Stanford News (http://news.stanford.edu/)

JULY 15, 2019

Stanford professor talks about his days as an intern for the Apollo program

From chasing toxic clouds to developing rocket fuels for Mars, Brian Cantwell shares stories of his time working on space exploration technologies – starting with an internship with the Apollo program.

BY TAYLOR KUBOTA

In early summer 1968, **Brian Cantwell (https://profiles.stanford.edu/brian-cantwell)** was fresh out of the University of Notre Dame with a degree in engineering and driving down to Houston. He was on his way to start an internship at the Manned Spacecraft Center – now the Johnson Space Center – where he would work on the Apollo program.

"This was the biggest thing going on at the time and I was delighted to be a small part of it," said Cantwell, now the Edward C. Wells Professor in the **School of Engineering (https://engineering.stanford.edu/)** and a professor of aeronautics and astronautics and of mechanical engineering at Stanford University. "At the time, this was the one place in the world you wanted to be if you were an engineer."

Since his days standing in fields with decibel meters and tracking clouds of toxic gas (he'll explain later), Cantwell has researched turbulence, combustion and, most recently, hybrid rocket fuels. One **new type of fuel (https://engineering.stanford.edu/magazine/article/rocket-fuel-made-wax)** he's working on now may play a role in future Mars missions.

Cantwell spoke with Stanford News about his time working on Apollo, watching the moon landing from a guard tower in Monterey and what he thinks about a return to the moon.

It was expensive and risky to put a person on the moon. Why was it so important?

It's a question people were asking at the time too. First, there were a whole series of technological innovations that took place through the Apollo program. The computers they used aboard the spacecraft were, by modern standards, crude but they proved that you could use computers to do a very complex mission. Other advances included new materials and especially large rocket engines.

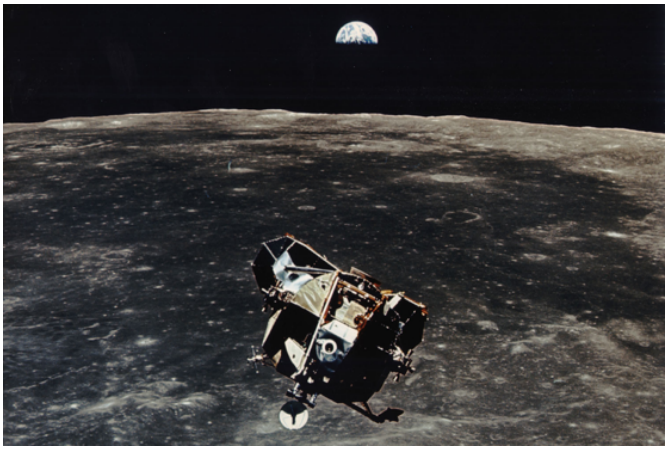
Honestly, though, the big reason was political: It was to get to the moon before the Russians. Although, later, when the Soviet Union fell, we recognized that their space program had really stalled.

How did you contribute to the Apollo program?

I was involved in testing the engine that took the astronauts off the moon and into orbit after their visit to the moon – that's the Lunar Module ascent engine. I also had a separate project, testing one of the pressure transducers on the first stage F1 engine on the Saturn V rocket.

the first moon landing, engineering Professor reflects on the small part he played in the . *(Image credit: Courtesy Stanford Engineering)*

Aside from that work, one of my primary jobs was to measure the sound pressure level from the motor tests. I would stand out in this big open field with a sound pressure level meter in my hand, reading 140-150 decibels. I had on ear protection but my whole body was shaking.



The Lunar Module – as an intern, Brian Cantwell was involved in testing the Lunar Module's ascent engine that took the astronauts off the moon and into orbit. *(Image credit: NASA)*

The other job I had was to get in a Land Rover with a walkie-talkie and chase clouds of very toxic material the engineers had to vent from the motor – an oxidizer called N_2O_4 (nitrogen tetroxide). When they vented it, it just would go up in the air forming a heavy, red gas, which then tended to float toward the ground. I had to call the firefighters if the clouds went into the surrounding neighborhoods. It was a very different era. Virtually everyone who lived around the Manned Spacecraft Center – which is now NASA Johnson – was connected to the space program somehow, so the idea of a little bit of rocket oxidizer floating down the street didn't bother them all that much.

Where were you for the Apollo 11 moon landing?

When Neil Armstrong landed on the moon, I was in a guard tower at the stockade at Fort Ord near Monterey, California, watching over prisoners in the yard. In fall of 1968, I got a draft notice that pulled me into the Army, where I was made a military policeman. On that day, I brought a radio with me to the guard tower. I listened to the whole sequence as they landed on the moon and I would call down to the prisoners in the yard to tell them what was happening. They were pretty excited to hear about it.

When I went back to the barracks, I decided I wanted to watch them step out on the moon. I was off duty, so I drove my car into Salinas and took a motel room. I sat there during the night as Neil Armstrong walked out onto the moon. The camera didn't create very good images but you could see most of what was going on. They had the camera set up so you could actually watch as he got down the ladder and took the first step. And it was amazing.

What work have you done since you interned in the Apollo program?

I was hired at Stanford to develop a program in propulsion in 1978 and I started my research around turbulent flow and combustion. Then, in the late 1990s my student, Arif Karabeyoglu, got me interested in hybrid rockets, which use a solid fuel and a liquid oxidizer that produce the combustion of hot gases needed for thrust but have the advantage that the two don't mix together – that makes them safer to use. Recent research in my lab is involved in applying hybrid propulsion to planetary exploration, including demonstrating feasibility for a Mars ascent vehicle.

It's a bit of a full circle there. In '68 I worked on the Lunar Module ascent engine, which would lift astronauts off the moon into orbit. Now, here we are, involved with the Mars ascent vehicle that will lift soil samples into orbit around Mars.

My students David Dyrda and Flora Mechentel also recently did some testing at the Jet Propulsion Lab to demonstrate a new ignition system we've been developing on a small motor that NASA hopes to use for some planetary exploration missions. It's interesting to see basic research showing potential for real applications to space exploration.

How do you feel about NASA's plans to return to the moon?

The idea of going to Mars is exciting but it's difficult. We need large launch vehicles to get there – we need these super-heavy lift rockets – but the real problem is sustaining the astronauts for that long journey, where you literally have nothing but what's there with you in the spacecraft.

Going back to the moon is a more reachable goal in a reasonable period of time and it could be used as a stepping stone to a much longer mission out to Mars and possibility eventually other moons of other planets. The idea of the Gateway – which is a proposed space station in orbit around the moon – is NASA's response to administrations that flip back and forth between wanting to go to Mars and wanting to go to the moon. It's an intermediate idea that could apply to both goals.

It's a much more exciting time now, with all the new commercial activity in space, than it was in the waning days of the space shuttle, when that was the only game in town. A lot of interesting things have happened in the last decade or so. I give credit to these entrepreneurs, like Elon Musk and Jeff Bezos, for being willing to invest in the future of space.

One thing that especially excites me about space travel right now is that there is a real possibility that in our lifetime we will discover that life has developed on another planet. I think this is truly the greatest exploration adventure of our time.

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