The Near Tragedy of Gemini 8: How Neil Armstrong's First Space Mission was almost his Last

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As the space race heated up in the 1960s, the National Aeronautics and Space Administration (NASA) scrambled to fulfill President John F. Kennedy's charge to put a man on the moon, and return him safely to earth, all before 1970. Though the Apollo program eventually succeeded, the earlier Gemini program was crucial to ensure the necessary training and technology to make it to the moon and back. In order to reach the president's deadline, NASA had to resort to an accelerated timeline. This involved managing risks against results, a dangerous game that nearly ended in disaster with Gemini 8. The mission represented several firsts. It was the first attempt at docking, an essential and technically challenging step that the media often overlooks in the grand scale of the moon landing. It was also both Neil Armstrong's and David Scott's first mission in space, and Armstrong's first mission in the command pilot seat of a spacecraft, marking the beginning of his path to become the first person on the moon. The mission also could have led to a lot of lasts, for both NASA and the crew. Once docked with the Agena, Armstrong and Scott found themselves in a critical in-space emergency, as the craft began to spin out of control. If not for Armstrong's quick actions and level-headed thinking, both he and Scott would have perished, most likely taking the president's deadline and public favor with them.

On 25 May 1961, President Kennedy gave a special State of the Union message to Congress on "urgent national needs," regarding economic and political initiatives he wanted to make relating to the Cold War. On his ninth talking point, he touched on space travel. He stated that the U.S should "commit to a goal, before the decade is out, of landing a man on the moon

and returning him safely to the Earth" (Special Message to the Congress, 1961). Kennedy's presidency up to this point had been a series of adverse events. Sputnik had become the first object in space four years prior, and just weeks before his address to congress, Yuri Gagarin became the first person to enter space, flying an orbit around earth. The failed Bay of Pigs invasion of Cuba also put pressure on his administration to act. Kennedy wanted Apollo, inherited from the Eisenhower administration, to boost public backing of the president and catch up to the Soviet Union's seemingly commanding lead in the Cold War (Garber, 2013).

Throughout the rest of 1961, NASA expanded to accommodate for the forthcoming challenge, acquiring land for the Manned Spacecraft Center (MSC) in Houston, Texas; and devising the plan of Lunar Orbit Rendezvous (LOR) to most efficiently reach the moon. LOR was a risky plan for its day, because it involved a series of elaborate rendezvouses and dockings between the Command/Service Module (CSM) and the Lunar Excursion Module (LEM). To test these systems and procedures in preparation for Apollo, NASA officially created the Gemini Program on December 7, 1961. Gemini was vital to provide both engineers and astronauts the methods to achieve Apollo, and none of its missions came close to the importance of Gemini 8, slated to test docking, a maneuver never performed in space before (Dunbar, 1992).

Gemini 8 came quickly after the successful Gemini 6A and Gemini 7 mission, which was NASA's first rendezvous in space. As Armstrong put it, from his vast engineering experience, there were "no textbooks on [rendezvous]; this was breaking new ground" (Scott and Leonov, 2004). Gemini 8 broke even newer and riskier ground in terms of crew and procedure. It was the first attempt at docking in orbit, but it also was "the first manned spacecraft to have onboard navigation capability," albeit very limited (Trials of Agena and Gemini 8). This meant extra training for the crew in order to control these systems. For Armstrong and Scott, it was also their

first spaceflight. Both men had been test pilots prior to this mission, and underwent intensive training to prepare for Gemini 8, including over 474 hours of training in spacecraft, systems briefing, and rendezvous simulation (Mission Training Plan).

The final difference between Gemini 8 and previous mission was of course the spacecraft they would be docking to: the Agena Target Vehicle (ATV). It was a 26 foot long cylindrical, unmanned spacecraft to help simulate and test docking for Apollo's LOR. The ATV had its own guidance computer and propulsion system to help test multiple maneuvers while in tandem with Gemini. Agena went into orbit prior to the Gemini module, which then followed to dock with the ATV. Of course, this was the plan, at least before Agena began showing signs of major problems.

Agena's problems began to arise during Gemini 6, which cast doubt on the feasibility of testing a successful docking. Five months prior to Gemini 8, on October 25, 1965, Gemini 6 was preparing to carry out the same mission, using an ATV to attempt docking in orbit. Yet, after the primary engines of Agena's rocket were fired, telemetry of the rocket failed, and the ATV exploded, cancelling Gemini 6's original mission. After multiple investigations into what went wrong, NASA's George Detko concluded that the failure occurred once the Agena separated from the Atlas booster, where he "believed a propellant line may have been damaged," which explained the short of the telemetry system (Trials of Agena and Gemini 8).

This failure threatened President Kennedy's timeline and NASA's forward motion in the moon race, as Scott remembered. The Gemini program "was still pretty fragile. We'd had launch vehicles blowing up, and trouble with Agena… It was a crucial time. People starting worrying more." (Scott and Leonov, 2004) Yet on the heels of five successful piloted Gemini missions, George Mueller, the Associate Administrator for Manned Space Flight at the time, argued

against cutting any Gemini missions short, as the information gathered, and maneuvers being tested were crucial to the success of Apollo and the moon landing.

Armstrong's files on Gemini, collected in his personal and professional papers at the Purdue Archives, are filled with all the warning signs of an impending mission catastrophe, laden with worrying test failures and delays. Even the company responsible for building the ATV was not confident in its success. Agena's initial failure prompted its maker, Lockheed, to investigate its troubled systems. Colonel Alfred J. Gardner, the Gemini Target Vehicle Program director, planned the necessary modifications and schedule testing of Agena's essential systems over the few months leading up to Gemini 8, and submitted his proposal to the "super tiger team," consisting of Lieutenant General John B. Hudson, Deputy commander of Launch Vehicles, Bernhard A. Hohmann of Aerospace Corporation, and L. Eugen Root, president of Lockheed (Trials of Agena and Gemini 8).

After assessing Gardner's findings, the group presented its final plan before a review board at the MSC on November 20, 1965. Within a week, its recommendations were approved, and Lockheed created the Project Surefire Engine Development Task Force to carry out the necessary changes and testing needed for Agena. With Air Force backing, Mueller pushed for Agena's tests to receive "high priority," even delaying the timeline for the development of the Apollo engines as a result (Trials of Agena and Gemini, 21). NASA's future was riding on the success of Gemini 8.

As the launch date approached, engineers raced to get the necessary testing done in time. Gemini Program manager Chuck Matthews spearheaded the altitude tests a month before the launch, and they brought worrying results. The first six tests were successes, but upon further analysis, Matthews found that all tests had an "incorrect oxidizer lead because of instrument

plumbing" (Trials of Agena and Gemini 8, 29). On February 12, 1966, a seventh test was run which bore even worse results. The test engine had a hard start and then failed due to contamination of water and alcohol in the fuel. Though the prospects for the ATV seemed bleak, NASA resolved its issues over the next month, approving it for flight on March 4, 1966, just twelve days before launch.

These problems were also a forewarning about Gemini 8. Test personnel found that in the low temperatures of space, the Freon fuel, used in the booster pack of the Extra Vehicular Activity (EVA or spacewalk) equipment, would cause the "poppet valve to stick open when the flow was initiated… causing the extravehicular astronaut to tumble" (Trials of Agena and Gemini, 37). EVA at the time was in its infancy and posed a significant risk for the astronaut outside of the cabin. Ed White, the first of NASA to do a spacewalk, encountered a troubling issue where his suit expanded during his EVA, making it hard for him to get back inside the cabin. Even with this glaring issue, no change to the suit was made to correct this problem, as "tight schedules and lack of anticipation meant some risks were overlooked" (Scott and Leonov, 2004). The Gemini program experiences many such glaring problems, all producing zero reaction from executives in fear of slowing down the acceleration to the moon.

The Gemini astronauts also felt the pressure of this accelerated timeline. Looking back on the time, Scott said "We were all pressing hard, staying up late, working every hour we could. No one could afford to get sick or miss a day. The schedule was too tight" (Scott and Leonov, 2004). These conditions should have been a warning sign to both the astronauts and the management of NASA, which was trading its usual methodic and articulate approach for a hazardous and expedited one.

Despite these issues, NASA planned Gemini 8 to launch as scheduled. In fact, personnel were so confident in the mission that "no deficiencies whatsoever were listed" at Mueller's Design Certification Review meeting (Trials of Agena and Gemini, 57). This confidence was not equally shared by the Agena's Lockheed team, which stated that Agena's Primary Propulsion Systems (PPS) would be ready and active for Gemini 8, but that firing the PPS would be "prohibited in any circumstances including emergencies" until more is understood about firing engines while docked." In other words, Gemini 8 was ready but firing the ATV was not. Quite a conflict for the planned docking mission. In fact, this problem was the first "Prohibited Operation" highlighted in the *Gemini Agena Target Vehicle Operational Capability Handbook* (Lockheed Missiles and Space, 1965).

After months of hard work, the crew and equipment were ready for the launch of both the Agena and the Gemini capsule. The mission planned to be a three-day endeavor, whereby Armstrong and Scott would go into orbit, and then dock with the ATV already in orbit, for a total of four times over the course of the three-day mission. Scott would also embark on an EVA to run experiments (Gemini Press Kit, 1966).

On March 16, 1966 at 10:00 am, the ATV lifted off from Cape Kennedy's Pad 14 just as planned. The Atlas booster's primary engines had no problem, as did the secondary Agena engines at separation. After a few heart-stopping moments, the Agena's primary engines also fired without issue and were able to put the Agena into orbit, exactly as planned. Next it was Gemini's turn to launch. On hearing about the success of Agena's insertion into orbit, Armstrong remarked, "beautiful, we will take that one" (Trials of Agena and Gemini, 61). Lift off for the Gemini launch vehicle had to be precise in order to rendezvous with the Agena capsule, so ground control shifted the countdown in order to get Armstrong and Scott up into orbit in time.

At 10:40 am, Gemini launched from Pad 19 and was in orbit a few minutes later. After a series of burns and a few hours of orbital flight, the crew positioned themselves 150 feet away from the Agena, completing the second rendezvous of the Gemini program and NASA history.

The astronauts spent the next thirty minutes inspecting the Agena, before they were given the go ahead to attempt docking. After months of accelerated manufacturing and training, it was time to see if the risk was worth the reward for the rookie astronauts. They began to gingerly approach Agena, making sure all the calculations of the docking computer were correct and watching the Agena approach through the viewport. After slowly inching towards the Agena for what seemed like ages, Armstrong radioed "Flight, we are docked! It's really a smoothie…" (Trials of Agena and Gemini, 71) Armstrong had done it, for the first time in spaceflight history, two vehicles were docked, proving that the LOR could be done, bringing NASA one step closer to the moon.

After docking, the crew began to run maneuver tests using the Agena's engines to complete rotations. The rotations performed even better than on ground simulations expected, completely 90 degree rotations 5 seconds faster than anticipated. For a few short minutes, it appeared that the Gemini Program and Agena could handle the deadlines set by Kennedy half a decade before. But these short minutes ended once Scott said "Neil, we're in a bank." (Trials of Agena and Gemini, 73). After completing the rotation, the Agena-Gemini capsule should have been level, but their instruments indicated that they had rolled 30 degrees. They could not tell at first, as the movement was too slow to detect physically, and they were in darkness and could not use the Earth as a reference point, so all they could depend on were the instruments.

Agena's past problems over the year made it a likely candidate for the reason of the spin. Armstrong worriedly instructed Scott to turn off the Agena's thrusters, believing they were the

source of the problem. After multiple attempts of turning Agena's thrusters on and off, Scott and Armstrong became more worried. The roll would stop for a moment and then start back up again just as suddenly as it has stopped. Nothing was working, and the roll was slowly building (Scott and Leonov, 2004). To make matters worse, the crew was out of communications range with ground control, making it impossible to get a second opinion about the problem and any solution. They were alone.

Armstrong and Scott made the decision to undock from the Agena, hoping to stop the spin. Yet this had the opposite effect, jolting the Gemini capsule into a violent, accelerated spin. It was now very clear that the Gemini capsule was at fault. Both pilots were in shock. Over the past months, all eyes were on the Agena. If something had gone wrong, it was Agena's fault more times than it was not. Armstrong and Scott had extensive training with every error that could go wrong with Agena, but neither astronaut, nor anyone at NASA "had ever dreamed" a problem of this scale would plague the Gemini 8 capsule (Scott and Leonov, 2004). Thankfully, they had flown into communication range again. "We have serious problems here. We're – we're tumbling end over end up here," Scott radioed to ground control (Trials of Agena and Gemini, 75). Ground had only just regained data and communication with Gemini and were struggling to come up with a solution to a problem they had only just learned about, using time the astronauts could not afford to lose. As they backed away from the Agena, the Gemini capsule quickly gained rotational speed. Scott knew the "chances of recovering from such a high rate of spin in space were very remote" (Scott and Leonov, 2004).

As the revolution increased to almost one revolution a second, both Scott and Armstrong began to experience vertigo and blurred vision, and if they did not act soon, they would black out and perish. Armstrong, running out of options, instructed Scott to try the hand controller that he

was just using, making sure it was the hand controller that was wrong and not something he was doing. Knowing they could not wait for ground control to come up with a solution, Armstrong had no choice but to activate the reentry control thrusters as a last-ditch effort to save their lives. To the crew's relief, the Gemini capsule finally slowed to a stop. The disaster had been handled and avoided, but only just. If Armstrong would have followed emergency procedure and possibly waited for a response from ground control, NASA would have lost two of its best astronauts.

Since Armstrong had activated the reentry thrusters, the mission had to be ended early. The concern being that if any of the boosters had a leak, they would not have the means to properly enter retrofire positions for reentry and would not have proper attitude control during it, an essential process to aid in torque control as they entered the atmosphere. After a series of further mistakes and miscommunications between ground control and Gemini 8, all four retrofire boosters ignited successfully and soon enough the astronauts splashed down and were rescued.

Once the news of what happened reached the media, *Life* magazine wanted to publish the story under the title, "Our Wild Ride in Space: by Neil and Dave." But Armstrong called and put a stop to the article. He knew that NASA could not afford the bad press during this crucial stage of the space program. As explained by Scott, "there was no way we could speculate over problems on the program… there would be congressmen saying, 'Gee, those guys almost died. I'm not going to vote more money for NASA.'" He recognized the reality of NASA as a federally funded organization and knew that, once accidents began to occur, funding might cease (Scott and Leonov, 2004). With the crew's blessing, neither NASA nor the media ever opened a free and honest debate about how close the mission came to catastrophe. Instead, the official narrative focused on a few tense moments. As a result, NASA never learned the full lessons of its failures, or set out to full review its procedures, helping to pave the way for the forthcoming

Apollo 1 fire (January 1967), that took the lives of three astronauts: Gus Grissom, Ed White, and Roger Chaffee.

Retired Space Shuttle astronaut Jerry Ross, who attended Purdue at the time of Gemini 8, heard NASA's same watered-down story as the general population, but upon entering the astronaut corps, learned what really happened. As he said, "NASA tries to make everything look nice… but they almost died." There was a cost to "pushing the boundaries" (Ross, 2018), as later exhibited in Apollo 1, Challenger, and Columbia.

The irony of the Gemini 8 mission is that it exhibited NASA at its worst, and at its best, in a moment personified by the piloting skills of Neil Armstrong. He had saved the Gemini 8 mission in March of 1966, just as he later saved the Apollo 11 mission in July of 1969 (in a dramatic landing of the LEM on the lunar surface). He rescued NASA from one of its potentially worst disasters and ensured its greatest triumph. In each case, his piloting talents and calm demeanor were on full display, a rare combination of engineering know-how and superb flying ability, always invested in the greater goal of the mission (Hansen, 2005).

One interesting detail about Gemini 8, and an apt commentary on Armstrong's key role, was that he brought with him a token from a former trailblazer of flight, a watch belonging to Jimmie Mattern, one of the first persons to attempt an around-the-world flight in 1933. Mattern never made it, as a fuel line in his plane froze once he entered the low temperatures above Siberia, and he crashed. The watch represented the drive of pilots to go where no one has gone before. But in the end, it also represented the common bond between two brave yet failed missions: Mattern's and Armstrong's. Days after the astronauts landed, Mattern wrote a heartfelt letter, recently donated by the Armstrong family to Purdue Archives, congratulating Armstrong and Scott on their safe return home. His poetic words captured just how the world felt about

Armstrong through both his Gemini and Apollo years. Mattern said that Armstrong and Scott "did not fly alone," but "a throng rode with you, the girls and boys, the fathers and mothers... all castes, all colors, all creeds of all Nations, as one, flew with you." (Mattern Letter) It is fitting, then, that we all flew with Armstrong: the first man to step foot on the moon and the same man who prevented Gemini's first near-disaster.

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