ORION:
a stepping stone to Mars

By: Henry M. Holden

BY LAUNCHING Orion on December 5, 2014, atop a United Launch Alliance Delta IV Heavy rocket, NASA is developing the capabilities needed to send humans to an asteroid by 2025 and Mars in the 2030s.

Following liftoff, the Orion reached an initial orbit of 115 miles by 552 miles. Two hours into the flight, the second stage ignited and sent Orion through the Van Allen radiation belt, not once, but twice, once up and once back.

With this flight, NASA marked a major milestone on its journey to Mars, traveling farther than any spacecraft designed for astronauts has been in more than 40 years.

The Van Allen radiation belt is a dangerous region that can damage the guidance system, onboard computers, or other electronics on the space craft, not to mention humans.

Orion reached a peak altitude of 3 609 miles (5 800 kilometres), some 15 times higher than the International Space Station.

But Orion has protection, lots of it. Its shielding was put to the test as the spacecraft sliced through the waves of radiation. Onboard sensors measured radiation levels inside the cabin, and critical safety data for future manned missions for scientists to study.

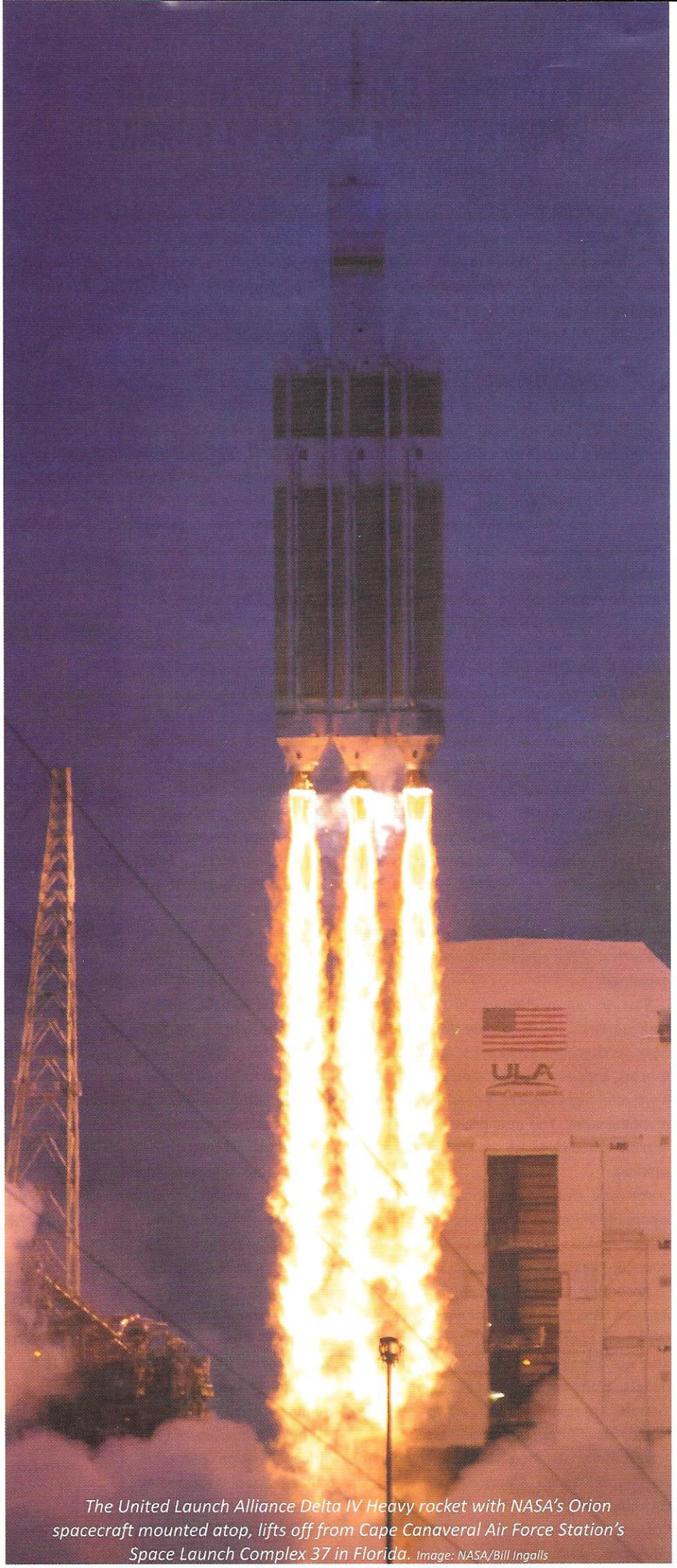
As expected, Orion returned with issues that will need to be solved before NASA sends people into this region of space.

Four hours and 13 minutes into the flight, the unmanned Orion hit speeds of 20 000 mph and weathered temperatures approaching 4 000 degrees Fahrenheit as it entered Earth's atmosphere.

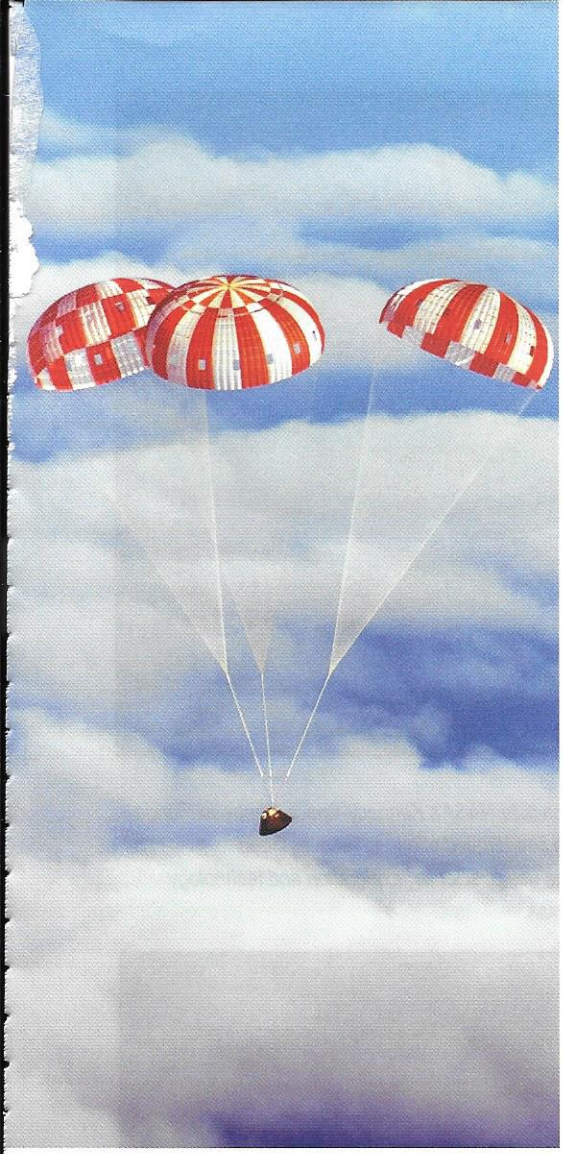
Its mission complete, the pilot, drogue and main parachutes deployed successfully slowing the craft down to about 20 mph for a soft splash down in the Pacific Ocean, 600 miles southwest of San Diego. The 75-mile descent to the ocean took 11 minutes with the expected signal blackout lasting a little more than two minutes.

"We really pushed Orion as much as we could to give us real data that we can use to improve Orion's design going forward," said Mark Geyer, Orion programme manager.

In the coming weeks and months NASA will be taking a look at that valuable information and applying lessons learned to the next Orion



The United Launch Alliance Delta IV Heavy rocket with NASA's Orion spacecraft mounted atop, lifts off from Cape Canaveral Air Force Station's Space Launch Complex 37 in Florida. Image: NASA/Bill Ingalls



Above: *Following a perfect launch and more than four hours in space, NASA's Orion spacecraft is seen descending under three massive red and white main parachutes, and then shortly after its bulls eye splashdown in the Pacific Ocean, 600 miles southwest of San Diego.* Image: NASA.

spacecraft already in production for the first mission atop the Space Launch System (SLS) rocket, Geyer added."

AN OCEAN OF INFORMATION

"The 1 200 on-board sensors provided us an ocean of information about everything from the effects of space radiation on our avionics, to the environment inside the crew cabin," said Mike Hawes, Lockheed Martin's Orion program manager.

"What we learn from this flight will improve Orion's designs and technology, and help us make future vehicles the best they can be."

After the flight, engineers removed samples of the heat shield to examine its performance and ablation rates during re-entry.

This analysis will help the technical team get a head start in determining how to optimise the development of future heat shields in preparation for the trip to Mars and back.

Top and above: *Recovery team members in rigid-hulled inflatable boats approach NASA's Orion spacecraft following its splashdown. A combined team from NASA, the Navy and Orion prime contractor, Lockheed Martin, retrieved it for return to shore. It was transported back to shore onboard the U.S. Navy's USS Anchorage.* Photos: U.S. Navy.

FUTURE MISSIONS

On future missions, Orion will launch on NASA's Space Launch System heavy-lift rocket currently being developed at the agency's Marshall Space Flight Centre.

A 70 metric-ton SLS will send Orion to a distant retrograde orbit around the moon on Exploration Mission-1 in the first test of the fully integrated Orion and SLS system.

NASA has big plans for Orion; the space agency says the capsule will one day get astronauts to an asteroid, Mars and other destinations in deep space.

But the first of those manned missions is at least seven years away.

The EFT-1 crew module that was returned to the KSC will next be used for Ascent Abort Test 2, a test of the launch abort system.

Orion's launch abort system is equipped with three powerful motors capable of pulling the capsule and crew a mile up and a mile away from an emergency on the launch pad which is designed to get astronauts out of danger in the event of a launch emergency.

The data gathered during EFT-1 will help engineers tweak and refine Orion in the lead-up to the capsule's next space test, which will take place in late 2017 or 2018.

EXPLORATION MISSION-1 (EM-1)

On that unmanned flight, called Exploration Mission-1 (EM-1), a different Orion capsule, which is currently being built by Lockheed Martin, will fly around the moon and return to Earth after spending about a week in deep space.

If all goes according to plan, SLS and Orion will fly together again on Exploration Mission-2 (EM-2), the first crewed flight for both the capsule and the rocket. NASA wants EM-2 to take astronauts out to visit a captured near-Earth asteroid that will be dragged into lunar orbit by a robotic probe.

The details of this "asteroid redirect mission" are still being worked out. The robotic capture craft may snag an entire small asteroid, or pluck a boulder off a much bigger space rock.

EM-2 could blast off as soon as 2021. NASA aims to get people out to the captured asteroid by 2025 at the latest, to meet a directive laid out by President Barack Obama, in 2010.

ON TO MARS

But all of these flights and activities are leading up to something even bigger. NASA officials say Orion will help accomplish the main long-term goal of the global human-spaceflight community: getting astronauts to the Red Planet and back.

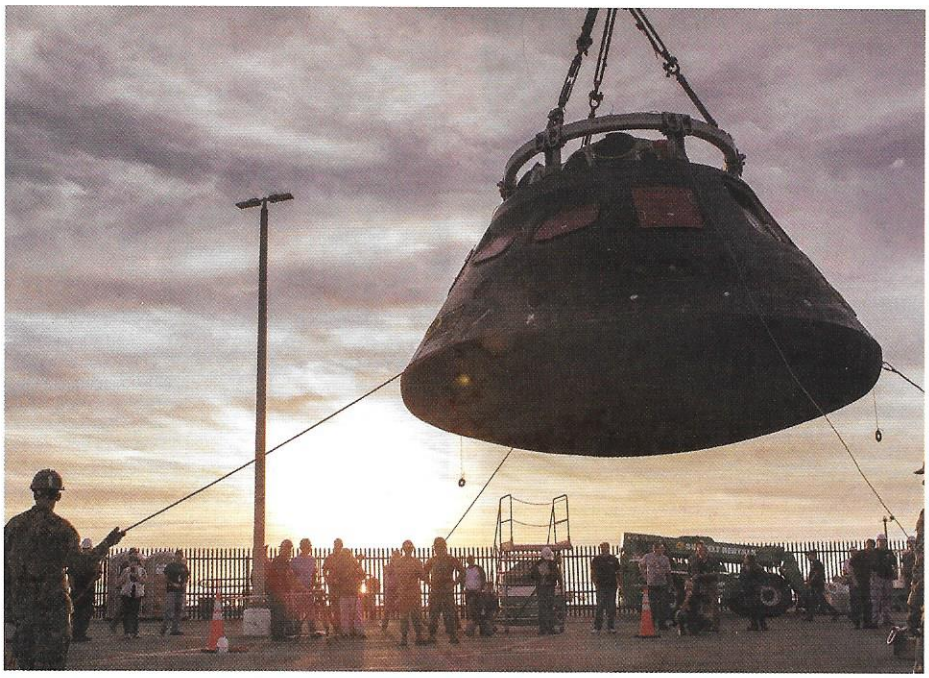
In NASA's vision, SLS will blast a crewed Orion toward Mars, ideally by the mid-2030s. The first mission may not touch down on the Red Planet, but putting space boots on Mars is definitely in the space agency's plans.

A one-off mission to an asteroid or Mars might be significant, but it does not do much to actually build a lasting and capable infrastructure to get off the planet Earth in any sustainable and meaningful way.

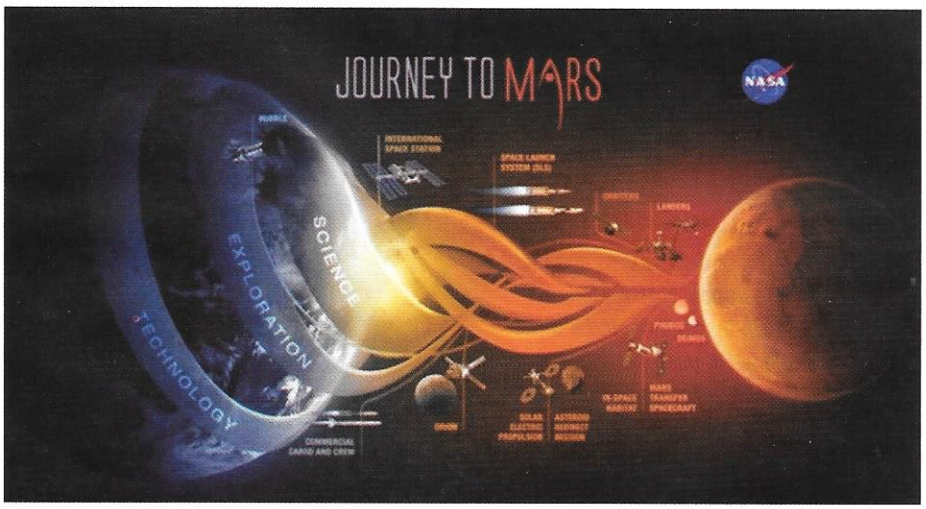
Orion is designed to support astronauts for up to 21 days at a time, and the trip to Mars will likely take at least six months. So, any manned Red Planet mission will also feature a habitat module, which will house the astronauts for most of the journey, NASA officials say. (Orion's main job on such long-term trips is to get astronauts into space and safely back to Earth.)

A lot of work needs to be done before NASA will be ready to mount a manned Mars mission. Engineers need to figure out the design of the habitat module, for example, and design a way to get super heavy loads down on the Red Planet's surface. (The 1-ton *Curiosity* rover, which landed in 2012, maxed out the agency's "sky crane" system.)

NASA is confident that Orion and SLS will be ready when the time comes. "Orion is the exploration spacecraft for NASA, and paired with SLS, we'll go explore the solar system."



Above: *Orion is being prepared for the overland trip back to NASA's Kennedy Space Centre in Florida. NASA, the US Navy and Lockheed Martin coordinated efforts to recover Orion.*
Below: *NASA plans on getting to Mars through the use of science, exploration and technology.*
Images: NASA.



A STEP BACKWARDS

If we are talking about building a habitat module on Orion, this is a step backward. Think back to the film **"2001 a Space Odyssey."** Author Arthur C. Clark had the right idea. We shouldn't be shooting people into space in an idea that is fifty years old, asking them to endure months in a sardine tin, and then returning them in a parachute rescue.

We should be building real spaceships such as the film's fictional *Discovery One* minus the sentient computer HAL of course. These vehicles should be non-re-entry vehicles, large enough to house a large crew comfortably for months. We built the International Space Station in space, so the idea has been proven doable.

Almost every high-tech device we have today, Hi-definition TV, smartphones, and cars with more computing power than the Apollo capsule, all came about because one man had a dream that became a reality, and as a result, US leadership in space.

That leadership and the dream is absent in the 21st century, at least in NASA and the US Government. NASA and the US Government have let the country lag behind in space exploration.

Some say we cannot afford a new dream. Others say we cannot not afford it. If we say we cannot then Russia and China will own the space around the Earth and the rest of our solar system someday.

An affordable way would be a cooperative effort with other counties provided they pull their own weight, and share equally in the finances. The US footed the majority of the bill for the International Space Station, and now we pay the Russians to take us there.

How sadly ironic. ✈