Air and Space this Week

Item of the Week

APOLLO 12, SURVEYOR 3, AND THE STEELY-EYED MISSILE MAN

Originally appeared November 14, 2022

KEY WORDS: Apollo 12 Surveyor 3 Conrad Bean Gordon John Aaron SCE to AUX

It was a dark and stormy night. OK, except for the spotlights. And it was in the late morning. But it was November 14, 1969, and under "cloudy, rainswept skies," the Apollo 12 launch vehicle was all systems "go." Lift-off was at 11:22 AM EST. Uneventful at first, the Saturn V rose ponderously, disappearing in the low-lying clouds. The mighty rocket's exhaust plume stood like a pillar, but, because it contained more than just water vapor, it was in effect a giant lightning rod. Onlookers were shocked as first one lightning bolt, then another a few seconds later, followed the plume from cloud to Earth…

AFTER APOLLO 11

Apollo Plans

The Apollo program was a well-thought-out plan to develop and test the technology to take astronauts to the surface of the Moon. Apollo 1 was a designation given after the first planned crew perished in capsule test. The next five numbered Apollo launches were non-crewed tests of the Saturn V launch vehicle. *Apollo 7* was the actual in-orbit test of the Command/Service module in low-Earth orbit with crew. *Apollo 8* was supposed to be the LEO test of the Lunar Module and *Apollo 9* was supposed to be the test mission where astronauts orbited the Moon without the LM. However, the LM wasn't ready in time for the rigorous Apollo schedule, so the two missions were switched. *Apollo 10* was the full-dress rehearsal, including flying the LM separately in lunar orbit but without landing. All were successful.

Apollo 11

The first crewed lunar landing attempt was *Apollo 11*. The mission was simple: Make good on JFK's pledge to "land a man on the Moon, before the decade is out, and return him safely to the Earth." The mission plan was to land safely, plant the Flag, collect a few nearby samples, and return home successfully. This they did.

The Rest of the Program

A suite of ten increasingly-complex Apollo lunar landing missions were planned, each building on the technical improvements and scientific understanding of the missions before. The science goals of the first four were to be relatively simple; different areas would be visited and the few scientific instruments to be left would get better, but the astronauts could only explore

a few hundred meters from their landing site. The remaining missions in the sequence, the "J missions,' would have the Lunar Roving Vehicle to extend EVA range.

The landing sites to be used had to be on the near side of the Moon for line-of-site communications, and relatively-near the lunar equator (fuel constraints); otherwise, scientific considerations played an important role in site selections. Some sites, were considered particularly important.

Scientists studied the Moon in great detail and found that they could make some sense of its surface by observing the concentration of craters in any one place versus another. Most were small, but some impact features were very large, and ejected material for many miles around. Geologists like to be able to tell how old various features are, and the material ejected from the large features were a wonderful tool. Anything the ejecta lay on top of had to be older than the impact, anything atop the ejecta had to be younger than the impact. [Hey, this isn't exactly rocket science!] So acquiring a sample from the ejected material from a given impact, returning it to Earth, and determining the age of it radiometrically, would be a valuable piece of info.

Apollo 11 was a very successful mission, but Neil and Buzz missed the planned landing site by over four miles. [The semi-automated landing system was taking them into a boulder field that could have wrecked the LM, so Neil overrode it and landed manually. The extra flying needed was a big part of the four-mile miss, and he came very close to running out of fuel. But that's another story, with another young engineering hero.]

Pre-mission science planning required the astronauts to land at the planned landing point; meeting the mission science objectives absolutely required it. Proving pin-point landings could be accomplished was one of Apollo 12's primary missions.

Apollo 13 famously failed, but its objective, material ejected from one of the Moon's large impact basins, was so important scientifically that *Apollo 14* went to the same site. Waning public interest affected the original program, and the three remaining missions, all the more-capable J-missions, adopted the highest priority and/or compromise sites; a story for another time.

APOLLO 12

Apollo 12 is one of my favorite NASA missions for four reasons. I already mentioned it was to demonstrate the ability to land where desired. This was no mean feat. We did have good imaging from the Lunar Orbiter series of satellites, but a compass won't work on the Moon and there was nothing like a GPS – how would one be sure they had landed where they planned?

Leave it to NASA to find a clever solution! NASA had sent a number of spacecraft to the Moon to plan for eventual landings. The Ranger series were first; they sent back pictures as they crashed straight into the Moon. The Lunar Orbiter series was mentioned above; five spacecraft covered the potential landing zone region photographically. Finally, the Surveyor series of spacecraft actually landed on the Moon and returned images and other data. Some scientists (Tommy Gold, from whom I took a college course) had hypothesized that the lunar surface

would be covered by a dangerous thick layer of dust, wrong, but more did need to be known about the surface before people landed on it.

NASA decided to use *Surveyor 3* as their landmark. They knew where it was, and if the astronauts could land withing EVA distance, it would prove the pin-point landing capability desired. And, in an additional benefit, returning pieces of *Surveyor 3* would allow engineers to assess how different types of materials held up under harsh lunar surface conditions.

The second reason I like the Apollo 12 mission was that Al Bean was aboard; he would become my boyhood hero and an inspiration to all of us who value NASA outreach (see here).

The third reason I like Apollo 12 is that it carried the first Apollo Lunar Science Experiment Package (ALSEP), powered by an RTG, for the astronauts to set up. I would like it even more if the Apollo 12 carried a version of the famous Laser Ranging Retroreflectors that were carried by Apollo 11, 14, and 15. Bouncing a laser beam from Earth to the reflectors on the Moon and back allow astronomers to determine the Earth-Moon distance with extreme precision, helping prove that the Moon is slowly receding from Earth and slowing Earth's rotation rate.

[Knowing the rate at which Earth's rotation is slowing provides geologists a very important, fully-independent cross-check on the accuracy of radiometric dating! For more on this, see the piece I prepared for NASA's Year of the Solar System observance back in 2011 – it's now posted on the A+StW website's "Archive: Other Stuff" page.]

The third reason I like the Apollo 12 mission is John Aaron, who personified my favorite maxim that "NASA does the near-Impossible, and they do it with style." More about him later.

THE CREW

Charles "Pete" Conrad Jr.

Apollo 12's mission commander was Charles "Pete" Conrad Jr., an experienced astronaut who flew on *Gemini 5* and then commanded the *Gemini 11* mission and would later command the first *Skylab* mission.

He was born on June 2, 1930, in Philadelphia. He overcame dyslexia and family financial setback during the Depression to go on to Princeton with a Navy ROTC scholarship. He was small, but extremely tough, both of which would serve him well later in life. Like so many astronauts, he was intensely interested in flight, earning his pilot's license before graduating from high school. He graduated from Princeton in 1953, and became an ensign in the Navy. He was sent to Pensacola for flight training, where he excelled and became a carrier-based fighter pilot.

Conrad then applied for the USN Test Pilot School at Patuxent, got in, and graduated in 1958 in Class 20, along with future astronauts Wally Schirra and Jim Lovell. He became a Captain on December 11, 1969. He then applied to NASA's astronaut program, striking to become part of the first group of astronauts selected.

The rigors of the medical screening process at NASA have been described elsewhere aplenty, and let's just say, Pete Conrad wasn't about to put up with it. He didn't appreciate that Space medicine was in its infancy and the medicos needed to know how the human body would react to Spaceflight and prolonged free-fall conditions. He acted up famously (*e.g.* his X-rated description of a Rorschach ink blot and wrapping a stool sample with a gift ribbon), and was not selected. Surprise, surprise.

Conrad returned to active flight duty, flying the F-4 Phantom. He was buddies by then with fellow pilot and Mercury astronaut Al Shepard, who invited him to apply to the second pool of astronauts. The medical tests had been toned down somewhat, and Conrad was selected for the New Nine group of astronauts on September 17, 1962.

Deke Slayton established a "three mission" rotation policy for astronauts to be able to train for their missions effectively. Astronauts would train for a mission as back-up, then fly the third mission after that. Pete's first gig was to be on the back-up crew for *Apollo 8*, then planned as the first LEO test of the full Apollo capsule and lunar module. Delays in readying the LM forced a mission swap between *Apollos 8* and *9*, so Pete was on *Apollo 9*'s back-up crew, which set him up to command the third flight following, *Apollo 12*.

After *Apollo 12*, Conrad was assigned to command the first crew to visit the newly-launched Space Station. During training for that mission, he visited various contractors building (sub)systems for consultations, a common practice for astronauts. Flying in a NASA T-38 jet, he was on his way back to Ellington AFB near JSC. Weather conditions were poor, and he opted to divert to nearby Hobby Airport. A generator failure at the most inopportune time forced him to find an airport with clear weather. He tried for Bergstrom AFB near Austin, but ran out of fuel just short of the runway and had to eject.

The *Skylab* Space Station sustained damage during its launch, losing one of its two solar panels and an important shade that would help keep *Skylab* cool enough to inhabit. Conrad led two EVAs on arrival at *Skylab*, rigging a solar shield that made his and subsequent two missions to *Skylab* possible.

After NASA, Conrad enjoyed several important positions, including one at the American Television and Communications Company, then moving over to a senior position at McDonnell Douglas, and also doing some consulting work.

Pete Conrad loved his motorcycle. On July 8, 1999, he, his wife, and other friends rode from Huntington Beach heading to Monterrey. He lost control in a turn near Ojai, and would die from the injuries incurred. He was buried with full honors at Arlington.

NASA has an honor grove of trees at JSC, dedicated to fallen astronauts. *Apollo 12* crewmate Al Bean gave the dedication of Conrad's tree at its planting, and pondered how Pete would react to the service. Bean recalled for the group assembled that one of Pete's favorite sayings was "When you can't be good, be colorful," and suggested Pete would have asked for colored lights to be put on his tree in the grove at Christmas time, instead of the all-white bulbs normally used. To this day, all the trees in the grove wear white bulbs, except one. Pete Conrad's.

Alan L. Bean

I covered Al Bean, a personal hero and role model for me, in an earlier Item of the Week. If you care about sharing the importance of NASA's work and STEM learning to others, you should check it out, here.

Richard F. Gordon, Jr.

Richard Francis Gordon Jr. was born in Seattle on October 5, 1929, the oldest of five children. He received a B.S. in Chemistry from the University of Washington in 1951, where he was a distant fraternity brother (Phi Sigma Kappa). He then enlisted in the Navy, earning his aviator wings in 1953. He applied for, and was accepted to, the USN Naval Test Pilot School at Patuxent in 1957. Along the way, he met and roomed with Pete Conrad while both were serving on the aircraft carrier *USS Ranger*.

Gordon applied for the second astronaut group, the one Conrad was in, and became a finalist but was not selected. He did make the third group, in 1963. His first assignment was as back-up Pilot for *Gemini 8* (the one that almost killed Armstrong and Dave Scott), which put him in line for *Gemini 11*, where he flew with Conrad.

Gordon was the Command Module Pilot for *Apollo 12*, keeping the CSM running smoothly while Conrad and Bean landed on the Moon. His next two assignments under the three-mission rotation would be the back-up crew for *Apollo 15*, and the prime crew for *Apollo 18*, where he was to get his turn to walk on the Moon. Alas for him, the final three planned Moon shots were cancelled; *Apollo 17* was the last (for now).

After Apollo, astronaut Gordon stayed with NASA until he retired from both NASA and the Navy in 1971. After NASA, he was the Executive VP for the New Orleans Saints NFL team and held a number of important positions in the petroleum industry. He also supported a number of charitable and civic organizations (*e.g.* Louisiana Heart Fund, March of Dimes, Muscular Dystrophy, and the Boy Scouts). He received numerous accolades for his flying and business successes. Richard Gordon passed away on September 12, 2017, and was buried with full honors at Arlington.

AN ACCURATE LANDING

Apart from the launch, the Apollo 12 mission was relatively uneventful. The spacecraft performed well, as did the LM, and Conrad and Bean made a successful landing in the Ocean of Storms about 500 feet from their target marker, the *Surveyor 3* spacecraft. They deployed the first ALSEP, collected over 75 pounds of rocks, and collected the camera and other materials from the Surveyor for analysis on Earth. The mission was an unqualified success! The only disappointment of any note at all involved the color TV camera taken to the lunar surface. Bean inadvertently pointed it at the Sun, which damaged its vidicon system of the camera. Rats! But the landing proved that NASA could put astronauts where they wanted to on the lunar surface.

Conrad and Bean lifted off the Moon's surface on the morning of November 20, and the command module splashed down safely in the afternoon of November 24, off American Samoa. The crew and command module were picked up by the carrier *USS Hornet*. Concern over some sort of extraterrestrial pathogen, *a la* Andromeda Strain, required that the astronauts and material they returned be quarantined for safety.

SURVEYOR 3 CAMERA

Reading through the communications transcript of the three Apollo 12 EVAs made me feel like I was there! One could imagine that they were on the surface of the Moon with Pete and Al as they made real-time observations and collections. EVA #2, when they visited the *Surveyor 3* spacecraft, is a particular favorite. They were able to cut the camera free from its mounting, and bring it and a number of other materials from the lander back for engineers to examine. Knowing how exposure to lunar surface conditions affected aluminum, mylar, and other spacecraft materials was of great importance for planning future missions!

The Apollo 12 Command Module, named *Yankee Clipper* by the crew, is now on display at the Virginia Air and Space Center, and the *Surveyor 3* camera was on display at the National Air and Space Museum in Washington, DC.

The camera was found by the astronauts to have considerable dust on it, as did much of the lander. They opined in real time about how much dust might have been raised by the LM's Descent Stage rocket. They knew it would be the object of much study later.

The examination of the camera was relatively routine. Not only were the scientists and engineers interested in seeing how materials withstood the lunar surface conditions, they were still mindful of the managerial and public interest/concern over "Moon bugs" causing an epidemic.

And, sure enough, bacteria were discovered inside the camera!

The idea of an alien germ threatening Earth was quickly debunked. The bacteria in question were common on Earth already – Streptococcus Mitis. The examination was in a Clean Room, so contamination after the flight was unlikely, but that also meant that the camera was contaminated prior to flight and the bacteria somehow managed to survive the extremely-harsh lunar environment for an extended period.

A flurry of excitement ensued – briefly. An examination of the examination quickly concluded that proper Clean Room protocol had been seriously violated, and that there was no doubt that the bacteria in question arrived in the camera after the Apollo 12 mission.

The *Surveyor 3* camera was one of the favorite artifacts of the NASM staff – something that had been sent to the Moon then retrieved was unique enough, but the camera was an object lesson in handing returned materials, too!

THE STEELY-EYED MISSILE MAN

You have seen references within A+StW over the years where I extoll NASA's ability to do the almost impossible, do it on time and (usually) under budget, and to do it with style. The following is one of the best examples of this flair I can think of.

Let's go back to our dark and stormy morning. Cue ominous music. I suppose that an outside observer, if this were a TV movie (not invented yet), the fact that *Apollo 11* was sent to the Sea of Tranquility and *Apollo 12* was headed for the Ocean of Storms might cause some concern.

The two lightning bolts that hit *Apollo 12* knocked out many electrical and electronic systems. The astronauts were confronted with more warning lights than they had ever seen, even in the most sadistic simulation test. Many of their instruments were out; others showed gibberish.

In Mission Control, the various system monitoring stations were in similar straits. Nobody had envisioned a malfunction so complete. This being NASA, there was no panic or delay, the console operators went to work chasing down what had happened (they weren't in a position to have seen the lightning). The only good thing was that the Saturn V was operating properly, but the controllers could not confirm that with their telemetry out. If the system couldn't be made right soon, an abort would be required, and a multi-billion-dollar mission, and perhaps three astronauts, would be lost.

The Apollo 12 Flight Director was working his first launch, but the EECOM (Electrical, Environmental, and COnsumables Manager) was the key person in this situation. His name was John Aaron. He had seen the present failure mode only once, over a year before, and he not only recognized it immediately, he remembered what to do.

The Apollo capsule had an electronic component, the Signal Conditioning Electronic package or "SCE," that converted data from sensors into electrical currents the spacecraft instrumentation could read. If its power supply was interrupted, it would shut down, making telemetry impossible. Aaron had learned the system needed to be re-booted, just like a wayward computer today that gets "fixed" by turning it off and on again.

The other controllers had little to do with this emergency; all eyes and ears were on EECOM awaiting an "abort" call with dread. Instead, they and both the Flight Director (FD) and Capsule Communicator (CAPCOM) hear Aaron make a steady-voiced call, "Turn SCE to Aux." Neither the FD nor CAPCOM (and no doubt none of the other controllers) knew what Aaron was talking about, but the CAPCOM relayed the message when Aaron repeated the call, "Turn SCE to Aux(illiary)."

Pete Conrad and Dick Gordon had no idea what the CAPCOM call meant, but thankfully, Al Bean did. The switch wasn't on the console in front of them, it was behind Bean's headrest. He immediately reached up and switched the SCE system to auxiliary power.

And poof, the telemetry was restored! The FD and controllers quickly confirmed all was now well, and the mission continued.

I always encourage NASM Docents and anyone interested in the manned Space program of the 1960s to read *The Right Stuff* by Tom Wolffe in order to get the feel and flavor of what those days were like. He describes a reputational pyramid for pilots, where the most daring and capable ascend to its summit.

There is a similar pyramid for flight controllers and managers. It's smaller, but no less important. Only a few reach its summit, recognized as the best. The guy who told Neil to go for landing when the *Eagle* was almost out of fuel was one. Gene Kranz of *Apollo 13* fame is one. John Aaron is most definitely another. He not only saved *Apollo 12* single-handedly, Kranz had him in charge of the *Apollo 13* power supply budget, a system of critical importance during the saving of the crew. Aaron's colleagues dubbed him the "Steely-Eyed Missile Man." No higher honor is possible. BTW: Aaron was 26 years old when he saved the day. I cover this event more from the Al Bean side here.

The NASA resources I found do not go into the origin of the nickname for John Aaron. But I suspect, and I did find several sources that indicate the term is actually older, and likely attributed to Strategic Air Command missile silo crews (here and here), who were in (friendly) competition with the B-52 guys as to who's deterrent force was more important.

In any case, it was Aaron's deed that moved the phrase into the public domain, and he did, after all, save an Apollo Moon shot from disaster! The meaning has broadened since then, and the earlier origin of the phrase is much less publicized.

CODA

Close reading of the material above reveals that the Apollo astronauts were on a three-mission rotation and that Conrad and Gorden had "flown" back-up missions together before moving on together to *Apollo 12* (they had also crewed *Gemini 11*). So where did Al Bean come from and why was he on *Apollo 12*?

Another astronaut, Clifton Curtis ("C.C") Williams Jr., was initially slotted in the rotation with Conrad and Gordon. Like all astronauts, he maintained flight status by making T-38 flights to various NASA centers and contractors. Williams had been selected in the third astronaut group (along with Richard Gordon) and had previously served as the back-up Pilot for *Gemini 10*.

C.C. was scheduled to fly from Cape Canaveral back to Houston on October 5, 1967. His family lived in Mobile, and his father was dying of cancer, so C.C. planned to stop there on the way. Everything was going OK on the flight, but over Tallahassee at over 22,000 feet, a mechanical failure jammed his aileron controls, resulting in a vertical dive at near-sonic speed. He ejected, but was too fast and too low for it to save him.

Needless to say, Conrad and Gordon were shocked, as was the rest of the Astronaut Corps (T-38 crashes had already claimed several astronauts, for example Eliot See, Charles Bassett, and Ted Freeman, and Class 3 alum Roger Chaffee died in the Apollo 1 fire). Conrad then turned to Al Bean to fill out the *Apollo 12* crew. Al suggested that the design of the mission patch for Apollo 12 show four stars prominently, one for each of the crew, and one for C.C. Williams.

Williams had been the only bachelor in the Corps, but after his selection, he married Jane Elizabeth "Beth" Lansche, who in an earlier life had been a water ski performer at Cypress Gardens. They had a daughter in early 1967, and Beth was pregnant with their second when the crash occurred.

Personal Note: When I post-Doc'd at the Lunar and Planetary Institute, the manager of one of my projects was C.C. Williams' widow. Beth was an outstanding, no-nonsense manager with a flair for strategic "big picture" thinking, and I greatly enjoyed working with/for her. It's been a while since then, and I hope both she and the daughters have had happy and productive lives.

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Last Edited on 13 November 2022