



your window to space

capcom

Volume 26 Number 4 March/April 2016



CapCom is published by Midlands Spaceflight Society

www.midspace.org.uk

Editor: Mike Bryce | President: David J Shayler | Secretary: Dave Evetts

Honorary Member: Helen Sharman OBE

space news roundup

“Year In Space” crew return to Earth (cover images)

NASA astronaut and Expedition 46 Commander Scott Kelly and his Russian counterpart Mikhail Kornienko returned to Earth Tuesday after a historic 340-day mission aboard the International Space Station. They landed in Kazakhstan 04:26 GMT on 2 March UK time).

Joining their return trip aboard a Soyuz TMA-18M spacecraft was Sergey Volkov, also of the Russian space agency Roscosmos, who arrived on the station on 4 September 2015. The crew touched down southeast of the remote town of Dzhezkazgan.

“Scott Kelly’s one-year mission aboard the International Space Station has helped to advance deep space exploration and America’s Journey to Mars,” said NASA Administrator Charles Bolden. “Scott has become the first American astronaut to spend a year in space, and in so doing, helped us take one giant leap toward putting boots on Mars.”

During the record-setting One-Year mission, the station crew conducted almost 400 investigations to advance NASA’s mission and benefit all of humanity. Kelly and Kornienko specifically participated in a number of studies to inform NASA’s Journey to Mars, including research into how the human body adjusts to weightlessness, isolation, radiation and the stress of long-duration spaceflight. Kelly’s identical twin brother, former NASA astronaut Mark Kelly, participated in parallel twin studies on Earth to help scientists compare the effects of space on the body and mind down to the cellular level.

One research project examined fluid shifts that occur when bodily fluids move into the upper body during weightlessness. These shifts may be associated with visual changes and a possible increase in intracranial pressure, which are significant challenges that must be understood before humans expand exploration beyond Earth’s orbit. The study uses the Russian Chibis device to draw fluids back into the legs while the subject’s eyes are measured to track any changes. NASA and Roscosmos already are looking at continuing the Fluid Shifts investigation with future space station crews.

The crew took advantage of the unique vantage point of the space station, with an orbital path that covers more than 90 percent of Earth’s population, to monitor and capture images of our planet. They also welcomed the arrival of a new instrument to study the signature of dark matter and conducted technology demonstrations that continue to drive innovation, including a test of network capabilities for operating swarms of spacecraft.

Kelly and Kornienko saw the arrival of six resupply spacecraft during their mission. Kelly was involved in the robotic capture of two NASA-contracted cargo flights -- SpaceX’s Dragon during the company’s sixth

commercial resupply mission and Orbital ATK’s Cygnus during the company’s fourth commercial resupply mission. A Japanese cargo craft and three Russian resupply ships also delivered several tons of supplies to the station.

Kelly ventured outside the confines of the space station for three spacewalks during his mission. The first included a variety of station upgrade and maintenance tasks, including routing cables to prepare for new docking ports for U.S. commercial crew spacecraft. On a second spacewalk, he assisted in the successful reconfiguration of an ammonia cooling system and restoration of the station to full solar power-generating capability. The third spacewalk was to restore functionality to the station’s Mobile Transporter system.

Including crewmate Gennady Padalka, with whom Kelly and Kornienko launched on 27 March 2015, 13 astronauts and cosmonauts representing seven different nations (the United States, Russia, Italy, Japan, Denmark, Kazakhstan and England) lived aboard the space station during the yearlong mission.

With the end of this mission, Kelly now has spent 520 days in space, the most among U.S. astronauts. Kornienko has accumulated 516 days across two flights, and Volkov has 548 days on three flights.

Expedition 47 continues operating the station, with NASA astronaut Tim Kopra in command. Kopra, Tim Peake of ESA (European Space Agency) and Yuri Malenchenko of Roscosmos will operate the station until the arrival of three new crew members. NASA astronaut Jeff Williams and Russian cosmonauts Alexey Ovchinin and Oleg Skripochka are scheduled to launch from Baikonur, Kazakhstan, on 18 March.

The International Space Station is a convergence of science, technology and human innovation that enables us to demonstrate new technologies and make research breakthroughs not possible on Earth. It has been continuously occupied since November 2000 and, since then, has been visited by more than 200 people and a variety of international and commercial spacecraft. The space station remains the springboard to NASA’s next giant leap in exploration, including future missions to an asteroid and Mars.

NASA
www.nasa.gov

NASA’s James Webb Space Telescope Primary Mirror Fully Assembled

The 18th and final primary mirror segment is installed on what will be the biggest and most powerful space telescope ever launched. The final mirror installation Wednesday at NASA’s Goddard Space Flight Center in Greenbelt, Maryland marks an important milestone in the assembly of the agency’s James Webb Space Telescope.

Using a robotic arm reminiscent of a claw machine, the team meticulously installed all

of Webb’s primary mirror segments onto the telescope structure. Once in space and fully deployed, the 18 primary mirror segments will work together as one large 21.3-foot diameter (6.5-metre) mirror.

The James Webb Space Telescope is the scientific successor to NASA’s Hubble Space Telescope. It will be the most powerful space telescope ever built.

JWST is currently targeted to launch from French Guiana aboard an Ariane 5 rocket in 2018. Webb is an international project led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.

NASA
www.nasa.gov

Apollo Astronaut Edgar Mitchell Dies at Age 85

Astronaut Edgar Mitchell, lunar module pilot on Apollo 14, passed away on 4th February in West Palm Beach, Florida, on the eve of the 45th anniversary of his lunar landing.

Mitchell joined Apollo 14 commander Alan Shepard, Jr., the first American in space, in the lunar module Antares, which touched down 5 February 1971, in the Fra Mauro highlands. It was Mitchell’s only spaceflight.

NASA
www.nasa.gov

Blackwell-Thompson Named Launch Director for SLS/Orion

The first flight of a Space Launch System, or SLS, rocket carrying the Orion spacecraft on an unpiloted mission to lunar orbit and back now has its launch director. Veteran spaceflight engineer Charlie Blackwell-Thompson will helm the launch team at NASA's Kennedy Space Center in Florida for the first flight test of a space system designed to carry astronauts into deep space before making a landmark journey to Mars.

Her selection as launch director means she will be the first woman to oversee a NASA liftoff and launch team.

That first flight, known as Exploration Mission 1, or EM-1, will be an important flight test before carrying astronauts, and Blackwell-Thompson said there is no shortage of planning, simulations and adaptations ahead in the next three years as the American space agency gets ready to launch the first rocket powerful enough to enable human exploration into deep space.

Full story on NASA web site:

NASA
www.nasa.gov/sls

SES-9 Satellite successfully launched on fifth attempt

It was fifth time lucky for SpaceX tonight (Friday, 4 March), as the Hawthorne, California-based launch services company successfully delivered its second Upgraded Falcon 9 booster into orbit from Space Launch Complex (SLC)-40 at Cape Canaveral Air Force Station, Florida. Liftoff occurred at 11:35 p.m. GMT, just a few minutes after local sunset.

Repeatedly thwarted on four occasions last week, due to a combination of deteriorating weather conditions and problems with loading the "densified" cryogenic oxygen aboard the vehicle, this mission was a particularly ambitious one. Aboard the vehicle was the 11,750-pound (5,330 kg) SES-9 communications satellite—the largest commercial payload ever launched by SpaceX—which was delivered into a Geostationary Transfer Orbit (GTO). A smooth countdown on Sunday was punctuated by a Range issue, associated with a boat entering the launch danger area, then dramatically aborted at T-0, after the start-up of the nine Merlin 1D+ first-stage engines. More recently, on Tuesday, the attempt was scrubbed several hours before T-0, due to unacceptable high-level winds.

Full story by Ben Evans at America Space
www.americaspace.com

NASA Space Launch System's First Flight to Send Small Sci-Tech Satellites Into Space

The first flight of NASA's new rocket, the Space Launch System (SLS), will carry 13 CubeSats to test innovative ideas along with an uncrewed Orion spacecraft in 2018.

These small satellite secondary payloads will carry science and technology investigations to help pave the way for future human exploration in deep space, including the journey to Mars. SLS' first flight, referred to as Exploration Mission-1 (EM-1), provides the rare opportunity for these small experiments to reach deep space destinations, as most launch opportunities for CubeSats are limited to low-Earth orbit.

"The 13 CubeSats that will fly to deep space as secondary payloads aboard SLS on EM-1 showcase the intersection of science and technology, and advance our journey to Mars," said NASA Deputy Administrator Dava Newman.

The secondary payloads were selected through a series of announcements of flight opportunities, a NASA challenge and negotiations with NASA's international partners.

"The SLS is providing an incredible opportunity to conduct science missions and test key technologies beyond low-Earth orbit," said Bill Hill, deputy associate administrator for Exploration Systems Development at NASA Headquarters in Washington. "This rocket has the unprecedented power to send Orion to deep space plus room to carry 13 small satellites – payloads that will advance our knowledge about deep space with minimal cost."

NASA selected two payloads through the Next Space Technologies for Exploration Partnerships (NextSTEP) Broad Agency Announcement:

Skyfire - Lockheed Martin Space Systems Company, Denver, Colorado, will develop a CubeSat to perform a lunar flyby of the moon, taking sensor data during the flyby to enhance our knowledge of the lunar surface

Lunar IceCube - Morehead State University, Kentucky, will build a CubeSat to search for water ice and other resources at a low orbit of only 62 miles above the surface of the moon

Three payloads were selected by NASA's Human Exploration and Operations Mission Directorate:

Near-Earth Asteroid Scout, or NEA Scout will perform reconnaissance of an asteroid, take pictures and observe its position in space

BioSentinel will use yeast to detect, measure and compare the impact of deep space radiation on living organisms over long durations in deep space

Lunar Flashlight will look for ice deposits and identify locations where resources may be extracted from the lunar surface

Two payloads were selected by NASA's Science Mission Directorate:

CuSP – a "space weather station" to measure particles and magnetic fields in space, testing practicality for a network of stations to monitor space weather

LunarH-Map will map hydrogen within craters and other permanently shadowed regions throughout the moon's south pole

Three additional payloads will be determined through NASA's Cube Quest Challenge – sponsored by NASA's Space Technology Mission Directorate and designed to foster innovations in small spacecraft propulsion and communications techniques. CubeSat builders will vie for a launch opportunity on SLS' first flight through a competition that has four rounds, referred to as ground tournaments, leading to the selection in 2017 of the payloads to fly on the mission.

NASA has also reserved three slots for payloads from international partners. Discussions to fly those three payloads are ongoing, and they will be announced at a later time.

On this first flight, SLS will launch the Orion spacecraft to a stable orbit beyond the moon to demonstrate the integrated system performance of Orion and the SLS rocket prior to the first crewed flight. The first configuration of SLS that will fly on EM-1 is referred to as Block I and will have a minimum 70-metric-ton (77-ton) lift capability and be powered by twin boosters and four RS-25 engines. The CubeSats will be deployed following Orion separation from the upper stage and once Orion is a safe distance away. Each payload will be ejected with a spring mechanism from dispensers on the Orion stage adapter. Following deployment, the transmitters on the CubeSats will turn on, and ground stations will listen for their beacons to determine the functionality of these small satellites.

NASA
<http://www.nasa.gov/sls>



ISS MISSION UPDATE

By George Spiteri

Expedition Forty-Six is completing its second month aboard the International Space Station (ISS). The orbiting outpost is Commanded by American Scott Kelly who along with Russian Flight Engineer Mikhail Kornienko are nearing the end of their year-long odyssey. The rest of the crew is comprised of Flight Engineers, Russians Sergei Volkov and Yuri Malenchenko, American Tim Kopra and Great Britain's Tim Peake.

The new upgraded Progress MS-01/62P unmanned cargo vehicle was launched from Baikonur's Site 31 at 0844 GMT (1444 local time) on 21st December. Progress docked at the Station's Pirs docking port at 1027 GMT on 23rd December delivering 2.8 tons of food, fuel and supplies to the crew.

Before the space craft arrived, Kelly and Kopra conducted an unscheduled spacewalk, exiting the Quest Airlock at 1245 GMT on 21st December. The EVA which lasted 3 hours 16 minutes was necessitated due to the Mobile Transporter rail car becoming stuck on the Station's Truss. Kelly and Kopra had to latch and secure the rail car to the worksite prior to the arrival of Progress the following day.

Veteran cosmonaut Yuri Malenchenko celebrated his 54th birthday on 22nd December, the crew also celebrated Christmas, the New Year and the Russian Orthodox Christmas on 7th January 2016.

Kopra and Peake exited the Quest airlock for the first spacewalk of 2016 at 1248 GMT on 15th January. After approximately two hours into their spacewalk the astronauts replaced the Sequential Shunt Unit which failed in November 2015 with a new unit. Kopra and Peake were conducting various secondary tasks when Kopra reported a small bubble of cold water inside his helmet. Flight Director Royce Renfrew ordered the crew back inside Quest and the spacewalk was terminated early after 4 hours 43 minutes at 1731 GMT. This was the first EVA by an "official" British astronaut and the 192nd dedicated to ISS assembly and maintenance.

Two small NanoSatellites, designated Aggie 4 and Bevo-2 respectively were deployed from Kibo's airlock just before 1600 GMT on 29th January on behalf of Texas university students to study navigation, rendezvous and docking procedures.

Malenchenko and Volkov took their turn at the next spacewalk when they left the Pirs airlock 15 minutes earlier than scheduled at 1255 GMT on 3rd February. 27 minutes into the EVA Volkov jettisoned a small flash drive containing messages commemorating the 70th anniversary of victory in World War Two. The cosmonauts also retrieved and installed a number of scientific experiments outside the Station's Russian segment and used a device to test new thermal coating techniques outside Pirs. The spacewalk ended after 4 hours 45 minutes at 1740 GMT. In total crews have worked outside the ISS for 50 days 4 hours 48 minutes.

As of 12th February, Kelly and Kornienko have completed 46 weeks in space, Volkov has logged 164 days in orbit whilst Malenchenko, Kopra and Peake have spent 60 days on the ISS.

GAS

Update:

NASA astronaut and Expedition 46 Commander Scott Kelly and his Russian counterpart Mikhail Kornienko returned to Earth on Tuesday after a historic 340-day mission aboard the International Space Station. They landed in Kazakhstan at 10:26 am on 2 March Kazakhstan time.

Joining their return trip aboard a Soyuz TMA-18M spacecraft was Sergey Volkov, also of the Russian space agency Roscosmos, who arrived on the station on 4 September 2015. The crew touched down southeast of the remote town of Dzhezkazgan.

More detail in next issue



ASTRONAUT NEWS

By Rob Wood



ISS Crewing Updates

In the ever changing world of ISS crewing assignments we turn to Russian sources for first news. It is again from here that we have news of crews due in 2017 and 2018. Some of this information was presented previously to readers in the May/June 2015 issue of CapCom but there has since been some changes.

In the earlier issue, I noted the following information on crews - ISS Expeditions 53/54-Soyuz MS-6 with Russian cosmonauts Sergey Prokopyev and Yevgeni Tarelkin for the third space station residency of 2017, and ISS Expeditions 55/56-Soyuz MS-8 with Russian cosmonauts Sergei Ryazansky and Denis Matveyev for the first crew to launch to the ISS in 2018.

The first change occurred as early as 1 June 2015, when Tarelkin resigned from the Russian Cosmonaut Team. In July 2015 he was replaced on Soyuz MS-6 by Oleg Artemyev. In the months that followed the Soyuz MS-6 and Soyuz MS-8 crews exchanged places but with Ryazansky moving to Soyuz MS-7 for the fourth and final Soyuz launch of 2017. Replacing Ryazansky, we had Aleksandr Skvortsov, who came into the Soyuz MS-8 crew with Matveyev. Later Matveyev himself was replaced by Ivan Vagner due to what was described as a temporary medical issue. The latter became known in December 2015, although the exact date of the change is unclear.

Previously, in September 2015, news came out of NASA on their participation in Soyuz MS-6, with Scott Tingle, and Soyuz MS-7, with Randolph Bresnik. The previous month, the Japan Aerospace Exploration Agency (JAXA), had named Norishige Kanai to Soyuz MS-7.

In mid-December 2015, Aleksandr Samokutyayev was linked to the second ISS Soyuz launch of 2018. As at mid-December 2015 the line-up for crews from the third ISS residency launch of 2017 reads:

ISS Expeditions 53/54-Soyuz MS-6 – Skvortsov, Vagner and Tingle.

ISS Expeditions 54/55-Soyuz MS-7 – Ryazansky, Kanai and Bresnik.

ISS Expeditions 55/56-Soyuz MS-8 – Prokopyev and Artemyev.

ISS Expeditions 56/57-Soyuz MS-9 – Samokutyayev.

NASA or others participation in the last two crews is awaited.

Skvortsov was born on 6 May 1966. He was serving as a Russian Air Force pilot when he was selected as a cosmonaut in 1997. He is an experienced cosmonaut who has spent 345 days in space over two spaceflights. He has flown two ISS residencies: ISS Expeditions 23/24-Soyuz TMA-18 in 2010 and ISS Expeditions 39/40-Soyuz TMA-12M in 2014.

Vagner, like Matveyev, who he replaced, was selected as a cosmonaut in 2010. Vagner was born on 10 July 1985. He was employed by S P Korolyov Rocket and Space Corporation Energiya and worked at Mission Control Centre (TsUP) from 2008. He is a spaceflight rookie.

Tingle is another spaceflight rookie. He joined NASA with the 2009 astronaut selection (Group 20). He was born on 19 July 1965. He is a Captain in the United States Navy and holds degrees in Mechanical Engineering. As a Naval Aviator he has flown variants of the McDonnell Douglas F/A-18 Hornet and Super Hornet off aircraft-carriers. He is also a graduate of the Naval Test Pilot School at Patuxent River.

Ryazansky was originally selected as a cosmonaut in 2003 as part of the cosmonaut squad of the Academy of Sciences' Institute of Bio-Medical Problems. He was born on 13 November 1974 and is a qualified medical

doctor. In 2011 he transferred full time to the Yuri Gagarin Cosmonaut Training Centre and has flown one ISS residency: ISS Expeditions 37/38-Soyuz TMA-10M in 2013/2014.

Kanai was born in Tokyo, in 1976. He is a Japan Self Defense Force medical doctor who received a military commission in 2002. He is qualified as a Diving Medical Officer having trained in underwater rescue techniques. He was selected as a JAXA astronaut in 2009 and joined NASA's Group 20 astronauts of the same year for astronaut candidate training. He has yet to fly in space.

Bresnik came to NASA via a 15 year career with the United States Marine Corps. He has flown the McDonnell Douglas F/A-18 on combat missions and is a qualified test pilot. He joined NASA as an astronaut candidate in 2004 (Group 19). He flew as a mission specialist on STS-129 Atlantis in 2009, an ISS assembly mission. He holds degrees in Mathematics and Aviation Systems.

Prokopyev is another cosmonaut from the 2010 selection. He has yet to fly in space. He was born on 19 February 1975 and has served as a pilot in the Russian Air Force flying Tupolev Tu-22M3 and Tu-160 strategic bombers.

Artemyev joined the cosmonaut team in 2003 after a career with the S P Korolyov Rocket and Space Corporation Energiya. He was born on 28 December 1970 and has degrees in Machinery, Physics and Personnel Management. He has flown one ISS residency: ISS Expeditions 39/40-Soyuz TMA-12M in 2014.

Samokutyayev has already flown two ISS residencies accumulating 331 days in space: ISS Expeditions 27/28-Soyuz TMA-21 in 2011 and ISS Expeditions 41/42-Soyuz TMA-14M in 2014/2015. He was serving as a Russian Air Force pilot when he was selected as a cosmonaut in 2003. He was born on 13 March 1970.

New Astronaut Selection

United States of America

On 14 December 2015, NASA announced that the astronaut candidate application website was live and accepting submissions up to 18 February 2016 for its 22nd class of astronauts. The successful applicants are expected to be announced in mid-2017. The news release optimistically noted that they may fly on any of four different United States spacecraft during their careers. They listed two commercial crew vehicles, NASA's Orion spacecraft and for some reason the ISS.

NASA Administrator and former astronaut Charles Bolden made a very bold statement for the release, "NASA is on an ambitious journey to Mars and we're looking for talented men and women from diverse backgrounds and every walk of life to help get us there." He then continued, "Today, we opened the application process for our next class of astronauts, extraordinary Americans who will take the next giant leap in exploration. This group will launch to space from US soil on American-made spacecraft and blaze the trail on our journey to the Red Planet."

Astronaut candidates must have a bachelor's degree from an accredited institution in engineering, biological science, physical science, computer science or mathematics. An advanced degree is desirable. Candidates must also have at least three years of related, progressively responsible professional experience, or at least 1,000 hours of pilot-in-command time in jet aircraft. Astronaut candidates must pass the NASA long-duration astronaut physical.

NASA commented that its future astronauts will again launch to the ISS from Florida's Space Coast on American-made commercial spacecraft. The two currently being developed are Boeing's CST-100 Starliner and the SpaceX Crew Dragon. These spacecraft will allow NASA to add a

seventh crew member to the ISS, effectively doubling the amount of time astronauts will be able to devote to research in space, expanding scientific knowledge and demonstrating new technologies.

They also said that astronauts will lift off from NASA's Kennedy Space Center aboard the Orion spacecraft, launched on the agency's Space Launch System rocket, to unprecedented missions in lunar orbit. There, the space agency will learn more about conducting complex operations in a deep space environment before moving on to longer duration missions as it progresses on its journey to Mars.

What the press release did not say was that none of the new spacecraft to launch from America have flown a manned mission yet. They are hoping to launch the commercial crew vehicles on crewed test flights in 2017 but even NASA at its most optimistic does not expect Orion before 2021. I expect none of them will fly in the years stated. I should also point out that at present there are only two manned flights scheduled for Orion with the second not before 2025/26.

We also have a new presidential race in progress. The current incumbent cannot continue because he has had two terms as president, which is the maximum allowed in United States law. In January 2017 there will be a new person in the White House. Therefore, we can expect a new 'Space Plan' in the months that follow. Who knows where that will take us.

Russia

In the May/June 2015 CapCom I reported that on the website of the Yuri Gagarin Cosmonaut Training Centre an article on the 55th anniversary of the founding of the training centre in January 2015 noted that the next cosmonaut selection will start at the beginning of 2016. Towards the end of 2015, the news out of Russia was that the selection is to be delayed until at least 2017.

China

The 27th Planetary Congress of the Association of Space Explorers was held in Beijing from 10 September to 15 September 2014. On 13 September 2014, Huang Weifen, Deputy Director of the Astronaut Centre of China, told delegates that China would finish the third round of astronaut selection in the next two years. She said that China's current astronauts (often called taikonauts) were all former air force pilots but the third round of selection will look at researchers, engineers and medical professionals from within their space programme.

She added that the new group would be selected with a view to constructing and working with a new space station for which the first module is scheduled for launch in 2018. Huang said that she did not expect any new female candidates since two were already on active service.

The above two paragraphs were written for the May/June 2015 issue of CapCom. There is no further news at present but it would be surprising if something was not already happening, even if we have not heard anything. Most, if not all, of the 1998 selection will have retired by the time the new modular space station is ready to receive crews and there are only another seven taikonauts available (assuming all the 2010 selection are still active). China will need some new taikonauts very soon.

Others

Canada, ESA and Japan have astronaut teams but do not appear to be considering adding to their cadre. All have sufficient numbers for their current requirements. India has a Human Spaceflight Programme but no astronauts and budgetary constraints suggest we should not be expecting any soon.

20-Year Cosmonaut Takes Up Management Role

On 18 January 2016, one of Russia's most experienced cosmonauts retired from active service. He took up a management role as a Deputy Commander of the cosmonaut corps. Mikhail Vladislavovich Tyurin during a 20-year career as a cosmonaut had spent 532 days in space, most of it aboard the ISS over three long-duration spaceflights. At the time of his retirement he was the seventh most experienced of the still active cosmonauts and fourteenth overall.

He was born in Kolomna, a historical town founded in the 20th Century, on 2 March 1960. Kolomna is part of the Moscow Oblast (or region), located about 70 miles southeast of Moscow itself. His father was in the military so he had to travel and move around a lot with his family.

When he was growing up he wanted to be a hockey player but his parents thought it more sensible to take a different path. Or, as Mikhail put it when asked how he became interested in engineering, "My parents made me do it." He had no ambition or dreams for becoming a cosmonaut; it was something that from his viewpoint was just a natural progression of his work career.

He described the process of his move towards the cosmonaut team as, "I just worked and worked, and was moved from one task for one job to another, and it was like a sequence of events."

In 1978 he graduated from a secondary school in the town of Belogorsk. He then underwent two years compulsory military service following which he held the rank of Lieutenant in the reserves. He studied at the Moscow Aviation Institute and graduated in 1984 with a degree in Mechanical Engineering. In July 1984 he joined the S P Korolyov Rocket and Space Corporation Energiya.

On 16 July 1992 he passed the Chief Medical Commission for fitness to proceed to cosmonaut training but it was almost two years before he was formally accepted as a candidate cosmonaut by the Interdepartmental Commission for the selection of cosmonauts and their appointments to flight crews. This came on 1 April 1994.

He conducted two years of basic training and in April 1996 B 1998 - 2000. He passed the state examinations at the Yuri Gagarin Cosmonaut Training Centre. He was officially confirmed as a 'Test Cosmonaut' by the Interdepartmental Qualification Committee on 25 April 1996. This made him eligible for advanced training, taking on ground positions associated with actual space missions and eventual assignment to a space crew.

Because of the way the cosmonauts were organised at that time, he joined Energiya's cosmonaut team. This gives us additional dates for his cosmonaut career. He was officially appointed a candidate cosmonaut of RSC Energiya on 16 June 1994 and formally a pilot-cosmonaut of RSC Energiya on 13 June 1996. In keeping with the plethora of dates in the Russian space programme that do not always follow a logical order he actually joined a Mir space station cosmonaut training group in May 1996.

In July 1997, he was reassigned to the ISS programme. On 28 July 1997, the Interdepartmental Commission named him to back-up and prime crews for the first and third ISS residencies. Through to 2014, he served on back-up crews for four flown missions and made three spaceflights.

His back-up assignments were: Soyuz TM-31/ISS-1, launched on 31 October 2000; Soyuz TMA-6/ISS-11, launched on 15 April 2005; Soyuz TMA-7/ISS-12, launched on 1 October 2005 and Soyuz TMA-09M/ISS36/37, launched on 28 May 2013.

His first spaceflight was STS-105/ISS-3/STS-108 (10 August – 17 December 2001), and this would be followed by Soyuz TMA-9/ISS-14 (18 September 2006 – 21 April 2007) and Soyuz TMA-11M/ISS38/39 (7 November 2013 – 14 May 2014).

He was a flight engineer on all three of his ISS residencies although he was back-up ISS commander for ISS-11 and ISS-37. He commanded the two Soyuz spacecraft that he flew and was classed as a mission specialist when using the US Space Shuttle on his first mission. Launch was on Discovery and he returned to Earth via Endeavour. He made three spacewalks on his first spaceflight and two more on his second.

He was a replacement for his second spaceflight and his back-up role on Soyuz TMA-7. In late 2003, Aleksandr Lazutkin had been assigned to the missions but in August 2005, whilst training in the USA, he had a heart attack. Tyurin was appointed to replace him.

In 2008, there were reports out of Russia that he had been assigned to a new mission. This appointment was never officially confirmed by the Russian Federal Space Agency. It has been suggested that the assignment did not happen because of the delay in the flight debut of the new Soyuz TMA-M series of spacecraft but this is not totally clear. In January 2011, it became known that he was nominated for the ISS38/39 residencies.

As part of the move to create a single cosmonaut squad he left RSC Energiya and on 26 February 2011 joined the cosmonaut team based at the Yuri Gagarin Cosmonaut Training Centre. On 1 October 2012, he was appointed a Deputy Head of the cosmonaut corps for scientific research and testing. A position he held for about a year.

In July 2015, he passed the cosmonaut fitness tests that would allow him to train for a fourth spaceflight but he decided against this. He requested release from the cosmonaut team and on 18 January 2016 this was officially confirmed by the Chief of the Yuri Gagarin Cosmonaut Training Centre.

Astronaut Departs After 15 Years Service

On 3 February 2016, NASA announced that veteran astronaut Kevin Ford had departed the agency on 29 January 2016. He had joined NASA in 2000 following 18 years of service in the United States Air Force. As an astronaut he made two spaceflights before taking up a management position in 2014.

“Kevin has served the office in a number of ways over the years, and we will certainly miss him,” said Chris Cassidy, Chief of the Astronaut Office at NASA’s Johnson Space Center. “I had the pleasure of serving as his backup for his space station mission, and consequently spent many weeks in Russia and Kazakhstan with him. Personally, I will miss his sense of humor and special insight into technical issues. He is a great American and true friend. We all wish him well and have no doubt that he will bring a great deal of valuable experience to all of his future endeavors.”

Kevin Anthony Ford (Colonel, USAF, Ret.) was born in Portland, Indiana, on 7 July 1960, although he grew up in the small town of Montpelier which is also in Indiana. In his early teens he became fascinated by flying. Although his early reading included ‘Carrying the Fire’ by Apollo 11’s Michael Collins, it was not the space part of the book that strongly caught his attention it was the sections about general aviation, such as the test flying part of Collins’ career. At about the same time his older brother, who was a qualified pilot, took him up for his first aircraft ride.

He got a job in a local grocery store. It was no coincidence that it was owned by a pilot, Tom Williams, who gave him a job so he could use his earnings to pay for flying lessons. He was taking two lessons a week at the age of 16 and soon obtained his private pilot licence (or certificate as it is called in the USA).

He attended Blackford High School, in Hartford City, Indiana, from where he graduated in 1978. He obtained a scholarship from the United States Air Force branch of the Reserve Officers’ Training Corps (ROTC) programme which he used to continue his education at the University of Notre Dame. The ROTC is a military scholarship programme funding students in return for military service following graduation. He graduated in 1982 with a Bachelor of Science degree in Aerospace Engineering.

Following graduation he was commissioned into the United States Air Force and underwent initial military-pilot training at Columbus Air Force Base in Mississippi. He learned to fly the Cessna T-37 Tweet, a twin-engine, jet military trainer, and the Northrop T-38A Talon, another twin-engine jet trainer but one that was supersonic. Next was training on the operational McDonnell Douglas F-15 Eagle, a twin-engine, all-weather, tactical fighter aircraft.

In 1984 he was assigned to the 22nd Tactical Fighter Squadron at Bitburg Air Base, in Germany, flying the F-15. He spent about three years based there before transferring to the 57th Fighter Interceptor Squadron at Keflavik Naval Air Station, in Iceland, still flying F-15’s. This posting ended in 1989. Also in 1989, he received a Master of Science in International Relations from Troy State University.

He then attended the United States Air Force Test Pilot School at Edwards Air Force Base, in California. Following graduation in 1990, he was posted to the 3247th Test Squadron at Eglin Air Force Base, in Florida, where he was involved in weapons development testing until 1994. That year he received a Master of Science degree in Aerospace Engineering from the University of Florida.

He next had the opportunity to attend the Air Force Institute of

Technology where he spent three years studying full-time for a Doctor of Philosophy degree in Astronautical Engineering. He received his doctorate in 1997. Following this he reported to the Test Pilot School at Edwards where he was Director of Plans and Programs, and also a flight and academic instructor.

During his test flying career he noticed the natural progression of test pilots to NASA and as he later put it in a NASA interview, “what better thing could there be than to go out and fly the orbiter.” He started applying. In fact he applied four times. These were for the NASA astronaut classes of 1995, 1996, 1998 and 2000. He was called for interview and examination for the first two but not the third. Perhaps most of us would have given up at this point but not Ford. In November 1999, he was back in Houston for NASA interview and examination.

He was selected as a pilot astronaut in 2000 (NASA Astronaut Group 18). After basic training he was assigned technical duties in the Astronaut Office. He worked on advanced exploration issues and the development and testing of the Shuttle Cockpit Avionics Upgrade. From January to December 2004 he was the Director of Operations at the Yuri Gagarin Cosmonaut Training Center. Through to July 2008, he served as a Space Shuttle and ISS CapCom at the Mission Control Center. He worked shuttle missions STS-115, STS-116, STS-117, STS-120, STS-122 and STS-123, as well as ISS expedition operations.

In June 2008, he retired from active military service. The following month, on 16 July 2008, NASA announced that he had been assigned as the pilot for STS-128, targeted for launch at the end of July 2009. With less delay than normal for the Space Shuttle, the mission lifted-off on 28 August 2009. However, the orbiter used was different. The flight was originally named for the Atlantis orbiter but in the event, Discovery was used.

STS-128 Discovery (28 August – 11 September 2009) delivered the Multi-Purpose Logistics Module ‘Leonardo’ filled with 15,000 pounds of science and storage racks to the ISS. Amongst Leonardo’s passengers was COLBERT or to give it its full name Combined Operational Load Bearing External Resistance Treadmill. It was named after a TV show, ‘The Colbert Report’ and its host Stephen Colbert. Also carried was a new Ammonia Tank Assembly to the ISS. The flight exchanged ISS residency crew members and oversaw three spacewalks.

NASA’s news release of 8 July 2010, confirmed that he had been assigned to an ISS residency. The mission was ISS-33/34 commencing in October 2012. This information had previously hit the public domain in February 2010. As part of his duties for this assignment he trained as a back-up for ISS-31/32 which launched on Soyuz TMA-04M on 15 May 2012. He was then able to commence full time preparations for his own long-duration spaceflight.

His second spaceflight was Soyuz TMA-06M/ISS-33/34 (23 October 2012 - 16 March 2013). The Soyuz launched from the Baikonur Cosmodrome in Kazakhstan and after two days docked with the ISS. He was a flight engineer for the Soyuz and served as flight engineer for ISS-33 before, on 17 November 2012, assuming command of ISS-34. He returned to Earth in Kazakhstan via the Soyuz descent module.

In the press release from NASA on his retirement, it was noted that he had accumulated more than 5000 flying hours. It reported that he holds FAA instructor ratings for airplanes and gliders, a commercial rating for helicopters, and a private rating for hot air balloons.

Prior to his ISS residency he was asked why is it worth taking the risk of flying in Space. “I think ultimately people want to go to space and to get out there somebody’s just got to head that way and put it to the test at some point,” he answered. “Just like when we expanded across the country and really went to all corners of the Earth. I think it’s in our human nature to want to do it yourself as a person. No matter how many times you go to somebody else’s slide presentation about their trip to Paris, it’s not the same.”

He discussed this further, “We really are all about the human experience. That’s what takes us there. I think an interesting piece of information is that one. If you ask somebody about the first time we went to the moon, few people think about the robotic missions to the moon that preceded Neil Armstrong, Buzz Aldrin and Mike Collins going to the moon. They usually just jump right to the point where we finally

got to the moon, when in reality we had several robotics missions. The US wasn't even the first one to the moon robotically; they don't really think about those. Now those robotic missions are super important to us and they teach us how to get there, but I think that the human, the emotional connection, comes about because we see ourselves out there. We project ourselves out there and we really want to go explore on our own, have a look with our own eyes."

Where Are They Now - Ex-Astronaut Movements in the Private and Public Sector

From February 2015, Claudie Haigneré returned to ESA as an adviser to the Director General. Previously she was the Chief Executive Officer of Universcience, a French science museum in Paris. Originally selected as a French candidate astronaut in 1985 by France's CNES space agency, she transferred to ESA in 1999. She completed two spaceflights: Soyuz TM-24/Soyuz TM-23 (1996) and Soyuz TM-33/Soyuz TM-32 (2001). Both flights were Soyuz exchange missions, the first to Mir and the second to ISS. She stood down as an astronaut in 2002.

From May 2015, Carl Walz has been Director of Business Development for Oceaneering International, Inc., in Houston. He was previously with Orbital ATK in Dulles, Virginia. He was a NASA astronaut from 1990 to 2003 although he remained with NASA in management roles until the end of 2008. He made four spaceflights: STS-51 (1993), STS-65 (1994), STS-79 (1996) and STS-108/ISS-4/STS-111 (2001-2002).

In September 2015, NASA's biographical page for William Gregory was updated to show that since April 2013 he has been an Advanced Instructor Pilot for Aviation Performance Solutions in Mesa, Arizona. Prior to this (November 2010 – April 2013) he had been Vice President of Business Development for Qwaltec, Inc. He was a NASA astronaut from 1990 to 1999 and was the pilot on STS-67 (1995), an astronomical research mission aboard the Space Shuttle Endeavour.

Marc Garneau, Canada's first astronaut and now turned politician, was on the winning side in the Canadian general election of 19 October 2015. On 4 November 2015, he was named Minister of Transport for the Liberal Government. In December 1983, he was one of the first six Canadians selected for astronaut training and was the first to fly when he was on STS-41G Challenger (1984). He made two further spaceflights both on Endeavour, STS-77 (1996) and STS-97 (2000). From November 2001 to November 2005, he was President of the Canadian Space Agency before leaving in order to enter politics.

A Texas A&M University news release dated 14 January 2016 reported that Bonnie Dunbar had joined their engineering college as a Texas A&M Engineering Experiment Station (TEES) Distinguished Research Professor in the Department of Aerospace Engineering. She also has a joint appointment as the director of the TEES Institute of Engineering Education and Innovation. She was a NASA astronaut from 1980 to 2005, completing five Space Shuttle flights: STS-61A (1985), STS-32 (1990), STS-50 (1992), STS-71 (1995) and STS-89 (1998). Her last two flights visited Russia's Mir space station and she also trained as the reserve astronaut to the first NASA astronaut on a Mir residency crew (Norman Thagard's mission of 1995).

On 8 February 2016, the National Academy of Engineering elected Kathryn Sullivan as one of its new members. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. She is one of 102 new members bringing the total membership up to a little over 2½ thousand. In 1978, she was one of the first six women selected to join NASA's astronaut corps. She became the first American woman to walk in space on her first spaceflight, STS-41G (1984). She flew on two more shuttle missions, STS-31 (1990) and STS-45 (1992). She left NASA in 1993 to become Chief Scientist at the National Oceanic and Atmospheric Administration (NOAA). In 2014, she was appointed Under Secretary of Commerce for Oceans and Atmosphere, and NOAA Administrator.

Failure is not an Option

"Failure is not an option" is a quote credited to NASA flight director Gene

Kranz following the explosion during the Apollo 13 mission. He never actually said it and it was an invention for Hollywood's movie version of Apollo 13. However, Kranz liked it so much he used it for the title of his autobiography.

NASA's flight directors, at the Mission Control Center at NASA's Johnson Space Center in Houston, lead teams of flight controllers, researchers, engineers and support personnel based around the world. They are involved in space station cargo and crew vehicle integration, and developing plans for future exploration missions. They make sure the astronauts in space have what they need to carry out their tasks.

Famous former flight directors from the early days of human spaceflight include Clifford Charlesworth, Gerald Griffin, Christopher Kraft, Glynn Lunney and the aforementioned Eugene Kranz. Amongst the Space Shuttle era flight directors are Ron Dittmore, Jay Greene and Milt Heflin. Prior to 2015, 86 people had been chosen to serve in the role.

On 21 September 2015, NASA announced that they had selected five additional flight directors: Rick Henfling, Vincent LaCour, Mary Lawrence, Anthony Vareha and Timothy Creamer. The last named is the first astronaut to become a flight director.

Timothy John 'TJ' Creamer (Colonel, United States Army, Ret.), first linked up with NASA in July 1995 on a United States Army posting as a Space Shuttle vehicle integration test engineer. Three years later he joined the astronaut corps although he would have a long wait before making his only spaceflight.

He was born in Fort Huachuca, in Arizona, on 15 November 1959. He was born into a military family with his father serving in the United States Army, so allied to his own military career, he moved around a lot. However, he does consider the town of Upper Marlboro, in Maryland, where he went through elementary school and intermediate school, to be his hometown.

For high school he attended Bishop McNamara High School in Forestville, Maryland, a private Catholic school providing a Catholic, college-preparatory education. He then attended Loyola College in Baltimore, Maryland. Mirroring the history of many NASA astronauts he attended college under the Reserve Officers' Training Corps (ROTC) programme. The ROTC is a military scholarship programme funding students in return for military service following graduation. His scholarship came from the Army branch of the programme.

He graduated from Loyola in 1982 with a Bachelor of Science degree in Chemistry. He then received his commission as a second lieutenant in the United States Army. For his first six months he worked with the armoured branch of the Army before attending the United States Army Aviation School from December 1982 to train on helicopters. He was designated an Army Aviator in August 1983, graduating as the distinguished graduate of his class.

He was posted to the 1st Armored 'Old Ironsides' Division. During his time with them he served as a section leader, platoon leader, flight operations officer and as a personnel staff officer. In 1987, he was assigned to the 82nd Airborne Division as a commander of an air cavalry troop in the 17th Cavalry and later as the personnel officer of the 82nd Aviation Brigade.

He attended MIT and graduated with a Master of Science degree in Physics in 1992. He was then posted as an Assistant Professor to the Department of Physics at the United States Military Academy for three years. He was next assigned to Army Space Command as a Space Operations Officer and in July 1995 he arrived at Johnson Space Center to start his job as a Space Shuttle vehicle integration test engineer.

He made applications for NASA's astronaut selections of 1995 and 1996 (Groups 15 and 16) but was unsuccessful. He applied again for the next selection and in October 1997 was called for interview and examination. The first time he had reached this far. He had a little longer to wait for news, but when it came, in the spring of 1998, it was good. NASA made the selection public on 4 June 1998. He was selected as a mission specialist astronaut for NASA Astronaut Group 17. After basic training he was assigned technical duties in the Astronaut Office, initially in the Space Station branch.

In November 2000, he was assigned as a support astronaut to ISS-3, which launched on 10 August 2001. He was the primary contact for all the crew needs whilst they were on orbit. The ISS-3 crew returned to Earth on 17 December 2001. Further technical assignments for the Astronaut Office followed. He was head of the Hardware Integration section of the Space Station branch from March 2002 and then was the Astronaut Office representative and coordinator for all things relating to on-orbit IT from October 2004.

He was next assigned to the Robotics branch, dealing with International Partners on all computer aspects of robotics operations as well as all command and control software and user interfaces. As part of this duty he was the real-time support lead for ISS-12, which flew in the October 2005 to April 2006 period, for all things involving robotics operations on the space station.

On 12 February 2008, NASA announced his appointment as back-up to a fellow Army man who also went by the name of Timothy. Timothy Kopra was the primary crew member for the named STS-127/ISS-19/STS128 mission. However, on 21 November 2008, NASA detailed changes in the numbering sequence of expeditions to reflect the start of six-person crews. The mission became ISS-20 although the shuttle numbering did not change.

Creamer therefore served as the back-up for STS-127/ISS-20/STS128. He was a back-up mission specialist for the shuttle portions of the mission and a back-up flight engineer for the ISS portion of the flight. The mission took place over 15 July 2009 to 11 September 2009.

The NASA release of 21 November 2008 also gave details of his prime crew assignment. In what turned out to be his only spaceflight, he was a flight engineer for Soyuz TMA-17/ISS-22/23 (21 December 2009 – 2 June 2010). He also served as the NASA Science Officer during his time on the space station. On 22 January 2010, he became the first astronaut to send a live tweet from orbit. After the flight he returned to duties involving IT.

In June 2011, he retired from the United States Army and also left the ranks of the active astronauts as he transitioned into management astronaut status. He was assigned to the Marshall Space Flight Center, Huntsville, Alabama, where he served for four years as a Payload Operations Director. At the time of the announcement of his appointment to the ranks of flight directors, he was the Astronaut Office's prime representative for Orion landing and recovery.

UK Astronaut Sightings

Brief details on UK astronaut sightings follow. For full details see Collect Space and their Sightings section - <http://www.collectspace.com/sightings/sightings-unitedkingdom.html> This is kept updated by many in the space community and is always more up to date than any printed material.

Eugene Cernan: 8–9 April 2016 with Space Lectures events in Pontefract.

Al Worden: 11-14 July 2016 at the Farnborough International Airshow.

To be named: 7-8 October 2016 with Space Lectures events in Pontefract - they have said there will be two astronauts attending.

NB: If anyone wants to know more about these or other sightings and they do not have access to Collect Space on the Internet please contact me either through the Midlands Spaceflight Society or by email at - RobandJill@blueyonder.co.uk - I often find out about visits at too short notice to put in CapCom. But, a word of warning. It is always best to check in advance of travelling that an event is taking place as planned. I travelled all the way to London a number of years ago to meet a cosmonaut only to discover he had cancelled because of work commitments. I had not phoned before travelling. I have no involvement in the organisation of the above astronaut events and therefore no liability is accepted for any changes that occur.

Bits & Pieces

1/ On 7 January 2016, it was reported that NASA astronauts Eric Boe and Robert Behnken had paid Boeing a visit to try out some of the training equipment for Boeing's CST-100 Starliner. "We have been learning about the spacecraft displays through slideshows. It's great to finally see what we are actually going to train on," Boe said. "The trainers look great, and this visit gives us an opportunity to meet with the Boeing engineers. We appreciate them allowing us to give input on these trainers so the devices are ready when they arrive at Johnson Space Center."

2/ Despite 'Gagarin' being the runaway winner in a public vote (see story in Bits and Pieces in last issue), the competition committee has selected 'Federation' as the name for the S P Korolyov Rocket and Space Corporation Energiya's new-generation Russian crew transportation spacecraft. The decision was made on 15 January 2015.

3/ Reports out of Russia say that in January 2016, Igor Komarov, the Chief Executive Officer of the Russian space agency, mentioned that discussions had taken place with Iran about training an Iranian cosmonaut. Komarov apparently emphasised that no treaty had been signed but the possibilities were being looked into.

4/ In the November/December issue of CapCom I reported that Yevgeni Tarelkin had left the Russian Cosmonaut Team in order to take up a position with the S P Korolyov Rocket and Space Corporation Energiya. It now appears that, although he did resign as a cosmonaut, his new job is in fact unknown.

COMMENTS & UPCOMING IN THE NEXT ISSUE OF ASTRONAUT NEWS

I do not have anything obvious for inclusion in the next issue but I do want to take the opportunity to wish Piers Sellers the best of luck in his battle with pancreatic cancer.

STOP PRESS

Sad news out of America: Ed Mitchell, the sixth human to walk on the Moon, died on 4 February 2016, he was aged 85. Also, Don Williams, Space Shuttle pilot and commander, member of the first group of astronauts who were chosen specifically to fly on the shuttle, died on 23 February 2016, aged 74.

Acknowledgements and sources:

Astroaddies; Astronaut.ru; Aviation Performance Solutions; CapCom (previous issues); Collect Space; ESA; Facebook; The Free Dictionary; Google; LinkedIn; Manned Spaceflight Log II 2006-2012 ©2013 by David J Shayler and Michael D Shayler; NASA and its various centres; NASA Astronaut Selections ©2003 AIS Publications; NASASpaceflight.com; National Academy of Engineering; Novosti Kosmonavtika; Praxis Manned Spaceflight Log 1961-2006 ©2007 by Tim Furniss and David J Shayler with Michael D Shayler; Russian Federal Space Agency; RussianSpaceWeb.com; Space.com; Spacefacts; Space Lectures; S P Korolyov Rocket-Space Corporation Energiya; Texas A&M University; United States Army; Who's Who in Space ©1999 by Michael Cassutt; Wikipedia; Yuri Gagarin Cosmonaut Training Centre.

“I Can Say What I Want”: Canada’s First Spacewalker Captivates Symphony Hall

by Ben Evans

Canada’s first spacewalker, its first-ever commander of a space vehicle and the voice of Mission Control for 25 Space Shuttle missions—to say nothing of having circled the Home Planet over 2,500 times, worked in the airless vacuum of low-Earth orbit in a pressurised suit for almost 15 cumulative hours and spent close to 166 days in orbit—visited Birmingham’s Symphony Hall on Tuesday, 19 January 2016. Veteran astronaut Chris Hadfield offered a funny, witty, inspirational and touchingly poignant take on what it feels like to depart the cradle of humanity and venture into the Universe beyond. Within the span of 90 minutes, or roughly the time it once took him to orbit the globe, a smartly grey-suited Hadfield regaled and captivated his audience with stories of his career and lessons for us all.

Today, the 56-year-old Hadfield is best remembered for having written and recorded his own songs during his five-month expedition to the International Space Station (ISS) between December 2012 and May 2013. Whilst aboard the orbital outpost, he penned and performed the song *Jewel in the Night* and, shortly before returning to Earth, sang a version of David Bowie’s *Space Oddity*, which helped him to accrue over a million Twitter followers in perhaps the largest social-media following of any astronaut in history. Prior to his increment, he became Canada’s first spacewalker—performing two EVAs with NASA astronaut Scott Parazynski—to install and activate the 57.7-foot-long (17.6-meter) Canadarm2 robotic arm onto the ISS in April 2001 and, before that, he became the first (and only) wearer of the Maple Leaf to board Russia’s Mir station in November 1995.

Born in August 1959, Hadfield grew up on a corn farm in south-western Ontario and derived an early fascination for aviation. “My philosophy has always been to try and take away a little bit from everyone that I meet,” he once told a NASA interviewer, “because everyone does something better than I do.” His inspiration came from Charles Lindbergh and Neil Armstrong and Buzz Aldrin and it was the landing of Apollo 11 on the Moon in July 1969 which crystallised in his mind what he wanted to do in his adult: Be an astronaut.

By the age of 15, Hadfield had won a glider pilot scholarship, then a powered pilot scholarship a year later, and after graduation from high school in 1977 he studied at the Royal Military College in Kingston, Ontario, later earning a degree in mechanical engineering. He then entered the Canadian Air Force, gaining the top pilot accolade in basic training, and later flying the CF-5 Freedom Fighter and CF-18 Hornet. He flew the latter on operational missions for the North American Air Defense Command (NORAD) during the second half of the 1980s, during which time he performed the first intercept of a Soviet Tupolev Tu-95 Bear bomber. Hadfield was selected to attend the U.S. Air Force’s famed Test Pilot School at Edwards Air Force Base in California—receiving the Liethen-Tittle Award for top graduate in 1988—and served as an exchange officer with the U.S. Navy, who named him as their “Test Pilot of the Year” in 1991. A master’s degree in aviation systems from the University of Tennessee came in 1992, as did selection from over 5,300 applicants to join Canada’s second group of astronauts. This group was folded into NASA’s own Group 14 intake and, after initial training, Hadfield became a qualified Space Shuttle Mission Specialist.

It was this remarkable man, thin, grey-suited and genuinely overawed by the warmth of his Birmingham reception, who stepped onto the stage of the Symphony Hall on Tuesday, 19 January. Hadfield began by paying homage to the city’s industrial heritage, drawing out

such illustrious names as the manufacturer Matthew Boulton and the physician and inventor Erasmus Darwin, both of whom were closely involved with the Birmingham Lunar Society and both of whom provided venues for its meetings at their respective homes in Handsworth and Lichfield. Clearly, Hadfield’s engineering background had left him well-versed in Birmingham’s pivotal role in the Industrial Revolution and he stressed that the number of manufacturing patents in the city was, by 1850, more than three times higher than anywhere else in the British Isles.

Hadfield’s talk was a mix of video footage, imagery and anecdotes from his three space missions. Turning one of the two chairs on-stage onto its back, he shared with his audience the peculiar experience of being inserted aboard the Shuttle, with his entire world tilted ‘backwards’ by 90 degrees; lying on one’s back for more than two hours before launch, with his legs elevated above his head, all whilst confined within a bulky pressure suit. After describing the protocols involved with suiting-up and getting to the launch pad aboard the Astrovan, he admitted that fear or excitement never occupied his mind in the final minutes before T-0. The only things which occupied Hadfield and his crewmates were the immediate steps that they needed to fulfil...in order to avoid ending up *dead*.

Minute by minute, second by second, he talked his rapt listeners through those final seconds, until just after Autosequence Start at T-31 seconds, which control of the countdown was handed-off from the Ground Launch Sequencer (GLS) to the Shuttle’s on-board suite of General Purpose Computers (GPCs). “And at 15 seconds,” he said, flipping a switch on his projector remote, “*this happens...*”

All at once, the screen showed a video presentation of the final seconds of a Shuttle’s time on Earth. The view centred upon the dark bells of the three main engines, with the familiar flurry of spark-like hydrogen burn igniters swirling at T-10 seconds, ahead of the ignition sequence at T-6.6 seconds. The sheet of translucent orange flame was quickly replaced by the three dancing Mach diamonds and, at T-0, the twin Solid Rocket Boosters (SRBs) roared to life and the stack left the launch pad. The early part of ascent, under the harsh impulse of the boosters, made it difficult to focus on reading the Shuttle’s instruments, Hadfield remembered, although the ride smoothed out when the SRBs were jettisoned and the astronauts headed to orbit on the main engines.

Throughout this cacophony of sound, vibration and light, Hadfield reminded everyone again, his thought process was on just one thing: What he needed to do, *next*, and watch out for, in order to avoid ending up *dead*.

Offering a nod of humorous reflection, he stressed that it had once been remarked to him that the odds of disaster aboard the Shuttle were about 1-in-38. “If BA offered those odds,” he darkly offered his audience, “would *you* buy a ticket?”

Hadfield remains the only Canadian to have visited as many as two orbital stations, having boarded Mir during the visit of Shuttle Atlantis on STS-74 in November 1995 and twice to the ISS. As Canada’s first spacewalker, he performed two EVAs during STS-100 in April 2001 to install and activate Canadarm2 and showed his audience breathtaking images of the green tentacles of light produced by the polar aurorae, reflecting that at one stage he actually witnessed the aurora between

the legs of his space suit, whilst outside. The experience of operating, entirely alone, in a pressurised suit was clearly a powerful one for Hadfield. He remembered holding onto the station during one quiet period and reflected that, in doing so, he was clinging to the last vestige of 7 billion fellow humans, with just his fingertips.

Unsurprisingly, his third mission offered him far more opportunity to talk about the subtleties of living in space for a prolonged period of time, as well as allowing him to notice the significant changes of human behaviour upon the Home Planet. At one stage, he presented a pair of shocking images of the land-locked Aral Sea. In the first perspective, taken in the late 1980s, the sea held a glorious position as the fourth-largest lake in the world, with an area of about 26,300 square miles; in the second, taken in the early years of the present century, it had shrunk to barely 10 percent of its original size.

The reason, Hadfield explained, was the intentional diversion of its feeder rivers to support Soviet and Russian irrigation projects. By 2007, the Aral comprised four lakes and, two years later, one of these had disappeared entirely and another had retreated to a thin strip. In August 2014, NASA's Terra satellite revealed for the first time in modern history that the eastern basin of the Aral had completely dried up, producing an area now known as the Aralkum Desert. Seeing this change was a stark reminder of the damage humanity continues to inflict upon its only home.

Hadfield's five months aboard the space station provided light relief in the form of his various crewmates. When he arrived in December 2012, alongside Russian cosmonaut Roman Romanenko and U.S. astronaut Tom Marshburn, his crew joined the Expedition 34 team of Commander Kevin Ford of NASA and Russians Oleg Novitsky and Yevgeni Tarelkin. Then, in mid-March 2013, when Ford's crew returned to Earth, Hadfield assumed command of Expedition 35—becoming the first Canadian in history to take the helm of an orbiting spacecraft—and led the station for the next two months. In late March, his crew was augmented with the arrival of Russian cosmonauts Pavel Vinogradov and Aleksandr Misurkin, together with NASA astronaut Chris Cassidy.

Misurkin, whom the crew nicknamed 'Sasha', was making his first spaceflight and this offered the grizzled veterans an opportunity to prank. On one occasion, presented with a floating bubble of water, he was asked to drink it up. The eager Misurkin, his Earth-legs having not yet entirely left him, moved in to guzzle the water, when—*splat*—it dispensed itself all over his face, to the sniggers of his crewmates. The trick, Hadfield reflected, was to gradually draw out the liquid from the bubble with a straw.

Other occasions were not quite so light-hearted. Hadfield spoke of a computer upgrade which left them temporarily without power and, in early May 2013, just a few days before his return to Earth, a potentially disastrous leakage of ammonia coolant from the P-6 truss. Hadfield was working at a Nanoracks glovebox, when Vinogradov—who he likened to the actor Charles Bronson—floated in, blurted out a babble of virtually indecipherable Russian and floated off again. What Vinogradov had seen was, in effect, what looked like *snow*, outside the station. It was, of course, flakes of ammonia, but it was of such severity that it necessitated a contingency EVA by Cassidy and Marshburn to inspect and perform corrective actions. It was another step in an ongoing effort to restore the P-6 truss, which had experienced several spells of leakage, but which was returned to its original operating configuration in November 2015.

Returning to Earth, Hadfield's first sensation after being pulled out of the Russian Soyuz spacecraft was not a particularly good one. He offered the audience an image of him, looking tired and sweaty, yet offering a thumbs-up to the camera, but did not shy away from the reality of his feelings at that moment: *Take this camera off me, so I can go and throw up*. Landing in a ballistic-descending, parachute-assisted Soyuz, with the final *thump* from the solid-fuelled rockets in the capsule's base, was quite distinct from the aircraft-like touchdown aboard the Shuttle. Yet Soyuz remains the safest piloted spacecraft in history, with an unblemished success record over more than four decades.

Education was clearly significant for Hadfield and he reflected that, in his youth, growing up in rural Canada, there was no space programme and no real opportunity for him to leave Earth. He opted to join the

military and become a pilot, of course, but it was not until much later in his career that he was appropriately positioned to make that "right place, right time" decision to be able to apply for admission to the Canadian Space Agency. And that was a lesson which emerged from one intriguing image of Hadfield, in space, seen by a young girl on a small television. The girl, her back to the camera, could have been no more than four or five years old, but was watching Hadfield's zero-gravity antics with rapt fascination. In Hadfield's mind, what made the image significant was that the young girl no longer saw the job of 'being an astronaut' as something which was impossible or closed-off to her, but something that was now more accessible. His current role at the University of Waterloo in Ontario includes advising students about aviation careers.

Closing out his 90-minute talk, which he noted had run for almost exactly the time it once took him to complete an orbit of the Home Planet, Hadfield took questions from the audience and, of course, performed his own rendition of David Bowie's *Space Oddity*: a song which had won him, by January 2016, more than 28 million YouTube views. In fact, even whilst in orbit, Hadfield had become the most social-media-savvy astronaut in history, with over a million Twitter followers and an extensive Reddit and Tumblr fan-base. His performance to the enthralled Symphony Hall on Tuesday, 19 January, was all the more poignant, of course, in light of Bowie's death just a few days earlier.

Before performing the song, as if to demonstrate how the presence or absence of terrestrial gravity remains in one's psyche, he paused for a sip of water, which he—"oops, sorry"—accidentally poured onto the floor of the auditorium. In the presence of gravity, of course, it did not form into a bubble and certainly did not float, but splattered to the ground. It was a trick he had also (literally) thrown into the unsuspecting audience, earlier in the show, when he attempted to describe the awe of living in an environment of perpetual free-fall. Taking questions after his talk, Hadfield was asked for tips to overcome a fear of flying—by a woman ironically seated in one of the highest parts of the Symphony Hall—whilst another queried his opinion about the existence of aliens.

For a second or two, Hadfield seemed in a quandary: If he admitted he'd seen anything, he wouldn't be believed, and if he admitted *not* having seen anything, the questioner might think he'd been silenced by a high-level conspiracy. The astronaut's response was perfectly timed and generated a crack of laughter from the audience. He may have flown aboard the space station, and may have worked at NASA, he said, but he wasn't an American astronaut.

"I'm a Canadian," he joked, with a twinkle in his eye. "I can say what I want!"

BE



Canadian Astronaut Commander Chris Hadfield pays tribute to David Bowie with his rendition of "Space Oddity" to a captive audience at Birmingham's Symphony Hall.

Image by Michelle Evans

They Played Their Part: In Memory Of Those We Lost In 2015 The Test Pilots

By Rob Wood

The first US Space Shuttle named Enterprise made a number of test flights involving the Boeing 747 Shuttle Carrier Aircraft under the Approach and Landing Test Programme. This involved both captive flights where Enterprise remained attached to the 747 and free-flights where the orbiter was released from its Shuttle Carrier Aircraft to glide to a landing at Edwards Air Force Base in California. Commander of the Shuttle Carrier Aircraft was Fitz Fulton with co-pilot Tom McMurtry. Sadly both died during the early months of 2015.

The early part of 2015 was not good for test pilots who had links to the space programme. As well as the two Shuttle Carrier Aircraft pilots, Lew Nelson, who had flown the first test flight of the iconic T-38 trainer aircraft, also died in early 2015.

Fitzhugh L. 'Fitz' Fulton, Jr., 1925-2015

Fitzhugh Fulton (Lieutenant-Colonel, USAF, Ret.) was born in Blakely, Georgia, on 6 June 1925. A photograph published in Air and Space magazine shows him as a young boy stood next to a biplane. His mother had labelled it "1st love", and how right she was. It was still a few years before he got to fly in an aircraft, initially as a passenger and a few more before he got to fly an aircraft himself.

His mother and two siblings moved to Columbus, this was still in Georgia, when his parents separated. It was also near an airfield. He hung around, helped out with a few chores and managed to scrounge the odd ride. This became a little more formalised as he swept the hangar, cleaned the aircraft, helped with the refuelling and did other jobs. For each job he got a credit of five minutes flight time. He saved these up to get 20 minute flying lessons.

He was barely aged 17 when he first soloed in a Piper J-3 Cub, a single-engine, propeller-driven, light aircraft. It was June 1942 and he was not even driving a car at this time. The following year he enlisted in the Army as an aviation cadet. This was at the height of World War Two. The war continued until September 1945 but due to delays in pilot training he did not see any action. He served for 23 years, initially in the United States Army Air Force (1943-1947) and then in the newly formed United States Air Force (1947-1966).

He received his commission and was awarded pilot wings in December 1944. He then trained to fly the Consolidated B-24 Liberator and the Boeing B-29 Superfortress, both, four-engine, propeller-driven, heavy bombers. With the war ending before he could fly combat missions and with the reducing need for bomber pilots he transitioned into transport aircraft.

He flew support flights in the Douglas C-54 Skymaster, a four-engine, propeller-driven, transport aircraft, during Operation Crossroads, which in 1946 saw two atomic weapons test-detonated at Bikini Atoll in the Marshall Islands. He then flew over 200 missions in the C-54 during the Berlin Airlift of 1948-1949.

In 1951, he reported to the United States Air Force Test Pilot School at Edwards Air Force Base but was only there for a few weeks when he learned he was to be deployed to Korea. The Korean War of 1950-1953, was in full swing and after training he joined the 13th Bombardment Squadron and flew 55 combat missions in the Douglas B-26 Invader, a twin-engine, propeller-driven, light bomber. After an eight month deployment he returned to the Test Pilot School from where he graduated towards the end of 1952.

His military test career included working with the X series of rocket aircraft. He was a carrier-aircraft pilot flying the B-29 for the Bell X-1 and the Boeing B-50 Superfortress (an upgraded version of the B-29) for the Bell X-2. Later, he was the nominated United States Air Force pilot on the Boeing B-52 Stratofortress, a subsonic, eight-engine, jet-powered strategic bomber, which was used to air-launch the North American X-15, a hypersonic, rocket-powered, research aircraft, that reached the edge of space.

He spent time at the UK's military test centre at Boscombe Down where he had the opportunity to fly Britain's Avro Vulcan and Vickers Valiant jet bombers. He was somewhat surprised by the 'fly in any weather' attitude of the British test pilots. He was used to mostly perfect weather conditions at Edwards. But, as the Brits explained to him, English weather was such that if you could not fly tests in England because of weather constraints then you would not fly any tests at all.

He officially retired from the military at the end of June 1966. He had been offered a posting to the Air War College at Maxwell Air Force Base in Alabama but was concerned this would put him 'flying a desk'. He wanted to keep flying and so in April 1966 he 'put his papers in'.

On 1 August 1966, he joined NASA as a civilian research/test pilot at their Flight Research Center (now named for Neil Armstrong). He was still based at Edwards because the centre was located inside the Air Force Base. He flew many types of aircraft for NASA, by some counts as many as 60.

Amongst the projects he worked on was the 'Top Secret' Lockheed SR-71 Blackbird, a long-range, Mach-3, strategic reconnaissance aircraft. The NASA test aircraft was given the designation YF-12C in order to hide its true military nature and help keep it a secret. In the mid-1970's, he flew the Blackbird to speeds and altitudes in excess of 2,000 mph and 70,000 feet.

He was named as one of the nominated pilots of the Shuttle Carrier Aircraft for the Space Shuttle Approach and Landing Tests, which took place in 1977. In his autobiography 'Father of the Mother Planes' he wrote, "I felt fully qualified but was surprised that so little time in the airplane was needed to make me legal to fly it." He was talking about checking out on the Shuttle Carrier Aircraft prior to flying it in the test programme. All it took was one 30-minute flight and one landing. He would receive NASA's Exceptional Service Medal for his work during the Approach and Landing Tests.

As well as flying the 747 Shuttle Carrier Aircraft during the Approach and Landing Tests, he also flew the aircraft with Enterprise attached during a European tour. This included the Paris Air Show of 1983. For this tour he received a second NASA Exceptional Service Medal. Following the start of orbital flights in 1981 he flew the Shuttle Carrier Aircraft on orbiter ferry missions to the Kennedy Space Center following shuttle landings at Edwards.

He retired from NASA on 3 July 1986 but still did not bring his long test flying career to a halt. On leaving NASA, he joined Scaled Composites at Mojave Airport, still based in California and not very far from Edwards, as Flight Operations Director and Chief Research Pilot. The airport is now called the Mojave Air and Space Port and it is where the SpaceShipTwo suborbital commercial spacecraft is now being built and tested. He spent three years with Scaled and flew on the maiden test

flights of the Model 133: Advanced Technology Tactical Transport, a demonstration aircraft built under a military contract and the Model 143: Triumph, a two-engine business jet prototype.

During a career in the military, civil service and industry, he logged over 16,000 flying hours in more than 240 types of aircraft. He was described on the Collect Space message board as having flown "just about everything" during his time at Edwards and that sums him up nicely.

He received many awards and honours for his flying career. As well as those already mentioned, these include three Distinguished Flying Cross medals for his test pilot work; a further Distinguished Flying Cross and five Air Medals for flying in Korea and taking part in the Berlin Airlift; and the Iven C. Kincheloe Award from the Society of Experimental Test Pilots. In 1999 he was inducted into the National Aviation Hall of Fame.

He died on 3 February 2015 as a result of complications from Parkinson's disease. He is survived by his wife, Erma; two daughters; a son; six grandchildren; three great grandchildren; and his sister Louise.

Thomas C. McMurtry 1935-2015

Thomas McMurtry was born in Crawfordsville, Indiana, on 4 June 1935, but attended schools in Rockville, Indiana. He graduated from Rockville High School in 1953. He then enrolled at the University of Notre Dame, Indiana, under a Navy Reserve Officers' Training Corps (ROTC) scholarship and in June 1957 received a Bachelor of Science degree in Mechanical Engineering. The ROTC is a military scholarship programme funding students in return for military service following graduation.

He was commissioned into the United States Navy following graduation from Notre Dame and then attended flight school. He qualified as a Naval Aviator in 1958. He would subsequently attend and graduate from the United States Naval Test Pilot School, at Patuxent River, Maryland.

He left the Navy in 1964 with the rank of Lieutenant and joined the Lockheed Corporation (now Lockheed Martin), an aerospace company specializing in military aircraft. During his time with Lockheed he flew test flights in their famous U-2, ultra-high altitude, single-jet engine, military reconnaissance aircraft.

Famous aircraft! Or, should that be infamous due to events that occurred during the 'Cold War'. The most notorious incident involving the U-2 was in 1962 when pilot Gary Powers was shot down over the Soviet Union whilst flying a spying mission for the Central Intelligence Agency.

McMurtry was recruited by NASA in 1967 as a research/test pilot. He took part in many projects. He worked with Fulton on the Shuttle Carrier Aircraft and the SR-71. He was also one of the pilots on the Kuiper Airborne Observatory project. This used a highly modified Lockheed C-141A Starlifter, a jet transport aircraft, as an airborne observation platform supporting research in infrared astronomy.

There were many military aircraft that he flew whilst at NASA. One project he worked on with links to spaceflight was the Martin Marietta X-24B, a rocket-powered, lifting-body aircraft. This was a joint USAF/NASA effort to test the ability of pilots to manoeuvre and safely land a wingless unpowered vehicle. The aircraft flew from 1973 to 1975. The same concept was used for the Space Shuttle. One of his fellow pilots on the X-24B was Dick Scobee, who later lost his life in the Space Shuttle Challenger accident of 1986.

Another earlier lifting-body aircraft project McMurtry was involved in was the Northrop M2-F3. Unlike the X-24B he was not the pilot. His job was to fly the chase planes. On one particular flight his Lockheed F-104N Starfighter was following the B-52 carrier-aircraft that was to drop test pilot Bill Dana in the M2-F3. McMurtry was to stay behind the M2-F3 to monitor flight control positions. This meant flying very slowly, close to stalling speed. And this is exactly what happened.

The M2-F3 was dropped and at about the same time McMurtry's F-104 stalled and went into a spin. Bill Brockett, a colleague who had

flown with McMurtry on the Kuiper Airborne Observatory project, takes up the story.

"The lifting body was flying, but everyone was riveted on the F-104 in a spin. The aircraft were notoriously hard to pull out. He had tried three recovery attempts. Then he tried once more and this time the aircraft's nose dropped low enough that the F-104 came out of the spin right in position at the wing of the lifting body and flew through the mission as if nothing had happened."

For McMurtry it was just another day at the office. What did he say at the end of the flight, "It would have been really embarrassing if I had to eject on a chase flight."

He served in a number of management roles at NASA's Flight Research Center. He was Chief Pilot before becoming Director for Flight Operations in 1986. On 27 July 1998 he became Associate Director for Operations and from February 1999 also served as acting Chief Engineer. He served in those roles until his retirement from NASA. He officially retired from NASA on 3 June 1999.

He had logged over 11,000 flying hours at the point he left NASA but he would carry on flying in the private sector for another 12 years and add 4,000 more hours to his logs. He worked for Wolfe Air Aviation Ltd. from 1999 to 2011 flying on all of their Lear and Cessna aircraft projects whilst also operating as a flight instructor. He was Wolfe Air's Lead Vectorvision pilot and flew aircraft conducting aerial videography in the film industry and at professional sporting events. He was nominated for a Screen Actors Guild Award for his work on Transformers 3: Dark Side of the Moon.

He was the recipient of many honours for his flying including NASA's Exceptional Service Medal; the Iven C. Kincheloe Award; NASA's Distinguished Service Medal; the 1999 Milton O Thomson Lifetime Achievement Award; and in October 2014 the Federal Aviation Administration's Wright Brothers Master Pilot Award.

He suffered a severe debilitating stroke in January 2012, forcing him to stop flying and retire from Wolfe Air. Resulting complications led to his death three years later on 3 January 2015. He is survived by his wife, Mary Louise; eight children; nine grandchildren; and his brother George.

Lew A. Nelson 1920-2015

The Northrop T-38 Talon, two-seat, twin-engine, supersonic jet trainer, is synonymous with NASA. The aircraft holds a very important place in NASA's history. They have used the aircraft for over 50 years. NASA operates a fleet of these aircraft for use as chase planes and astronaut trainers. Lew Nelson was the test pilot who, from Edwards Air Force Base, flew the T-38 on its first flight on 10 April 1959.

The T-38 was the world's first supersonic flight trainer. Since 1962, every pilot in the United States Air Force has conducted training in the aircraft. Plenty of other service and civilian pilots as well as foreign nationals have seen time in the cockpit. Over 1100 were built through to 1972 with about half still flying today. Many of the aircraft have between 15,000 and 19,000 flight hours.

The T-38 was designed by a team headed by Edgar Schmued. Before the T-38, Schmued's work was fundamental in the design of the North American P-51 Mustang, one of the most successful fighter-bombers of World War Two. The North American F-86 Sabre and the F-100 Super Sabre, both jet fighters, are two more of his designs.

Lew Albert Nelson was born in San Diego, California, on 13 September 1920. He became interested in flying as a child and was flying models at a young age. He was still in high school when he had his first piloting experience in a Piper J-3 cub and with that he knew what his career choice was.

The Civilian Pilot Training Program (CPTP) was a United States Government sponsored project established in the late 1930's to train and expand the nation's civilian pilot base. It was a thinly disguised scheme to increase the pilot pool for the military in case war broke out. Nelson joined the CPTP in 1939 whilst at junior college.

He served in the United States Army Air Force in World War Two, having enlisted shortly after the 7 December 1941 attack on Pearl Harbor, which officially brought the United States into the war. He was awarded two Distinguished Flying Crosses and four Air Medals for his service which continued until 1947.

He then attended the University of Southern California (USC) in Los Angeles from where he graduated in 1949 with a Bachelor degree in Aeronautical Engineering. Eleven years later, in 1960, he earned a Master's degree in Engineering from the University of California, Los Angeles.

Following graduation from USC, he joined the National Advisory Commission on Aeronautics (NACA) where he worked as an aeronautical engineer. NACA would morph into NASA in 1958. He was only with NACA for a short time before joining the Northrop Corporation, a leading aerospace company. He was a Northrop test pilot from 1950 to 1972 and then continued in management roles until his retirement in 1986.

In 1952 he was promoted to Chief Experimental Test Pilot for Northrop. He made the first flights of a number of their aircraft including the N-156F (or, as it subsequently became known, F-5), T-38 and YA-9A (a rival of the A-10 Warthog). Amongst his management roles was as Director of the Flight Test Engineering Section.

He was a founding member of the Society of Experimental Test Pilots and was also a Fellow of the society. He was a member of the Aerospace Walk of Honor. He has logged over 5000 flight hours.

He suffered a stroke in 2011 which limited his activities. He died on 16 January 2015 following a long battle with Parkinson's disease. He is survived by his wife, Elaine; one son; one daughter; one stepdaughter; seven grandchildren; and nine great grandchildren.

Acknowledgements and sources:

Air & Space Magazine; At the Edge of Space – The X-15 Flight Program ©1992 by Milton O.Thompson; CapCom (previous issues); Collect Space; Facebook; Gathering of Eagles Foundation; Legacy.com; Los Angeles Times; NASA; National Aviation Hall of Fame; Roxaluni.com; Thetartanterror.blogspot.co.uk; Thisdayinaviation.com; Wikipedia; Wolfe Air Aviation; Zoominfo.com.

Intensive Training For Mars Voyage

With just days to go before the departure of ExoMars, mission teams at ESOC, Darmstadt, are in the final stages of their months-long training that ensures everyone knows their job the moment the mission comes alive.

The ExoMars 2016 mission is set for launch on 14 March from Baikonur Cosmodrome in Kazakhstan on a powerful Proton rocket, marking the start of a seven-month cruise to the Red Planet.

The complex and challenging mission will be operated by teams at ESA's ESOC control centre in Darmstadt, Germany, where, after months of simulations covering all phases of the journey to Mars, training is in the final, intensive phase.

Working in tight coordination

For any new mission flown from ESOC, diverse teams of European specialists provide a unique mix of expertise, all working in tight coordination toward the precise moment when a just-launched spacecraft 'wakes up' in space.

"While we'll be monitoring TGO's liftoff and the boost phase very closely, in fact, for us, the most critical moment occurs after the spacecraft separates from the launcher upper stage, when it sends its first signals," says ExoMars Spacecraft Operations Manager Peter Schmitz.

"That's the moment we've been training months for, when we establish contact, receive the first onboard status information and can start sending telecommands. That's when we'll have a mission."

It takes a team of teams

Peter and the 14-strong Flight Control Team will be supported by additional experts from across the centre and the project team at ESA's ESTEC technical centre in the Netherlands, providing specialised knowledge and capabilities in areas such as deep-space mission operations, flight dynamics, ground stations and software and systems.

Since November 2015, training for ExoMars has included more than 20 simulation sessions, in which teams sit in the control rooms, paced through every phase of the TGO mission, especially the launch and early orbits and the initial commissioning and cruise to Mars.

Additional simulations are planned during the interplanetary journey, focusing on critical activities such as the mid-course trajectory correction, Schiaparelli's separation and the TGO's insertion into Mars orbit.

What Is Exomars?

The ExoMars programme is a joint endeavour between ESA and the Russian space agency, Roscosmos.

The primary goal of the ExoMars programme is to address the question of whether life has ever existed on Mars. This relates to its name, with the 'exo' referring to the study of exobiology – the possible existence of life beyond Earth (sometimes also referred to as astrobiology).

The programme comprises two missions. The first will be launched in March 2016 and consists of the Trace Gas Orbiter (TGO) and Schiaparelli, an entry, descent and landing demonstrator module. The second is planned for launch in 2018 and comprises a rover and surface science platform.

TGO's main objectives are to search for evidence of methane and other trace atmospheric gases that could be signatures of active biological or geological processes. Schiaparelli will test key technologies in preparation for ESA's contribution to subsequent missions to Mars.

The 2018 rover that will carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. The 2016 TGO will act as a relay for the 2018 mission.

ESA
www.esa.int

NASA Targets May 2018 Launch of Mars InSight Mission

NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission to study the deep interior of Mars is targeting a new launch window that begins 5 May 2018, with a Mars landing scheduled for 26 Nov 2018.

InSight's primary goal is to help us understand how rocky planets – including Earth – formed and evolved. The spacecraft had been on track to launch in March 2016 until a vacuum leak in its prime science instrument prompted NASA in December to suspend preparations for launch.

InSight project managers recently briefed officials at NASA and France's space agency, Centre National d'Études Spatiales (CNES), on a path forward; the proposed plan to redesign the science instrument was accepted in support of a 2018 launch.

"The science goals of InSight are compelling, and the NASA and CNES plans to overcome the technical challenges are sound," said John Grunsfeld, associate administrator for NASA's Science Mission Directorate in Washington. "The quest to understand the interior of Mars has been a longstanding goal of planetary scientists for decades. We're excited to be back on the path for a launch, now in 2018."

NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, will redesign, build and conduct qualifications of the new vacuum enclosure for the Seismic Experiment for Interior Structure (SEIS), the component that failed in December. CNES will lead instrument level integration and test activities, allowing the InSight Project to take advantage of each organization's proven strengths. The two agencies have worked closely together to establish a project schedule that accommodates these plans, and scheduled interim reviews over the next six months to assess technical progress and continued feasibility.

The cost of the two-year delay is being assessed. An estimate is expected in August, once arrangements with the launch vehicle provider have been made.

The seismometer instrument's main sensors need to operate within a vacuum chamber to provide the exquisite sensitivity needed for measuring ground movements as small as half the radius of a hydrogen atom. The rework of the seismometer's vacuum container will result in a finished, thoroughly tested instrument in 2017 that will maintain a high degree of vacuum around the sensors through rigors of launch, landing, deployment and a two-year prime mission on the surface of Mars.

The InSight mission draws upon a strong international partnership led by Principal Investigator Bruce Banerdt of JPL. The lander's Heat Flow and Physical Properties Package is provided by the German Aerospace Center (DLR). This probe will hammer itself to a depth of about 16 feet (five meters) into the ground beside the lander.

SEIS was built with the participation of the Institut de Physique du Globe de Paris and the Swiss Federal Institute of Technology, with support from the Swiss Space Office and the European Space Agency PRODEX program; the Max Planck Institute for Solar System Research, supported by DLR; Imperial College, supported by the United Kingdom Space Agency; and JPL.

"The shared and renewed commitment to this mission continues our collaboration to find clues in the heart of Mars about the early evolution of our solar system," said Marc Pircher, director of CNES's Toulouse Space Centre.

The mission's international science team includes researchers from Austria, Belgium, Canada, France, Germany, Japan, Poland, Spain, Switzerland, the United Kingdom and the United States.

JPL manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama. The InSight spacecraft, including cruise stage and lander, was built and tested by Lockheed Martin Space Systems in Denver. It was delivered to Vandenberg Air Force Base, California, in December 2015 in preparation for launch, and returned to Lockheed Martin's Colorado facility last month for storage until spacecraft preparations resume in 2017.

NASA is on an ambitious journey to Mars that includes sending humans to the Red Planet, and that work remains on track. Robotic spacecraft are leading the way for NASA's Mars Exploration Program, with the upcoming Mars 2020 rover being designed and built, the Opportunity and Curiosity rovers exploring the Martian surface, the Odyssey and Mars Reconnaissance Orbiter spacecraft currently orbiting the planet, along with the Mars Atmosphere and Volatile Evolution Mission (MAVEN) orbiter, which is helping scientists understand what happened to the Martian atmosphere.

NASA and CNES also are participating in ESA's (European Space

Agency's) Mars Express mission currently operating at Mars. NASA is participating on ESA's 2016 and 2018 ExoMars missions, including providing telecommunication radios for ESA's 2016 orbiter and a critical element of a key astrobiology instrument on the 2018 ExoMars rover.

NASA
<http://www.nasa.gov/insight>
<http://www.nasa.gov/journeytomars>

Ariane 5 Launch Contributes to Ariane 6 Development

An Ariane 5 lifted off on 9 March to deliver telecom satellite Eutelsat-65 West A into its planned transfer orbit. Liftoff of flight VA229 occurred at 05:20 GMT (02:20 local time, 06:20 CET) from Europe's Spaceport in Kourou, French Guiana.

Eutelsat-65 West A was the sole passenger on this launch. With a mass of 6707 kg, it was released about 27 minutes into the mission.

Positioned at 65°W in geostationary orbit, the satellite has a design life of 15 years and will provide coverage throughout Latin America and especially Brazil with video and direct-to-home broadcasting, as well as flexible high-speed broadband access.

After satellite separation, the propellants' temperature and level were recorded to study its behaviour in the rocket's upper stage under microgravity. This information will help to design the upper stage for Ariane 6.

Flight VA229 was the second Ariane 5 launch of the year and the 85th Ariane 5 mission.

ESA
www.esa.int

Scott Kelly Retires from NASA

NASA astronaut and one-year crew member Scott Kelly will retire from the agency, effective 1 April. Kelly joined the astronaut corps in 1996 and currently holds the American record for most time spent in space.

After retiring, Kelly will continue to participate in the ongoing research related to his one-year mission. He will provide periodic medical samples and support other testing in much the same way that his twin brother, former astronaut Mark Kelly, made himself available for NASA's Twins Study during his brother's mission.

NASA
www.nasa.gov

ExoMars On Its Way

On the morning of 14 March 2016 the European Space Agency (ESA) Mars probe ExoMars was launched from Baikonur Cosmodrome. ExoMars consists of two spacecraft: an orbiter to study trace gases in the thin Martian atmosphere - the Trace Gas Orbiter (or TGO), and Schiaparelli, an entry, descent and landing demonstrator module.

ESA
www.esa.int

NASA's Juno Spacecraft Breaks Solar Power Distance Record

NASA's Juno mission to Jupiter has broken the record to become humanity's most distant solar-powered emissary. The milestone occurred on Wednesday 13 January, when Juno was about 493 million miles (793 million kilometres) from the sun.

The previous record-holder was the European Space Agency's Rosetta spacecraft, whose orbit peaked out at the 492-million-mile (792-million-kilometre) mark in October 2012, during its approach to comet 67P/Churyumov-Gerasimenko.

Launched in 2011, Juno is the first solar-powered spacecraft designed to operate at such a great distance from the sun. That's why the surface area of solar panels required to generate adequate power is quite large. The four-ton Juno spacecraft carries three 30-foot-long (9-meter) solar arrays festooned with 18,698 individual solar cells. At Earth distance from the sun, the cells have the potential to generate approximately 14 kilowatts of electricity. But transport those same rectangles of silicon and gallium arsenide to a fifth rock from the sun distance, and it's a powerfully different story.

"Jupiter is five times farther from the sun than Earth, and the sunlight that reaches that far out packs 25 times less punch," said Rick Nybakken, Juno's project manager from NASA's Jet Propulsion Laboratory in Pasadena, California. "While our massive solar arrays will be generating only 500 watts when we are at Jupiter, Juno is very efficiently designed, and it will be more than enough to get the job done."

Prior to Juno, eight spacecraft have navigated the cold, harsh underlit realities of deep space as far out as Jupiter. All have used nuclear power sources to get their job done. Solar power is possible on Juno due to improved solar-cell performance, energy-efficient instruments and spacecraft, a mission design that can avoid Jupiter's shadow, and a polar orbit that minimizes the total radiation. Juno's maximum distance from the sun during its 16-month science mission will be about 517 million miles (832 million kilometres), an almost five percent increase in the record for solar-powered space vehicles.

Juno will arrive at Jupiter on 4 July 2016. Over the next year the spacecraft will orbit the Jovian world 33 times, skimming to within 3,100 miles (5,000 kilometres) above the planet's cloud tops every 14 days. During the flybys, Juno will probe beneath the obscuring cloud cover of Jupiter and study Jupiter's aurorae to learn more about the planet's origins, structure, atmosphere and magnetosphere.

NASA's Jet Propulsion Laboratory, Pasadena, California, manages the Juno mission for the principal investigator, Scott Bolton, of Southwest Research Institute in San Antonio. Juno is part of NASA's New Frontiers Program, which is managed at NASA's Marshall Space Flight Center in Huntsville, Alabama. Lockheed Martin Space Systems, Denver, built the spacecraft. The California Institute of Technology in Pasadena manages JPL for NASA.

NASA
<http://www.nasa.gov/juno>



Midlands Spaceflight Society

Contact

Dave Evetts, Secretary,

Midlands Spaceflight Society
124 Stanhope Rd, Smethwick
B67 6HP

Tel. 0121 429 8606

(evenings & weekends only) or
e-mail mss.shop@midspace.org.uk

Web Site:

www.midspace.org.uk

Contributions to CapCom

The Editor welcomes contributions for CapCom. Articles on any aspect of space exploration are considered. Articles in Word format or text files should be sent by email to capcom.editor@midspace.org.uk.

The Society is not responsible for individual opinions expressed in articles, reviews or reports of any kind. Such opinions are solely those of the author. Material published in CapCom does not necessarily reflect the views of the Society. Any comments directly concerning the magazine should be addressed to the Editor via the email address above.

Copy Deadline

All copy intended for the **May/June 2016** issue should be emailed to the editor by
Friday 8 April 2016