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## SPECIAL REPORT

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### RACE TO THE MOON:

#### A Look Back at the Beginnings of American Space Travel

by **Bill Warren**

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#### Introduction

If I seem fixated on the *Apollo 11* Moon landing it's because -- in my humble opinion, at least -- *Apollo 11* (and the five other successful *Apollo* missions) represents the greatest technological achievement in mankind's history.

Starting from scratch in the 1950s using rockets designed by an ex-Nazi, **Wernher von Braun**, in less than two decades the U. S. developed a space technology the likes of which the world had never seen before. Everything that the U. S. has accomplished in space since then is directly attributable to what we learned during the three programs -- Mercury, Gemini and Apollo -- that NASA used to make manned space flight more than science fiction, a dream or an idle fancy.

The race to become the first nation to place humans on the **Moon** had military roots. (So did our Interstate highway system: it was created by **Pres. Dwight D. Eisenhower** in the late 1950s as a way to transport troops and materials within the U. S. in wartime.)

Toward the end of World War II, the Germans introduced the world to a new kind of terror: rockets that could be aimed at targets hundreds of miles away. Starting in late 1944, the Nazis launched over 3,000 huge V-2 rockets carrying explosive warheads at allied troops and other targets in England, the Netherlands, Belgium, France and Germany. Only 9,000 troops and civilians were killed, because many of the rockets misfired or were off-target. But if the Germans had developed rocket technology a few years earlier, the outcome of the war might have been decidedly different.

After the war, Russia and the U. S. emerged as bitter enemies, and both nations regarded rockets as vital to national defense. The thinking back then was, *Whoever controls space, controls the planet*. Thus began the "space race" of the late 1950s-early 1970s.

At the time, little was known about how to send rockets into space. Learning how to do it involved building larger rockets and expanding our understanding of science and technology. Eventually, the scientific goals became so compelling that they largely replaced the military goals. But without those original military imperatives it is unlikely that the space race would ever have gotten off the ground.

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## The Day the World Changed

The world changed forever on Oct. 4, 1957, when Russia successfully launched the first artificial satellite, *Sputnik 1*, into low Earth orbit. The beachball-sized satellite orbited the Earth for 15 weeks before falling back through the atmosphere and burning up.

A month later, the Cold War – a post-World War II period of bitter mistrust and competition between the world’s two superpowers, the U. S. and Russia – heated up even more. On Nov. 3, the Russians launched *Sputnik 2*. It carried into orbit a dog named **Laika**. But the little Samoyed husky died a few hours later when her space capsule overheated. Laika was the first living creature ever to be sent beyond Earth’s atmosphere – but she was also the first to die in space. She would not be the last.

Those events shocked and terrified American military leaders: the Russians were well on their way to developing a technology capable of launching missiles at the U. S. from orbiting spacecrafts. The result was a frantic race to develop powerful rockets and place satellites in Earth orbit for defense purposes.

America officially entered the space race when, on Jan. 31, 1958, a Jupiter C rocket based largely on the German V-2 design lifted an unmanned U. S. satellite, *Explorer 1*, into Earth orbit. Its instruments revealed a radiation belt of charged particles in the upper atmosphere. It was named the Van Allen belt for **James Van Allen**, the man who accurately interpreted the data that the satellite sent back. His discovery pointed out the necessity of protecting astronauts and instruments from radiation, not just in outer space, but also while leaving or re-entering Earth’s atmosphere.

## NASA

On July 29, 1958, **Pres. Dwight D. Eisenhower** signed the National Aeronautics and Space Administration Act, creating NASA to develop America’s space program. However, it would take another three years before NASA received the kind of funding and public support necessary to implement major goals in manned space travel.

Thirteen months later, on Sept. 14, 1959, the Russians became the first nation to reach the Moon when their unmanned *Luna 2* spacecraft executed a planned crash-landing near the **Sea of Tranquility**. Over the years since then, other nations have crash-landed unmanned spacecrafts into the Moon, but only three – - Russia, the U. S. (in 1966) and China (in 2013) – have ever soft-landed successfully.

On Oct. 6, 1959, the unmanned *Luna 3* spacecraft orbited the Moon, extending Russia’s lead in the space race and giving mankind its first look at the far side of the Moon via a series of grainy, unclear photos.

Occurring less than a month apart, those two achievements show how difficult and time-consuming the process of conquering space was. The aerospace industries in Russia and the U. S. involved thousands of companies and hundreds of thousands of scientists, engineers and workers developing and producing the millions of parts for each rocket and its payload. It wasn’t a matter of saying, “Let’s send a man into space (or the Moon)” and then doing it; rather, it was a slow process of taking one small step at a time to find out what worked and what didn’t work. Whenever politicians in either country attempted to short-cut the process by skipping intermediate steps, the result almost invariably was failure – and in some cases, the loss of lives.

On May 25, 1961, **Pres. John F. Kennedy** addressed the joint houses of Congress, setting a national goal of placing a man on the Moon before the end of the decade. (He didn’t say it, but he meant *before 1968*: he wanted an American Moon landing to occur during his second term of office, which would have ended in Jan., 1968. But even if he had not been assassinated on Nov. 22, 1963, the *Apollo 1* tragedy extended NASA’s scheduled Moon landing date from 1967 to 1969.)

At any rate, Pres. Kennedy’s speech immediately galvanized public support and massive funding for America’s space program. NASA developed a 3-stage program – Mercury, Gemini and Apollo – that would create rockets powerful enough to carry our astronauts to the Moon and train astronauts and ground crews to function under the stressful

conditions of space travel. Pres. Kennedy's speech subtly shifted America's goals in space from military to scientific purposes. At that point, the space race became a competition to see which nation, the U. S. or Russia, would be the first to land a man on the Moon.

### Mercury

The Mercury program was literally a voyage into the unknown. Each step along the way showed us what we needed to know and do in order to land on the Moon. By the time the Mercury phase concluded in 1964, we knew that humans could function in a weightless environment for brief periods of time without suffering serious short-term health problems.

Before sending astronauts (or cosmonauts, in Russia's case) to the Moon, however, it was considered necessary to send other, more expendable forms of life to explore the hazards of space travel. Animal activists protested the cruelty of risking (and in some cases sacrificing) animal lives to further the advancement of science – but the goal of getting to the Moon before the Russians did was overwhelmingly supported by Congress and the public, so the protesters' complaints were ignored. (If the race to become the first nation to place humans on the Moon were being staged today instead of the 1960s, the decision to use animalnauts might not be so readily accepted by the public.)

In the late 1940s and early '50s, U. S. scientists began sending animals into the upper atmosphere aboard captured German V-2 rockets and high altitude balloons to study the effects of cosmic rays on living organisms. Their first subjects were fruit flies and mice, but as testing continued they switched to monkeys and chimpanzees due to their similarity to humans. (The Russians preferred to use dogs, which were generally more docile and therefore more easily controlled.) On Nov. 29, 1961, **Enos**, a male chimpanzee aboard an Atlas 5 rocket, became the first American animalnaut to orbit the Earth. (He orbited it twice, actually.) Enos survived the flight and returned to Earth safely.

Still...NASA's goal was to place *astronauts* on the Moon, not animalnauts. Thousands of Americans, young and old, applied for astronaut positions. NASA eventually selected seven of them -- **Alan Shepard, Virgil (Gus) Grissom, Gordon Cooper, Donald (Deke) Slayton, Wally Shirra, John Glenn** and **Scott Carpenter** – to be America's first astronauts. They became known as the "Magnificent 7" or "Mercury 7," and they quickly became America's darlings. (The most glaring omission from that elite group was **Charles [Chuck] Yeager**, a USAF pilot who, in 1947, had become the first pilot to exceed the speed of sound in level flight. Yeager was clearly America's most accomplished pilot, having flown scores of missions aboard a series of experimental planes designed to test the limits of speed and altitude. Yeager's age may have been the deciding factor: he was 36 when the Mercury 7 astronauts were selected.)

Even before the Mercury program got off the ground, though, something shocking happened. As if to further underscore how far behind the U. S. was in the space race, on April 12, 1961, a Russian cosmonaut, **Yuri Gagarin**, rode his *Vostok 1* space capsule into low Earth orbit. Gagarin completed one orbit, returned to Earth safely and instantly became Russia's greatest living hero. (Gagarin died in a plane crash near Moscow in 1968.) But the Americans would catch up with and pass the Russians in space achievement within a few short years.

On May 5, 1961, Alan Shepard rode his *Mercury 3* space capsule on a 15-min. suborbital flight to become the first American to venture beyond Earth's upper atmosphere. His flight covered 302 miles downrange from Cape Kennedy, Fla. He landed safely in the Atlantic Ocean.

Two months later, on July 21, 1961, Gus Grissom completed a successful suborbital flight aboard Mercury's *Liberty Bell 7* spacecraft. Upon landing in the Atlantic Ocean, however, the hatch suddenly blew off, causing the capsule to take on water and sink in 15,000 ft. of water. (It was recovered by the U. S. in 1999.) Grissom escaped unharmed, and was rescued by Marine divers.

After that, all Mercury, Gemini and Apollo capsules wore large flotation collars similar to life

preservers to keep the capsules afloat after splashdown.

Four more Mercury flights followed, including John Glenn's historic first orbital flight by an American astronaut on Feb. 20, 1962. Each Mercury mission attempted new maneuvers and longer flights in space.

Like the Russians, in returning from space U. S. astronauts retro-fired their spacecrafts to slow down, and then deployed parachutes to soft-land. As previously noted, the U. S. preferred ocean splashdowns, whereas the Russians preferred terrestrial landings on Russian soil so the U. S. could not witness the landings or recover their spacecrafts.

One of the major differences between the U. S. and Russian space programs was *secrecy*. Although the Russians loudly proclaimed their successes, they never acknowledged their failures. (There were indications that they may have launched a manned lunar mission in early 1969, when ham radio operators around the world intercepted what was thought to be transmissions between a cosmonaut and Russia's mission control. But the Russians never acknowledged a launch of any kind on that date, which suggests that, whatever the mission was, it failed.)

The U. S., on the other hand, could hardly hide its launches at Cape Kennedy in Fla., and we didn't hide our failures (of which there were many, especially while we were developing powerful new rockets for the Mercury, Gemini and Apollo programs).

(Time out for trivia: Another difference between the U. S. and Russian space programs lay in how they solved problems. Early in the manned space flight years, our astronauts complained that their ballpoint pens wouldn't work under weightless conditions, so American engineers devised pens that didn't depend on gravity for ink to flow. The Russians' solution was to use pencils.)

The last Mercury mission was a 22-orbit flight by **Gordon Cooper** on May 15-16, 1964. By then, though, a Russian cosmonaut had flown a 64-orbit mission in *Vostok 3*, and in 1963 **Valentina Tereshkova** had become the first woman in space.

## Gemini

The Mercury program represented America's first tentative steps beyond Earth's atmosphere. Gemini was far more ambitious. Armed with more powerful rockets and an infinitely greater understanding of what lay ahead and how to get there, the Gemini program involved: examining the medical effects on astronauts of extended periods in orbit, and astronauts steering their spacecrafts, docking with another vehicle already in orbit, conducting space walks and working in space, and controlling re-entry to achieve precise landings in predetermined areas. All of those tasks except space walks would be necessary in order for astronauts to land a Lunar Module (LM, pronounced "lem") on the Moon, leave its surface, return to the Command Module and return to Earth safely.

The Gemini program involved 19 launches between Apr., 1964 and Nov., 1966: two unmanned launches, seven target vehicles for practicing rendezvous and docking procedures, and ten manned missions. All of them were successful. The manned missions ranged in duration from five hours to two weeks in orbit.

On June 3, 1965, **Ed White** aboard *Gemini 4* became the first American to walk in space, an activity which popularized the term EVA, or extra-vehicular activity. (A month and a half earlier, the Russian cosmonaut **Alexei Leonov** had left his *Voshkod 2* spacecraft for a 12-minute spacewalk. He later admitted that he was terrified throughout his EVA.)

Aboard *Gemini 8* on Mar. 16, 1966, astronauts **Neil Armstrong** and **Gordon Cooper** successfully docked with an orbiting unmanned Agena vehicle that had been launched earlier. After undocking, however, their capsule began to spin wildly out of control. On the verge of blacking out from the vehicle's rapid, dizzying gyrations, Armstrong finally managed to stabilize the capsule, and the rest of the trip back to Earth was uneventful. Armstrong's quick thinking and coolness under pressure during the unexpected -- and potentially deadly -- crisis contributed to his being selected for the later *Apollo 11* Moon landing.

The last Gemini flight (*Gemini 12*) was on Nov. 11, 1966; its crew consisted of **Jim Lovell** and **Eugene (Buzz) Aldrin**. But Aldrin, like Armstrong, had bigger fish to fry, although neither of them knew it at the time.

By 1966 the Russian space program was in disarray. They never developed a propulsion system comparable to our *Saturn V* rocket, but the ultimate setback came when their rocket designer and long-time program director, **Sergei Korolev**, died unexpectedly in Jan., 1966. Less than a month later, on Feb. 3, unmanned *Luna 9* made the first soft-landing on the Moon. But that was it. The Russian space program achieved sporadic successes after that, but it never fully recovered. There would be no more “firsts” for the Russians in the race to the Moon.

By the time the Gemini program shut down, the U. S. had clearly outdistanced its rival in terms of technical superiority and know-how. The stage was set. Apollo lay ahead, with Moon landings clearly in its sights.

### Apollo

The Gemini program had been an unbridled success. There were glitches along the way, of course, but aside from Gemini 8 none had been severe enough to compromise the missions or endanger the astronauts or their spacecrafts.

*Apollo 1* changed all that.

**Apollo I.** During a launch rehearsal involving Apollo I and its crew on Jan. 27, 1967, an electrical fire erupted, killing all three astronauts – **Gus Grissom**, **Ed White** and **Roger Chaffee**. Manned Apollo flights were suspended for 20 months while the causes of the fire were studied and addressed. However, the development and testing of the LM and Saturn V rocket continued with the successful unmanned launches of *Apollo 2*, *3*, *4*, *5* and *6*.

**Apollo 7.** The first successful manned Apollo mission was flown by Wally Schirra, **Donn Eisele** and **Walter Cunningham** aboard *Apollo 7* on Oct. 11, 1968. They tested the Command Module in Earth orbit.

**Apollo 8.** On Dec. 21, 1968, **Frank Borman**, **Jim Lovell** and **William Anders** became the first humans to orbit the Moon. In doing so, they also became the first humans to see the Earth in its entirety. Their descriptions of what our planet looks like from 240,000 miles away were decidedly unscientific but highly emotional. An American atheist, **Madalyn Murray O’Hair**, filed a federal lawsuit against NASA when the astronauts read a biblical passage from Genesis on Christmas eve. The suit was later dismissed.

Apollo 8 was the first U. S. mission to use the mighty 3-stage Saturn V rocket booster engine that all of the Moon landings would rely on. Even today, Saturn V remains the tallest, heaviest and most powerful rocket ever launched successfully. It was 363 ft. tall, weighed 6,540,000 lbs. and was capable of carrying a payload of 310,000 lbs. (Apollo 11’s Command Module and Lunar Module weighed 100,000 lbs.) During its brief period of maximum thrust, Saturn V generated a force of nearly 4g’s, during which time a 180-lb. astronaut would feel as if he weighed 650 lbs. or more. Each Saturn V launch cost \$185 million in 1969-72 dollars. (That would be \$10.7 billion per launch in 2016 dollars.)

As mentioned, the Saturn V rocket consisted of three stages. The first stage slowly lifted the rocket and its payload off the ground. At an altitude of about 59 mi., the first stage, its fuel supply exhausted, disengaged and fell back into the ocean about 300 mi. downrange, at which time the second stage fired. It burned for six minutes, bringing the rocket to nearly orbital velocity. Then the process repeated itself, with the second stage falling away and the third stage firing and burning for 2.5 min. The third stage took the capsule into Earth orbit, at which time the Command Module (containing the astronauts) and Lunar Module (LM) separated from the third stage. From there, the Command Module would take the astronauts the rest of the way to the Moon.

A single-stage rocket, on the other hand, would have had to carry its total weight – minus the fuel it expended along the way – all the way to the Moon.

**Apollo 9.** *Apollo 9* was launched on Mar. 3, 1969. Its crew – **James McDivitt**, **David Scott**, and **Rusty Schweikert** – spent a week and a half in low Earth orbit, testing the LM engines, the backpack life support system our astronauts would wear on the Moon, the navigation systems and docking maneuvers. *Apollo 9* proceeded without error and proved the LM's and backpack's ability to function as planned.

**Apollo 10.** *Apollo 10* was the final dress rehearsal for the Moon landing. Launched on May 18, 1969, the crew of **Gene Cernan**, **John Young** and **Thomas Stafford** achieved lunar orbit and did everything that the Apollo 11 crew would do except land.

After separating from the Command Module while orbiting the Moon, the LM carrying Stafford and Cernan flew to within 8.4 miles of the Moon's surface before returning to the Command Module, re-docking successfully and returning to Earth.

**Apollo 11.** On July 20, 1969, after a manually controlled, last-second search for a level landing site in the unexpectedly rocky and boulder-strewn **Sea of Tranquillity**, Neil Armstrong and Buzz Aldrin landed on the Moon.

"Houston, Tranquillity Base here," Armstrong announced. "The *Eagle* has landed." Back in Houston, Mission Control's **Charles Duke** replied, "Roger, Tranquillity, we copy you on the ground. You got a bunch of guys about to turn blue. We're breathing again. Thanks a lot."

When the *Eagle* touched down, it had less than 30 seconds of allotted fuel left before the LM would have had to return to the Command Module without setting down.

Armstrong and Aldrin spent a total of 21 hrs. and 36 min. on the Moon, including one 2-1/2 hr. Moon walk. They planted a U. S. flag, collected 94 lbs. of Moon rocks, took 175 photographs and broadcast back to Earth the first color tv images of the Moon. Aldrin was originally scheduled to be the first to walk on the Moon, but three months before the launch Armstrong pulled rank and insisted that, as mission commander, he – Armstrong -- should be the first to step down onto

the Moon. With Russia thought to be on the verge of sending a lander before the Apollo 11 launch, NASA officials caved in to Armstrong's demand in order to avoid a disruption that might jeopardize the mission. They changed the agenda to permit Armstrong to be the first to leave the LM. Aldrin didn't like it – but being the consummate team player, he was willing to settle for being the second man on the Moon.

After hopping down three ft. from the last rung of the ladder onto the lunar surface (which, incidentally, he couldn't see from the ladder), Armstrong delivered his famous line: "That's one step for (a) man, and one giant leap for mankind." And it *was* a defining moment in human history: Russian cosmonauts watching the live CBS broadcast cheered wildly when Armstrong stepped down onto the Moon; and later, cosmonaut Alexei Leonov commented, "Everyone forgot that we are all citizens of different countries on Earth. That moment really united the human race." Armstrong and Aldrin's Moon walk was watched on live tv by an estimated 600 million people around the world.

Prior to the *Eagle*'s landing, no one really knew if the soft lunar surface would support the weight of a spacecraft without it sinking or toppling over onto its side. (Unlike terrestrial soil, the lunar soil was found to be extremely fine, like black talcum powder -- and it clung to the astronauts' shoes, gloves and space suits. But it was substantial enough to support their weight and that of the LM.)

Aldrin and Armstrong quickly discovered that, due to the Moon's reduced gravity – 1/6<sup>th</sup> that of Earth's – walking normally wouldn't work on the lunar surface. In order to move from one place to another without risking falling over from the backpacks they were wearing, they developed a galloping gait like children riding a hobby horse. All of America's lunar astronauts used that galloping motion or hopping to get around on foot.

Before leaving the Moon, Aldrin and Armstrong left behind a plaque that read, *Here men from the planet Earth first set foot on the moon. July 1969 A.D. We came in peace for all mankind.* It was signed by the three astronauts (**Michael Collins**

was the Command Module pilot who remained in orbit) and **Pres. Richard M. Nixon**.

P.S. #1 to the Apollo 11 mission: In a desperate last-ditch effort to share the world spotlight with Apollo 11, on July 21<sup>st</sup> while Armstrong and Aldrin were on the Moon the Russians sent *Luna 15*, an unmanned spacecraft that had been launched earlier and was already in lunar orbit, to land on the Moon and study soil samples. During descent, however, the Russian lander malfunctioned and crashed into the (aptly named, in this case) **Sea of Crises**.

P.S. #2 (more time out for trivia): Here's a question you'll have no trouble answering at this point: *Our astronauts planted American flags in all six successful lunar landings; which is the only flag not still standing?* (The answer: the Apollo 11 flag. It had been planted only 25 ft. from the LM, and when the Eagle lifted off the Moon Aldrin saw the flag being blown over by the Ascent Engine's exhaust. After that, flags were planted at least 100 ft. from the LM.)

**Apollo 12-17.** In all, seven Apollo lunar missions landed a total of twelve U. S. astronauts on the Moon. They planted flags, conducted scientific experiments, rode around in lunar rovers (*Apollo 15, 16 & 17*), hit golf balls (Alan Shepard, *Apollo 14*), hopped around the lunar landscape, brought back soil samples and Moon rocks, and returned safely. The only major problem that arose in those seven missions was when *Apollo 13* suffered an onboard explosion on the way to the Moon, forcing astronauts **Jim Lovell, Fred Haise** and **Rusty Swigert** to circle the Moon aboard the LM before returning to Earth in the Command Module. The return trip to Earth was a harrowing journey because the explosion depleted much of their oxygen – thus, the necessity of spending part of the trip in the LM, which had a separate oxygen supply. But they made it home safely, as everyone knows who watched the **Tom Hanks** movie *Apollo 13*.

**The Moon Walkers.** Aldrin and Armstrong were the first, of course – but ten other U. S. astronauts

blazed other trails on the lunar surface between 1969-1972.

**Apollo 12.** **Charles "Pete" Conrad** and **Alan Bean** (Nov. 19-20, 1969). They landed in the **Ocean of Storms** within walking distance of *Surveyor 3*, which had soft-landed on the Moon in 1967. Besides collecting Moon rocks to bring home, Conrad and Bean removed some small parts of *Surveyor 3* (including a camera) and brought them back to Earth.

**Apollo 14.** **Alan Shepard** and **Edgar Mitchell** (Feb. 5-6, 1971). Their Moon walks in the **Fra Mauro Highlands** totaled nearly 9-1/2 hrs., and they collected 94 lbs. of Moon rocks.

(Incidentally, the amount of lunar material the Apollo astronauts were permitted to bring back was determined early in the planning stages of each mission. Why? Because space aboard the LM was severely limited, and the Ascent Engine that would lift them back to the Command Module carried a specific predetermined amount of fuel. In order to bring back more Moon rocks than planned, the astronauts had to jettison an equal amount of tools or equipment they had used on the Moon. For example, on Apollo 17 **Jack Schmitt** left his rock hammer on the Moon so he could bring back more rocks. [The Lunar rovers didn't count because they were left behind and were never intended to be lifted in the ascent stage.]

**Apollo 15.** **David Scott** and **Jim Irwin** (July 30-Aug. 2, 1971). They were the first to use a Lunar Roving Vehicle (LRV, or simply "lunar rover"), which they drove around the landing site at **Hadley Rille**. Later, they got in trouble when it was discovered that they had secretly brought along postage stamps that they planned to sell when they returned to Earth.

Scott and Irwin spent three days on the Moon, including 18-1/2 hrs. outside the LM, and returned with 170 lbs. of lunar material.

**Apollo 16.** **John Young** and **Charles Duke** (April 21-24, 1972). They spent three days on the Moon and conducted three Moon walks totaling 20 hrs.

and 14 min. They drove their lunar rover a total of 16.6 mi., and collected 211 lbs. of soil and rock samples from the lunar highlands area.

**Apollo 17. Gene Cernan and Harrison “Jack” Schmitt** (Dec. 11-14, 1972). They spent 22 hrs. outside the LM on three extended Moon walks and lunar rover excursions in **Taurus-Littrow Valley**. Fittingly for the last Moon mission, the Apollo 17 astronauts broke several records: the longest stay on the Moon, the longest EVA duration, the largest lunar sample and the longest time spent in lunar orbit. (Apollo 17 was also the first night launch of a human space flight, and the first mission to have no one on board who had been a test pilot.)

### Conclusion

After Apollo 17, with no other worlds immediately capable of being conquered, NASA’s attention turned to creating an Earth-orbiting space station (our first was *Skylab*, launched in 1973), and to sending unmanned probes to other planets in the solar system.

The years 1969-1972 were unparalleled in mankind’s brief tenure on Earth. In that short span, the U. S. put a dozen men on the Moon, and they brought back a total of 842 lbs. of lunar material. Given the relatively primitive state of technology back then, it was an achievement that almost defies belief. (In fact, some people believe it never happened: they believe the Moon walks were faked by actors performing on a Hollywood sound stage.)

It has been 44 years since anyone has walked on the Moon; now, we’re talking about sending astronauts to **Mars** someday. If we ever make it, I wonder: Will that act generate pride in what we have accomplished? (It certainly did with the Apollo Moon program!) Or will we feel the need to apologize for being the most technologically advanced nation on Earth?

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