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# AEROSPACE

A M E R I C A

## Dazzling images from our nearest star

**A conversation with Buzz Aldrin  
Paradigm shift in U.S. space policy**

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## Buzz Aldrin

*The whole world saw you walking up the stairs to Air Force One last April arm in arm with President Obama. You were headed to the space conference in Florida. What were you talking about?*

He thanked me for my help in supporting his space plan.

*That's it?*

He's a very smart guy.

*Much of the program you've advocated for years is included in the new plan. Do you feel vindicated?*

No, because there is a lot of work to be done. We didn't get everything we sought.

*What, for example?*

There is still a need to develop a runway lander type vehicle for the space taxi, not a space capsule. And I urged the shuttle be extended so as to speed the development of a shuttle-derived heavy-lift vehicle. That doesn't seem to be likely now.

*So you have no use for capsules?*

No, I didn't say that. Making the space taxi that flies to and from the international space station a capsule is a

***"Making the space taxi that flies to and from the international space station a capsule is a pretty dumb idea."***

pretty dumb idea. But a space capsule would work in a deep space mission.

*What difference does it make?*

A space taxi, by definition, should be able to return crew and ISS experiments to a runway to speed their processing and to carry the larger payloads that a lifting body runway lander can deliver. A space capsule shape strongly limits the down mass and increases the g forces sustained during reentry. I have flown reentry profiles aboard capsules, and I can tell you that delicate samples

coming home from the ISS would sustain a more benign environment aboard a glider.

Now, for deep space missions, a capsule would be preferred for its ability to aerocapture and to otherwise sustain reentry speeds coming back from a deep space or planetary entry. There, wings and a lifting shape become problems for the heat shield and the higher heating loads and g forces. So I think an Orion-like vehicle would be preferred for use with a deep space vehicle, and a lifting body preferred for returning taxi missions from ISS. Each has a place.

*For years, policymakers have ignored many of your ideas. Now they're being codified into policy. Why now? What has changed?*

Things are really bad, and that's when change becomes possible. Government bureaucracies aren't known for their ability to make substantial changes; they're not very agile. NASA faces difficult times in transitioning from the shuttle era to an agency more focused on research and deep space manned flight.

This opens up the possibility of hearing new approaches. Under Constellation, the program of record was falling so far behind schedule that there

was no funding to build the Ares V or the Altair lander. It needed all of the funding just for "Apollo on steroids." That's because under [former NASA Administrator] Mike Griffin the focus became returning to the Moon, rerunning the Moon race we won 40 years ago.

I have had a unified strategic vision for space that is appropriate for the 21st-century world we face. The Cold War is over. Today, to demonstrate global space leadership requires that you collaborate and build coalitions with other nations, not see them as competi-

tors. But Charlie Bolden has a tough job ahead of him as he wrestles his agency into a new focus. The forces that support the status quo are very entrenched.

*So you'd abandon the Moon entirely?*

No, I believe we should go back to the Moon, only this time as part of an international partnership that establishes a lunar development authority. We are a great power and have the experience to help the other nations that want to develop the Moon. Same for the station. Our role today is to express our leadership by facilitating the space programs of our partners.

***"Things are really bad, and that's when change becomes possible."***

China, India, South Korea, Brazil all are seeking to develop advanced space programs, some of which include manned space programs. We can help make that a reality. And when we do, our stature increases, which strengthens our strategic interests.

*Why the focus on Mars for all these years?*

Our survival requires us to become a true multiplanet species. We need to identify places we can go in the solar system that could be candidates for habitation and colonization. Mars offers us tremendous scientific benefits, in understanding global climate change, possible life—and even, during the period when it was wet, advanced life. It is the best candidate we know of to support a human colony. So that's why Mars should be our focus, not the Moon.

*What's the relationship between Mars and heavy lift?*

A heavy-lift system is a better way to launch an interplanetary deep space vehicle into low Earth orbit than two vehicles. Using today's EELVs would require half a dozen launches of small

packages; that would not be desirable. To go anywhere beyond Earth orbit requires greater lift than we have today.

### **So you endorse the president's proposal to speed up a heavy-lift vehicle?**

It won't take us five years to design.

### **How long would it take?**

If we used the existing space shuttle infrastructure we could start now. That's why shuttle extension was so critical. But that doesn't seem to be in the planning, so we may have to change course and try a "clean sheet" approach.

### **You no longer favor a shuttle-derived heavy-lift design?**

That's my preferred approach, but without shuttle extension you lose the workforce and the shuttle systems. So an entirely new approach may be needed.

### **And you didn't support the Ares I and Ares V vehicles?**

The Ares I used five-segment motors that were unproven and underpowered for the weight of the Orion. And Ares V was too big. So it was clear to me that we needed a different approach to heavy lift.

### **How can NASA develop a deep space vehicle under their budget pressure?**

If we utilize the spare parts left over from the ISS construction, or inflatable technology, we can get at least to the prototype stage fairly quickly without a huge expenditure of funds. There is always the tendency to go for the most expensive approach, the Cadillac, when something cheaper is available. The idea is to get us out into deep space as soon as we can start.

### **What is the most difficult thing about a manned Mars mission?**

We don't have the technology to sustain a Mars crew for the long trip required by chemical rocket propulsion systems. That's why we need to develop

capabilities like the VASIMR plasma rocket and other designs, to shrink the transit times to Mars or asteroid rendezvous. We also need more research in radiation shielding. And a heavy-lift booster and possible advanced upper stages. We should be working on these areas now, and I think the new R&D budget supports this. In-space refueling of upper stages is a technology we should develop.

*Buzz Aldrin was educated at the U.S. Military Academy at West Point, graduating third in his class with a B.S. in mechanical engineering. He then joined the Air Force, where he flew F-86 Sabre Jets in 66 combat missions in Korea, shot down two MiG-15s and was decorated with the Distinguished Flying Cross. After a tour of duty in Germany flying F-100s, he earned his doctorate of science in astronautics at MIT and wrote his thesis on manned orbital rendezvous.*

*Selected by NASA in 1963 into the third group of astronauts, Aldrin was the first with a doctorate and became known as "Dr. Rendezvous." The docking and rendezvous techniques he devised for spacecraft in Earth and lunar orbits became critical to the success of the Gemini and Apollo programs and are still used. He also pioneered underwater training techniques, as a substitute for 0-g flights, to simulate spacwalking.*

*In November 1966 during the Gemini 12 mission, he performed the world's first successful spacwalk, overcoming prior difficulties experienced by Americans and Russians during extravehicular activity and setting a new EVA record of 5 hr 30 min.*

*On July 16, 1969, Aldrin, Neil Armstrong and Michael Collins were launched aboard the Apollo 11 mission. On July 20 Aldrin and Armstrong landed their lunar module, Eagle, on the Moon's surface, spending 21 hr on the Sea of Tranquility. Apollo 11 returned 46 lb of Moon rocks,*

### **Recently the LCROSS [Lunar Crater Observation and Sensing Satellite] mission detected substantial amounts of water on the Moon. Would you take advantage of this in your Mars scenario?**

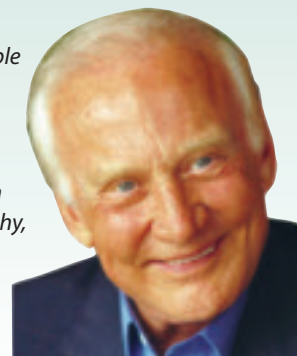
Robots can mine the water on the Moon, and we could teleoperate those robots from a deep space vehicle on a lunar flyby test flight—or by students back here on Earth. You don't need a

*the first lunar samples to be returned by an Apollo crew.*

*Upon returning from the Moon, Aldrin was decorated with the Presidential Medal of Freedom, the highest U.S. peacetime award. A 45-day international goodwill tour by Aldrin and the crew followed, with 23 other countries bestowing numerous distinguished awards and medals. Asteroid 6470 Aldrin is named for him, as is the Aldrin Crater on the Moon.*

*Since retiring from NASA and the Air Force, Aldrin has devised a master plan for missions to Mars known as the Aldrin Mars Cycler—a spacecraft system with perpetual cycling orbits between Earth and Mars. He has received three U.S. patents for his schematics of a modular space station, Starbooster reusable rockets and multicrew modules for spaceflight. Aldrin founded Starcraft Boosters, a rocket design company, and the ShareSpace Foundation, a nonprofit devoted to advancing space education, exploration and affordable spaceflight experiences.*

*Aldrin published an autobiography, Magnificent Desolation, in 2009.*



Moon base to do that. And when we do return to the Moon, the lunar development corporation will set out extraction plans and those nations that wish to will participate.

### **“There is always the tendency to go for the most expensive approach, the Cadillac, when something cheaper is available.”**

***If you compare your Apollo 11 flight to an asteroid rendezvous mission today, which would you say is the more difficult to accomplish?***

The asteroid mission will be very challenging, but it's a good precursor to missions to Phobos and Mars settlement.

***Why Phobos? Why not just go straight on to a Mars landing?***

Because the gravity on Phobos is substantially less than Mars, meaning that missions to Phobos can build a sustainable base, and building our first settlement off-world would be less complicated on Phobos.

***Why is an asteroid mission a good precursor to a Mars mission?***

It tests many of the same technologies, plus planetary defense. Unless we want to go the way of the dinosaurs, we need to understand these NEOs [near-Earth objects] and develop ways to deflect any that may threaten the Earth in the future. Under the Constellation program there just wasn't any funding available for any of this.

***What are the technologies needed for the asteroid mission?***

First is a heavy-lift launch system, preferably with an upper stage that can be refueled. You'd launch the stage, and after it performs its [injection] mission it remains in space, available for the next payload. The HLV [heavy-lift vehicle] would use the new hydrocarbon booster engines called for in the FY11 budget, new stronger but lightweight stage structures and bulkheads, a new launch facility in Florida that incorporates shuttle experience along with the experiences of other launch systems. Perhaps horizon-

tal vehicle processing. The trajectory for the asteroid intercept would be highly optimized for minimal transit times.

Then the design of the spacecraft. The habitat would have to be sized to ac-

commodate both the crew and optical instruments and telescopes, the ability to catalog data from observations. Some means to possibly either land on an asteroid or extract a sample and bring it back into the ship. A capsule like Orion docked to one end that can become a lifeboat in an emergency, but also perform an aerocapture maneuver at the end of the flight. The capsule could dock with a runway lander lifting body for the return trip back to Earth, or land itself.

Above all, the technology to allow the crew to survive the high-radiation environment. New in-space propulsion systems to maneuver around the asteroid once the capsule/habitat is in orbit, and the propulsion to break out of orbit to the return trajectory.

None of these capabilities exists today. Ideally, I would like to see that HLV be fully reusable at some point, which would require flyback boosters.

***Why not just build new Saturn Vs?***

The technology is dated, as are the engines, structures and guidance. Plus the tooling and construction facilities are gone. The best approach is either an interim step, which would be an all-cargo shuttle-derived solution using the shuttle facilities, workforce, engines, tank and boosters, followed by the new design. You may have to get there in incremental steps. But an advanced reusable vehicle should be our technological objective.

***There has been concern over the shift in space taxi services from Orion CEV/Ares I to commercial entrepreneurs. You've supported this change. Why?***

Private contractors are well within the capability to carry both crews and cargoes to the station. NASA can over-

see that while shifting to a focus on exploration missions. Routine space transportation can be performed by commercial industry. Gives us more options and a greater number of systems that can be developed.

***Isn't there a risk in trusting the lives of astronauts to unproven vehicles?***

They won't be unproven by the time astronauts fly on them. They will have to follow man-rating requirements and submit to NASA regulation.

***Your former colleagues, like Neil Armstrong, Jim Lovell and Gene Cernan, don't agree—they call this shift the end of American human spaceflight.***

A commercial industry that will have multiple crew vehicles flying in space, NASA developing Orion for deep space missions, a manned, heavy-lift launch vehicle, a budget that increases \$6 billion over five years—how is that the end of human spaceflight?

***You call your ideas a unified vision. How is it unified?***

It combines exploration, commercial development, science and security. Furthermore, all of the elements support each other—shuttle extension to speed the development of heavy lift, runway landers for ISS taxi services, a capsule and habitat for deep space missions, partnering with other nations to advance use of the ISS and the lunar surface, missions to Phobos that establish the technology for colonization of Mars. It's a strategic approach.

***Okay, I have to ask about [your TV appearance on] Dancing with the Stars. Why did you do that?***

To call attention to the successes of the Apollo program and get people to think about the future, support our military personnel, those who also supported our space program, and old geezers like me.

***So you admit to being an old geezer?***

I wanted to show people of my age that you can go out and get up and try to do new things. Be active. I'm 80 years old, so if I can do it so can you.