

## Historian Corner

By Barb Sande

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Historical information and informative stories for the MARS STAR

### Introduction

Welcome to History Corner! I'm Barb Sande and I'm your new curator to a world of interesting stories about our space and launch vehicle programs. I want this to be a fun experience and not get too bogged down in technical details, so with this in mind, History Corner is composed of four subsections:

- **Program Profile** This section will have short write-ups of key programs that influenced the space industry.
- **On This Date in History** This section contains major milestones of historical company programs. The milestones date back to the beginnings of the space program.
- **History on the Road** This section features a profile of a museum or historical site of interest to MARS members, so you can consider traveling to the locations and seeing them for yourself. Have a story idea for History on the Road? Please send your articles!
- **Test Your Knowledge.** This final section has quiz questions and fun puzzles to test your knowledge of historical space programs, companies and missions. No prizes yet (I'm working on it) but I'm sure you'll enjoy the quiz.

### Program Profile

Space program fans have the opportunity to celebrate the 50th anniversary of the first and second moon landings in 2019. As Apollo influenced many young people in the 1960s and 70s to consider careers as engineers in the Aerospace industry (myself included), the Program Profile in the next few newsletters examine the Apollo program.

The profiles included here are of the first two "dress rehearsal" crewed missions (Apollo 7 and Apollo 8).

#### **Apollo 7 Mission**

Launched: 10/11/1968 11:02:45 EDT

Launch Complex 34

Splashdown: 10/22/1968 07:11:48 EDT, Atlantic, USS Essex recovery ship

Saturn 1B AS-205 Launch Vehicle

Orbit: 140 by 183 nm elliptical at 31 degrees Inclination



**Apollo 7 Crew -- Commander: Walter M. Schirra, Jr., Lunar Module Pilot: R. Walter Cunningham, Command Module Pilot: Donn F. Eisele (Photo Credit: NASA)**

The Apollo 7 mission was the first crewed Block II Apollo Command/Service Module (CSM) flight, the first three-person American crew in space, and the first mission that had live television from orbit. The Block II CSM was a major redesign of the North American Rockwell Command/Service Modules after the Apollo 1 fatal fire on the ground in January 1967. The Apollo 7 crew performed simulated rendezvous and docking maneuvers with the S-IVB stage of the Saturn 1B to demonstrate this requirement for Lunar Module (LM) docking. All three astronauts suffered from severe head colds during the mission, leading to concerns for re-entry and possible ear damage (no problems occurred). The success of Apollo 7 led to a rapid review of the mission profile for Apollo 8. On 11/11/1968, the decision was made by NASA to "go" for a lunar orbit mission for Apollo 8. Schirra is the only astronaut that flew missions for the Mercury, Gemini and Apollo programs; he became well-known for his expert commentary on CBS news with Walter Cronkite covering future Apollo missions.

#### **Apollo 8 Mission**

Launched: 12/21/1968 07:51:00 EST

Launch Complex LC-39A

Splashdown: 12/27/1968 10:52:51 am PST, Pacific, USS Yorktown recovery ship

Saturn V AS-503 Launch Vehicle

Lunar trajectory and return with 10 orbits of the moon (70 miles altitude)



**Apollo 8 Crew -- Commander: Frank Borman, Lunar Module Pilot: William A. Anders, Command Module Pilot: James A. Lovell, Jr. (Photo Credits: NASA, NASA Goddard Space Flight Center)**

The Apollo 8 mission was audacious in its scope and objectives and was the first crewed flight of the massive Saturn V launch vehicle (three stages, 363 feet tall, 7.8 million pounds of thrust for five Stage I F-1 Rocketdyne engines). The crew had been training for a later earth orbit mission with the CSM and LM, but this was revised to a CSM-only translunar trajectory, lunar orbit, and return. One other issue driving this decision was the delay in production of the LM at Grumman.

This was the first time in space program history that a human crew left earth orbit, traveled through the Van Allen radiation belts, and went into orbit around another body in the solar system. Lunar Orbital Injection occurred approximately 69 hours after launch on the far side of the moon, while out of communication with Mission Control. Apollo 8 did 10 orbits of the moon, the astronauts took hundreds of pictures (including the famous Earth Rise photo), and spent Christmas Eve reading from the book of Genesis during the telecast. Trans-Earth Injection occurred in the early hours of Christmas (again, while out of communication) and Apollo 8 returned to Earth for its splashdown in the northern Pacific.



**Apollo 8 Saturn V Launch**



**Earth Rise from Lunar Orbit**

More about crew member William A. Anders: He became the Vice-Chairman and later the CEO of General Dynamics in the early 1990s, just before the space division was spun off to Martin Marietta in 1994.

The next issue of STAR includes the missions of Apollo 9 and 10, with an article about the first two landings (Apollo 11 and 12) coming this fall.

References:

[https://www.nasa.gov/mission\\_pages/apollo/missions/apollo8.html](https://www.nasa.gov/mission_pages/apollo/missions/apollo8.html)

[https://www.nasa.gov/mission\\_pages/apollo/index.html](https://www.nasa.gov/mission_pages/apollo/index.html)

[https://www.nasa.gov/mission\\_pages/apollo/missions/apollo7.html](https://www.nasa.gov/mission_pages/apollo/missions/apollo7.html)

## **On This Date in History**

This section has key milestones retrieved from publicly available information for LM, ULA and heritage programs from 10 to 60 years ago. Delta launches prior to the formation of ULA, unless it included an LM or heritage company payload or upper stage, are not listed. The information is not meant to be all-inclusive. No naming of classified programs is made, even if the program is now considered unclassified. The events reflect milestone activity in the quarter previous to the release of the MARS STAR for the timeframes noted -- where appropriate, key press releases are also included; significant milestones are in bold.

## **Ten Years Ago (January - March 2009)**

- 01/18/2009: NRO-26 launched by ULA Delta IV(H), LC-37B, CCAFS
- 01/26/2009: LM Press Release: *Lockheed Martin Readies Historic Operations & Checkout Facility For Orion Spacecraft Integration Work*
- 02/06/2009: LM NOAA-19 (N) launched by ULA Delta II-7320, SLC-2W, VAFB

- 02/12/2009: LM Press Release: *First Lockheed Martin-Built MILSTAR satellite marks 15 years on orbit*
- 02/13/2009: LM Trident II D5 missile launched, Pacific Ocean
- **02/17/2009: LM Press Release: *Lockheed Martin-Built DSCS satellites achieve 200 years of on-orbit operations***
- 03/07/2009: Kepler Exosolar Observatory launched by ULA Delta II-7925, LC-17B, CCAFS
- 03/15/2009: STS-119 (Discovery) with LM External Tank, United Space Alliance management (LM/Boeing Joint Venture) launched, LC-39A, KSC
- 03/18/2009: Two LM THAAD missiles launched, Barking Sands, Kauai; target destroyed
- 03/24/2009: LM GPS IIR-20/M7 launched by ULA Delta II, LC-17A, CCAFS

### **Twenty Years Ago (January - March 1999)**

- **01/03/1999: LM Mars Polar Lander and microprobes (JPL) launched by Delta II, LC-17B, CCAFS [MPL and microprobes failed at Mars arrival on 12/03/1999]**
- 01/27/1999: ROCSAT-1 launched by LM Athena I, LC-46, Spaceport Florida
- **02/07/1999: LM Stardust Comet Sample Return Mission launched by Delta II, LC-17A, CCAFS**
- 02/09/1999: Two LM Trident II D5 missiles launched, ETR
- 02/15/1999: Telstar 6 launched by ILS Proton-K, 81/23 Baikonur, Kazakhstan [ILS was a joint launch venture with LM as a partner]
- 02/16/1999: JCSAT-6 launched by LM Atlas IIAS, LC-36A, CCAFS
- 03/10/1999: LM Peacekeeper test launch, LF-02, VAFB
- 03/21/1999: AsiaSat 3S launched by ILS Proton-K, 81/23 Baikonur, Kazakhstan
- 03/18/1999: Four LM Trident II C4 missiles launched, ETR
- 03/29/1999: LM THAAD test launch, WSMR, New Mexico

### **Thirty Years Ago (January - March 1989)**

- 03/13/1989: STS-29 (Discovery) launched, with an MM External Tank, LC-39B, KSC

### **Forty Years Ago (January - March 1979)**

- 02/24/1979: Solwind launched by GD Atlas F, SLC-3W, VAFB
- **03/05/1979: Voyager I flies by Jupiter on its solar system voyage [Voyager I was launched**

### **by MM Titan IIIE and GD Centaur upper stage from LC-41, CCAFS on 09/05/1977]**

- 03/16/1979: Classified payload launched by MM Titan 23D-21, SLC-4E, VAFB

### **Fifty Years Ago (January - March 1969)**

- 01/22/1969: Classified payload launched by MM Titan IIIB-6/Lockheed Agena, SLC-4W, VAFB (Agena partial failure)
- 02/09/1969: TACSAT-1 launched by MM Titan IIIC-17, LC-41, CCAFS
- 02/25/1969: Mariner 6 Mars flyby mission launched by GD Atlas SLV-3C Centaur D, LC-36, CCAFS
- 02/26/1969: RCA ESSA-9 lunched by Delta E1, LC-17B, CCAFS
- **03/03/1969: Apollo 9 mission launched from LC-39A, KSC (see program profile article next quarter)**
- 03/04/1969: Classified mission launched by MM Titan IIIB-7/Lockheed Agena, SLC-4W, VAFB
- 03/18/1969: GD Atlas F (OV-2) technology demonstration launch, ABRES-A2, VAFB
- 03/19/1969: Classified mission launched by Thorad-SLV2G-AgenaD (Lockheed Agena), SLC-3W, VAFB
- 03/27/1969: Mariner 7 Mars flyby mission launched by GD Atlas SLV-3C Centaur D, LC-36A, CCAFS

### **Sixty Years Ago (January - March 1959)**

- 01/16/1959: GD Atlas SGM-65B launched, LC-14, CCAFS (failed)
- 01/19/1959: Lockheed UGM-27 AX Polaris launched, LC-25A, CCAFS (failed)
- 01/27/1959: GD Atlas SGM-65C launched, LC-12, CCAFS
- 02/04/1959: GD Atlas SGM-65B launched, LC-11, CCAFS (final flight of Atlas B)
- **02/06/1959: Martin Titan I (maiden flight) HGM-25A launched, LC-15, CCAFS**
- 02/20/1959: GD Atlas SGM-65C launched, LC-12, CCAFS (failed)
- 02/25/1959: Martin Titan I HGM-25A launched, LC-15, CCAFS
- 02/27/1959: Lockheed UGM-27 AX Polaris launched, LC-25A, CCAFS (failed)
- **02/28/1959: Discoverer 1 launched by Thor DM-18 with Lockheed Agena-A (maiden flight), LC-75-3-4, VAFB (first spacecraft in polar orbit)**

Reference websites:

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

[https://en.wikipedia.org/wiki/Timeline\\_of\\_spaceflight](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

The first feature of "History on the Road" describes our visit to the Titan II Missile Museum in March, 2018, located 25 miles south of Tucson, Arizona. Future inputs are solicited from MARS members!

This silo facility, known as 571-7, contained a Titan II nuclear-armed ICBM on alert from 1963 to 1982. There were 54 total Titan II facilities deployed in groups of 18 around three different Air Force Bases (Davis-Monthan, Tucson; Little Rock AFB, Arkansas; and McConnell AFB, Kansas). The Titan II missiles had advantages over predecessor systems by using hypergolic propellants with on-board storage, inertial guidance systems, and in-silo launch capability within minutes of command. The Titan II deployed the largest nuclear warheads at that time and could travel over 5,500 miles to intended targets. The missile sites were staffed 24/7, with four-person crews performing 24-hour "alert" shifts.

When this facility came off alert in 1982, the Air Force contacted the Tucson Air Museum about the possibility of turning the site into a museum. The museum opened in May, 1986 and became a National Historic Landmark in 1994. Over 1.5 million visitors have ventured to the site since it opened.

Our visit happened on a lovely day in early March, 2018. We drove down from Tucson to Sahuarita, easily finding the Titan II Museum using phone navigation, and entered the facility through the visitor's center, which contains a small museum, a briefing room, restrooms, and a gift shop. The standard one-hour tours (25 people maximum per tour) are scheduled throughout the day at the museum. There are also special tours that are longer in duration and explore more of the facility; these smaller tours require reservations, minimum age limit and physical abilities to participate (e.g., ability to climb many more stairs or even ladders, if necessary).

Tour participants assemble 15 minutes prior to the tour for a safety briefing and a short video. The group then proceeds outside to the 55 stairs in the entry portal that go down to Level 2 of the facility; an open elevator is available for disability access, but the elevator must be reserved in advance. On Level 2, visitors are given an overview of the Launch Control Center and a launch simulation is performed. The tour docents demonstrate the fail-safe features of the launch control center (e.g., no single person can launch the vehicle).

The tour continues down a long cableway from the Control Center, anchored by huge 3-ton blast doors at each end, to the actual silo. The missile in the silo was a test vehicle and did not see active duty, but it was still required to have alterations to assure the Russians from their orbital observations that this was a museum relic. You can peer into the upper part of the silo at the second stage through large, thick glass windows.

After the tour on Level 2, the tour group is brought back to the surface and can spend time exploring the grounds, which includes a viewpoint stand looking into the top of the silo, a mockup of the Aerojet engines, and other features of the silo facility, like the intruder alert systems.

We really enjoyed seeing this piece of Titan history and I spent quite a bit of time talking to the docents afterwards about the Titan II SLV program that had 13 successful flights of deactivated and refurbished silo missiles from 1988 to 2003, launching NOAA and DMSP satellites, Landsat 6, QuickScat, Coriolis, Clementine, and a few classified programs. I highly recommend taking the time to visit if you are in the Tucson area! Here are a few photos of the museum (photo credits, Steve and Barb Sande):



Map of Titan II Silos in Arizona



**View of the Titan II Silo**



**Missile View from Ground Level**



**Titan II Launch Control Center**



**Missile View from Level 2**

*The Titan II Missile Museum is located at 1580 W. Duval Mine Road, Sahuarita, Arizona. The museum is open from 9:45 to 5:00 pm, seven days a week (except Thanksgiving and Christmas). The one-hour tours (that are also accessible) begin at 10:00 am, with the final tour at 3:45 pm. Current one-hour tour costs are \$10.50 for Adults 13 & up, \$9.50 for Seniors, Military, and Pima County Residents, and \$7.00 for Juniors (ages 4-12). Children 4 & under are free. Other specialty tours may be reserved by calling the museum at (502)-625-4598. Visit <http://www.titanmissilemuseum.org/home> for more information.*

## Test Your Knowledge

Here are five brainteasers (or not!) to test your historical knowledge. Answers are located elsewhere in the Star. In the future (not with this issue), the quizzes will require response to the historian.

1. Titan II ICBMs used an inertial guidance system. This was considered too bulky for the Titan II Gemini Launch Vehicle program. What type of guidance system was used on Titan II Gemini Launch Vehicle?
2. LM Mars InSight Lander landed on Mars on November 26, 2018. What was the name of the previous successful LM Lander and where and when did it land on Mars?
3. What were the predecessor fleet ballistic missiles (names) before the Trident series were developed by Lockheed Corporation?
4. Who was the only astronaut to fly on missions for the Mercury, Gemini and Apollo programs?
5. Although this milestone is not included in this edition, the first manned Atlas launch occurred 57 years ago on February 20, 1962. What was the program, who was the astronaut and how many orbits did he perform before re-entry?

Introducing your new historian, Barb Sande. I retired from LM Denver in November 2017 after working 37 years for MM and LM. I spent 25 years on the Titan Launch Vehicle program, mostly in Mission Success (Electrical, Systems), until the program ended in 2005. I did studies and data analyses for Central Mission Success and Audit until my retirement. I have a BSEE and MBA from the University of Colorado and am an AIAA Associate Fellow and an IEEE Senior Member. I have a keen interest in space program history and was fortunate to see the launch of Apollo 15 while in high school. I also maintained history databases at work that were used by programs, business development and customers. My husband Steve and I spent 15 years doing STEM outreach for the NASA/JPL Solar System Ambassadors Program, and including many presentations about the Apollo program. I've been married to Steve for almost 40 years; he is a Civil Engineer by education and is the publisher of an Apple product review website. We love traveling, photography, church and charitable activities, space history, baseball games and history, symphony and opera, good science fiction, and our two cats we adopted from the Dumb Friends League. Contact me at [barbsande@comcast.net](mailto:barbsande@comcast.net) or 303-887-8511.

Historian Corner Quiz Answers:

1. Radio Guidance System
2. Phoenix Lander, arrived May 25, 2008, North Pole region of Mars
3. Polaris, Poseidon
4. Walter M. Schirra
5. Mercury-Atlas 6, John Glenn, approximately 3 orbits