Polaris AX launched, LC-25, CCAFS (failed)
- 08/11/1959: GD Atlas SM-65D launched, LC-13, CCAFS
- 08/13/1959: Classified launch by Thor DM-18 Lockheed Agena-A, LC-75-3-4, VAFB
- 08/14/1959: Martin Titan I HGM-25A launched, LC-19, CCAFS (failed)
- 08/14/1959: Lockheed UGM-27 Polaris AX launched, LC-25B, CCAFS
- 08/19/1959: Classified launch by Thor DM-18 Lockheed Agena-A, LC-75-3-5, VAFB
- 08/24/1959: GD Atlas SM-65C launched, LC-12, CCAFS
- 08/25/1959: Lockheed UGM-27 Polaris AX launched, LC-25A, CCAFS (failed)

Events in September (10 to 60 years ago)

- 09/02/2009: LM Press Release Lockheed Martin's Orion Program is "Go for CDR"
- 09/03/2009: LM UGM-133 Trident II D5 launched, Eastern Range
- 09/04/2009: LM UGM-133 Trident II D5 launched, Eastern Range
- 09/08/2009: Classified launch, ULA Atlas V 401, SLC-41, CCAFS
- 09/17/2009: LM Press Release: New Missile Warning Satellite built by Lockheed Martin begins major environmental test phase [SBIRS]
- **09/24/2009: LM Press Release: Lockheed-Martin Built IKONOS Satellite marks 10 years in operations**
- 09/25/2009: USA-208/209 launched by ULA Delta II 7920-10C, SLC-17B, CCAFS
- 09/23/1999: Echostar 5 launched by GD Atlas IIAS, SLC-36, CCAFS
- **09/23/1999: Mars Climate Orbiter (MCO) is lost at Mars orbit insertion**
- **09/24/1999: LM IKONOS-2 launched by LM Athena II, SLC-6, VAFB (last Athena II launch)**
- **09/04/1989: DSCS-II/III launched by MM Titan 34D/Transtage, LC-40, CCAFS (final flight of Titan 34D and Transtage)**
- 09/06/1989: Classified launch by MM Titan II 23G, SLC-4W, VAFB
- **09/25/1989: FLTSATCOM-8 launched by GD Atlas G, LC-36B, CCAFS (last Atlas G)**
- 09/20/1979: HEAO-3 launched by GD Atlas SLV-3D, LC-36B, CCAFS
- 09/22/1969: Classified launch by Thorad-SLV-25-Lockheed Agena-D, SLC-3W, VAFB
- 09/30/1969: Classified/Technology Demonstration launch by Thorad-SLV-2G-Lockheed Agena-D, SLC-3W, VAFB

- 09/09/1959: Big Joe 1 (Boiler-plate Mercury capsule) launched by GD Atlas SM-65D, LC-14, CCAFS (partial failure)
- 09/09/1959: GD Atlas SM-65D launched, LC-576A-2, VAFB
- 09/17/1959: GD Atlas SM-65D launched, LC-13, CCAFS (failure)
- 09/21/1959: Lockheed UGM-27 Polaris A1 launched, LC-29A, CCAFS
- 09/28/1959: Lockheed UGM-27-Polaris AX launched, LC-25A, CCAFS (failure)

Reference websites:

<https://nssdc.gsfc.nasa.gov/planetary/chronology.html#2014>

https://en.wikipedia.org/wiki/Timeline_of_spaceflight

<https://www.ulalaunch.com/missions>

<https://news.lockheedmartin.com/news-releases?year=2019>

<https://space.skyrocket.de>

<http://www.astronautix.com>

History on the Road

Check back in the next MARS STAR for road trip stories and pictures from the Apolopalooza events at Wings Over the Rockies!

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